



THIKA WATER AND SEWERAGE COMPANY LIMITED (THIWASCO)

TENDER NO: THIWASCO/031/BCEST/2023-2024

**BOREHOLE EQUIPPING & CONSTRUCTION OF ELEVATED STEEL TANK AT
MAGANA PRIMARY SCHOOL**

**MANAGING DIRECTOR
THIKA WATER AND SEWERAGE COMPANY LTD,
P.O. BOX 6103 - 00100, THIKA – KENYA.**

NOVEMBER 2023

**CLOSING DATE
Tuesday, December 5, 2023 at 12.00noon**

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INVITATION TO TENDER

PROCURING ENTITY: Thika Water & Sewerage Company Ltd (THIWASCO)

CONTRACT NAME AND DESCRIPTION: Borehole Equipping & Construction of Elevated Steel tank at Magana Primary School

1. **THIWASCO** invites sealed tenders for the Borehole Equipping & Construction of Elevated Steel tank at Magana Primary School
2. Tendering will be conducted under open competitive method National using a standardized tender document. Tendering is open to all eligible bidders.
3. Qualified and interested tenderers may obtain further information and inspect the Tender Documents during office [0800 to 1600 hours] at the address given below
4. A complete set of tender documents may be purchased or obtained by interested tenders upon payment of a non- refundable fees of [**Kshs.1,000.00**] to the following account;
Account Name: **Thika Water and Sewerage Company Ltd**
Bank: Equity
Account No. 0090294932028 Code 027
Tender documents may be obtained electronically from the Website www.thikawater.co.ke. Tender documents obtained electronically will be free of charge.
5. Tender documents may be viewed and downloaded for free from the website www.thikawater.co.ke. Tenderers who download the tender document must forward their particulars immediately to procurement@thikawater.co.ke to facilitate any further clarification or addendum.
6. Tenders shall be quoted be in Kenya Shillings and shall include all taxes. Tenders shall remain valid for **182** days from the date of opening of tenders.
7. All Tenders must be accompanied by a **original Tender Security of kshs.200,000.00 from a bank or institutions approved by PPRA**
8. The Tenderer shall chronologically serialize all pages of the tender documents submitted.
9. Completed tenders must be delivered to the address below on or before ***[Tuesday, December 5, 2023 at 12.00noon]***. Electronic Tenders **will not be** permitted.
10. Tenders will be opened immediately after the deadline date and time specified above or any dead line date and time specified later. Tenders will be publicly opened in the presence of the Tenderers' designated representatives who choose to attend at the address below
11. Late tenders will be rejected.

12. The addresses referred to above are:

Address for obtaining further information and for purchasing tender documents

Name of Procuring Entity: **Thika Water and Sewerage Company Ltd**

Physical address for hand Courier Delivery to an office or Tender Box: **Thika Head Office Near Bluepost Hotel, Along Haile Sellasie Road**

Postal Address: **P.O. Box 6103-01000 Thika**

Name, telephone number and e-mail address of the officer to be contacted.: **Procurement Office, 0720418444, Procurement@thikawater.co.ke**

Address for Submission of Tenders.

Name of Procuring Entity: **Thika Water & Sewerage Company Ltd** Postal Address **P.O. Box 6103-01000 Thika**

Physical address for hand Courier Delivery to an office or Tender Box: **Thika Head Office Near Bluepost Hotel, Along Haile Sellasie Road**

Address for Opening of Tenders.

Name of Procuring Entity: **Thika Water & Sewerage Company Ltd**

Physical address for the location: **Thika Head Office Near Bluepost Hotel, Along Haile Sellasie Road**

[Authorized Official (name, designation, Signature and date)]

Name: Dr. Moses Kinya

Designation: Managing Director

Signature _____

Date _____

PART 1 - TENDERING PROCEDURES

SECTION I: INSTRUCTIONS TO TENDERERS

A General Provisions

1. Scope of Tender

- 1.1 The Procuring Entity as defined in the Appendix to Conditions of Contract invites tenders for Works Contract as described in the tender documents. The name, identification, and number of lots (contracts) of this Tender Document are **specified in the TDS**.

2. Fraud and Corruption

- 2.1 The Procuring Entity requires compliance with the provisions of the Public Procurement and Asset Disposal Act, 2015, Section 62 “Declaration not to engage in corruption”. The tender submitted by a person shall include a declaration that the person shall not engage in any corrupt or fraudulent practice and a declaration that the person or his or her sub-contractors are not debarred from participating in public procurement proceedings.
- 2.2 The Procuring Entity requires compliance with the provisions of the Competition Act 2010, regarding collusive practices in contracting. Any tenderer found to have engaged in collusive conduct shall be disqualified and criminal and/or civil sanctions may be imposed. To this effect, Tenders shall be required to complete and sign the “Certificate of Independent Tender Determination” annexed to the Form of Tender.
- 2.3 Unfair Competitive Advantage - Fairness and transparency in the tender process require that the firms or their Affiliates competing for a specific assignment do not derive a competitive advantage from having provided consulting services related to this tender. To that end, the Procuring Entity shall indicate in the **Data Sheet** and make available to all the firms together with this tender document all information that would in that respect give such firm any unfair competitive advantage over competing firms.
- 2.4 Unfair Competitive Advantage -Fairness and transparency in the tender process require that the Firms or their Affiliates competing for a specific assignment do not derive a competitive advantage from having provided consulting services related to this tender being tendered for. The Procuring Entity shall indicate in the **TDS** firms (if any) that provided consulting services for the contract being tendered for. The Procuring Entity shall check whether the owners or controllers of the Tenderer are same as those that provided consulting services. The Procuring Entity shall, upon request, make available to any tenderer information that would give such firm unfair competitive advantage over competing firms.

3. Eligible Tenderers

- 3.1 A Tenderer may be a firm that is a private entity, a state-owned enterprise or institution subject to ITT 3.7 or any combination of such entities in the form of a joint venture (JV) under an existing agreement or with the intent to enter into such an agreement supported by a letter of intent. Public employees and their close relatives (*spouses, children, brothers, sisters and uncles and aunts*) are not eligible to participate in the tender. In the case of a joint venture, all members shall be jointly and severally liable for the execution of the entire Contract in accordance with the Contract terms. The JV shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the members of the JV during the tendering process and, in the event the JV is awarded the Contract, during contract execution. The maximum number of JV members shall be specified in the **TDS**.
- 3.2 Public Officers of the Procuring Entity, their Spouses, Child, Parent, Brothers or Sister. Child, Parent, Brother or Sister of a Spouse, their business associates or agents and firms/organizations in which they have a substantial or controlling interest shall not be eligible to tender or be awarded a contract. Public Officers are also not allowed to participate in any procurement proceedings.
- 3.3 A Tenderer shall not have a conflict of interest. Any tenderer found to have a conflict of interest shall be disqualified. A tenderer may be considered to have a conflict of interest for the purpose of this tendering process, if the tenderer:
- a) Directly or indirectly controls, is controlled by or is under common control with another tenderer; or
 - b) Receives or has received any direct or indirect subsidy from another tenderer; or

- c) Has the same legal representative as another tenderer; or has a relationship with another tenderer, directly or through common third parties, that puts it in a position to influence the tender of another tenderer, or influence the decisions of the Procuring Entity regarding this tendering process; or
- d) Any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the works that are the subject of the tender; or
- e) any of its affiliates has been hired (or is proposed to be hired) by the Procuring Entity as Engineer for the Contract implementation; or
- f) Would be providing goods, works, or non-consulting services resulting from or directly related to consulting services for the preparation or implementation of the contract specified in this Tender Document or
- g) Has a close business or family relationship with a professional staff of the Procuring Entity who:
 - i) are directly or indirectly involved in the preparation of the Tender document or specifications of the Contract, and/or the Tender evaluation process of such contract; or
 - ii) would be involved in the implementation or supervision of such Contract unless the conflict stemming from such relationship has been resolved in a manner acceptable to the Procuring Entity throughout the tendering process and execution of the Contract.

- 3.4 A tenderer shall not be involved in corrupt, coercive, obstructive, collusive or fraudulent practice. A tenderer that is proven to have been involved any of these practices shall be automatically disqualified.
- 3.5 A Tenderer (either individually or as a JV member) shall not participate in more than one Tender, except for permitted alternative tenders. This includes participation as a subcontractor in other Tenders. Such participation shall result in the disqualification of all Tenders in which the firm is involved. A firm that is not a tenderer or a JV member may participate as a subcontractor in more than one tender. Members of a joint venture may not also make an individual tender, be a subcontractor in a separate tender or be part of another joint venture for the purposes of the same Tender.
- 3.6 A Tenderer may have the nationality of any country, subject to the restrictions pursuant to ITT 4.8. A Tenderer shall be deemed to have the nationality of a country if the Tenderer is constituted, incorporated or registered in and operates in conformity with the provisions of the laws of that country, as evidenced by its articles of incorporation (or equivalent documents of constitution or association) and its registration documents, as the case may be. This criterion also shall apply to the determination of the nationality of proposed subcontractors or sub-consultants for any part of the Contract including related Services.
- 3.7 Tenderer that has been debarred from participating in public procurement shall be ineligible to tender or be awarded a contract. The list of debarred firms and individuals is available from the website of PPRA www.ppra.go.ke.
- 3.8 Tenderers that are state-owned enterprises or institutions may be eligible to compete and be awarded a Contract(s) only if they are accredited by PPRA to be (i) a legal public entity of the state Government and/or public administration, (ii) financially autonomous and not receiving any significant subsidies or budget support from any public entity or Government, and (iii) operating under commercial law and vested with legal rights and liabilities similar to any commercial enterprise to enable it compete with firms in the private sector on an equal basis.
- 3.9 A Firms and individuals may be ineligible if their countries of origin (a) as a matter of law or official regulations, Kenya prohibits commercial relations with that country, or (b) by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, Kenya prohibits any import of goods or contracting of works or services from that country, or any payments to any country, person, or entity in that country. A tenderer shall provide such documentary evidence of eligibility satisfactory to the Procuring Entity, as the Procuring Entity shall reasonably request.
- 3.10 Foreign tenderers are required to source at least forty (40%) percent of their contract inputs (in supplies, subcontracts and labor) from national suppliers and contractors. To this end, a foreign tenderer shall provide in its tender documentary evidence that this requirement is met. Foreign tenderers not meeting this criterion will be automatically disqualified. Information required to enable the Procuring Entity determine if this condition is met

shall be provided in for this purpose is be provided in “*SECTION III - EVALUATION AND QUALIFICATION CRITERIA, Item 9*”.

- 3.11 Pursuant to the eligibility requirements of ITT 4.10, a tender is considered a foreign tenderer, if the tenderer is not registered in Kenya or if the tenderer is registered in Kenya and has less than 51 percent ownership by Kenyan Citizens. JVs are considered as foreign tenderers if the individual member firms are not registered in Kenya or if are registered in Kenya and have less than 51 percent ownership by Kenyan citizens. The JV shall not subcontract to foreign firms more than 10 percent of the contract price, excluding provisional sums.
- 3.12 The National Construction Authority Act of Kenya requires that all local and foreign contractors be registered with the National Construction Authority and be issued with a Registration Certificate before they can undertake any construction works in Kenya. Registration shall not be a condition for tender, but it shall be a condition of contract award and signature. A selected tenderer shall be given opportunity to register before such award and signature of contract. Application for registration with National Construction Authority may be accessed from the website www.nca.go.ke.
- 3.13 The Competition Act of Kenya requires that firms wishing to tender as Joint Venture undertakings which may prevent, distort or lessen competition in provision of services are prohibited unless they are exempt in accordance with the provisions of Section 25 of the Competition Act, 2010. JVs will be required to seek for exemption from the Competition Authority. Exemption shall not be a condition for tender, but it shall be a condition of contract award and signature. A JV tenderer shall be given opportunity to seek such exemption as a condition of award and signature of contract. Application for exemption from the Competition Authority of Kenya may be accessed from the website www.cak.go.ke
- 3.14 A Kenyan tenderer shall provide evidence of having fulfilled his/her tax obligations by producing a valid tax clearance certificate or tax exemption certificate issued by the Kenya Revenue Authority.

4. Eligible Goods, Equipment, and Services

- 4.1 Goods, equipment and services to be supplied under the Contract may have their origin in any country that is not eligible under ITT 3.9. At the Procuring Entity's request, Tenderers may be required to provide evidence of the origin of Goods, equipment and services.
- 4.2 Any goods, works and production processes with characteristics that have been declared by the relevant national environmental protection agency or by other competent authority as harmful to human beings and to the environment shall not be eligible for procurement.

5. Tenderer's Responsibilities

- 5.1 The tenderer shall bear all costs associated with the preparation and submission of his/her tender, and the Procuring Entity will in no case be responsible or liable for those costs.
- 5.2 The tenderer, at the tenderer's own responsibility and risk, is encouraged to visit and examine the Site of the Works and its surroundings, and obtain all information that may be necessary for preparing the tender and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the tenderer's own expense.
- 5.3 The Tenderer and any of its personnel or agents will be granted permission by the Procuring Entity to enter upon its premises and lands for the purpose of such visit. The Tenderer shall indemnify the Procuring Entity against all liability arising from death or personal injury, loss of or damage to property, and any other losses and expenses incurred as a result of the inspection.
- 5.4 The tenderer shall provide in the Form of Tender and Qualification Information, a preliminary description of the proposed work method and schedule, including charts, as necessary or required.

B. Contents of Tender Documents

6. Sections of Tender Document

- 6.1 The tender document consists of Parts 1, 2, and 3, which includes all the sections specified below, and which should be read in conjunction with any Addenda issued in accordance with ITT 8.

PART 1 Tendering Procedures

- i) Section I - Instructions to Tenderers (ITT)
- ii) Section II - Tender Data Sheet (TDS)
- iii) Section III - Evaluation and Qualification Criteria
- iv) Section IV - Tendering Forms

PART 2 Works Requirements

- i) Section V - Drawings
- ii) Section VI - Specifications
- iii) Section VII - Bills of Quantities

PART 3 Conditions of Contract and Contract Forms

- i) Section VIII - General Conditions of Contract (GCC)
- ii) Section IX - Special Conditions of Contract (SC)
- iii) Section X - Contract Forms

- 6.2 The Invitation to Tender Document (ITT) issued by the Procuring Entity is not part of the Contract documents.
- 6.3 Unless obtained directly from the Procuring Entity, the Procuring Entity is not responsible for the completeness of the Tender document, responses to requests for clarification, the minutes of the pre-Tender meeting (if any), or Addenda to the Tender document in accordance with ITT 8. In case of any contradiction, documents obtained directly from the Procuring Entity shall prevail.

The Tenderer is expected to examine all instructions, forms, terms, and specifications in the Tender Document and to furnish with its Tender all information and documentation as is required by the Tender document.

7. Site Visit

- 7.1 The Tenderer, at the Tenderer's own responsibility and risk, is encouraged to visit and examine and inspect the Site of the Required Services and its surroundings and obtain all information that may be necessary for preparing the Tender and entering into a contract for the Services. The costs of visiting the Site shall be at the Tenderer's own expense.

8. Pre-Tender Meeting

- 8.1 The Procuring Entity shall specify in the **TDS** if a pre-tender meeting will be held, when and where. The Procuring Entity shall also specify in the **TDS** if a pre-arranged pretender site visit will be held and when. The Tenderer's designated representative is invited to attend a pre-arranged pretender visit of the site of the works. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.
- 8.2 The Tenderer is requested to submit any questions in writing, to reach the Procuring Entity not later than the period specified in the **TDS** before the meeting.
- 8.3 Minutes of the pre-Tender meeting and the pre-arranged pretender site visit of the site of the works, if applicable, including the text of the questions asked by Tenderers and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all Tenderers who have acquired the Tender Documents in accordance with ITT 6.3. Minutes shall not identify the source of the questions asked.
- 8.4 The Procuring Entity shall also promptly publish anonym zed (*no names*) Minutes of the pre-Tender meeting and the pre-arranged pretender visit of the site of the works at the web page identified in the **TDS**. Any modification to the Tender Documents that may become necessary as a result of the pre-tender meeting and the pre-arranged

pretender site visit, shall be made by the Procuring Entity exclusively through the issue of an Addendum pursuant to ITT 8 and not through the minutes of the pre-Tender meeting. Nonattendance at the pre-Tender meeting will not be a cause for disqualification of a Tenderer.

9. Clarification and amendments of Tender Documents

- 9.1 A Tenderer requiring any clarification of the Tender Document shall contact the Procuring Entity in writing at the Procuring Entity's address specified in the **TDS** or raise its enquiries during the pre-Tender meeting and the pre-arranged pretender visit of the site of the works if provided for in accordance with ITT 8.4. The Procuring Entity will respond in writing to any request for clarification, provided that such request is received no later than the period specified in the **TDS** prior to the deadline for submission of tenders. The Procuring Entity shall forward copies of its response to all tenderers who have acquired the Tender Documents in accordance with ITT 6.3, including a description of the inquiry but without identifying its source. If specified in the **TDS**, the Procuring Entity shall also promptly publish its response at the web page identified in the **TDS**. Should the clarification result in changes to the essential elements of the Tender Documents, the Procuring Entity shall amend the Tender Documents appropriately following the procedure under ITT 8.4.

10. Amendment of Tendering Document

- 10.1 At any time prior to the deadline for submission of Tenders, the Procuring Entity may amend the Tendering document by issuing addenda.
- 10.2 Any addendum issued shall be part of the tendering document and shall be communicated in writing to all who have obtained the tendering document from the Procuring Entity in accordance with ITT 6.3. The Procuring Entity shall also promptly publish the addendum on the Procuring Entity's web page in accordance with ITT 8.4.
- 10.3 To give prospective Tenderers reasonable time in which to take an addendum into account in preparing their Tenders, the Procuring Entity shall extend, as necessary, the deadline for submission of Tenders, in accordance with ITT 25.2 below.

C. Preparation of Tenders

11. Cost of Tendering

- 11.1 The Tenderer shall bear all costs associated with the preparation and submission of its Tender, and the Procuring Entity shall not be responsible or liable for those costs, regardless of the conduct or outcome of the tendering process.

12. Language of Tender

- 12.1 The Tender, as well as all correspondence and documents relating to the tender exchanged by the tenderer and the Procuring Entity, shall be written in the English Language. Supporting documents and printed literature that are part of the Tender may be in another language provided they are accompanied by an accurate and notarized translation of the relevant passages into the English Language, in which case, for purposes of interpretation of the Tender, such translation shall govern.

13. Documents Comprising the Tender

- 13.1 The Tender shall comprise the following:
- a) Form of Tender prepared in accordance with ITT 14;
 - b) Schedules including priced Bill of Quantities, completed in accordance with ITT 14 and ITT 16;
 - c) Tender Security or Tender-Securing Declaration, in accordance with ITT 21.1;
 - d) Alternative Tender, if permissible, in accordance with ITT 15;
 - e) Authorization: written confirmation authorizing the signatory of the Tender to commit the Tenderer, in accordance with ITT 22.3;

- f) Qualifications: documentary evidence in accordance with ITT 19 establishing the Tenderer's qualifications to perform the Contract if its Tender is accepted;
- g) Conformity: a technical proposal in accordance with ITT 18;
- h) Any other document required in the **TDS**.

13.2 In addition to the requirements under ITT 11.1, Tenders submitted by a JV shall include a copy of the Joint Venture Agreement entered into by all members. Alternatively, a letter of intent to execute a Joint Venture Agreement in the event of a successful Tender shall be signed by all members and submitted with the Tender, together with a copy of the proposed Agreement. The Tenderer shall chronologically serialize pages of all tender documents submitted.

13.3 The Tenderer shall furnish in the Form of Tender information on commissions and gratuities, if any, paid or to be paid to agents or any other party relating to this Tender.

14. Form of Tender and Schedules

14.1 The Form of Tender and Schedules, including the Bill of Quantities, shall be prepared using the relevant forms furnished in Section IV, Tendering Forms. The forms must be completed without any alterations to the text, and no substitutes shall be accepted except as provided under ITT 20.3. All blank spaces shall be filled in with the information requested.

15. Alternative Tenders

15.1 Unless otherwise specified in the **TDS**, alternative Tenders shall not be considered.

15.2 When alternative times for completion are explicitly invited, a statement to that effect will be included in the **TDS**, and the method of evaluating different alternative times for completion will be described in Section III, Evaluation and Qualification Criteria.

15.3 Except as provided under ITT 13.4 below, Tenderers wishing to offer technical alternatives to the requirements of the Tender Documents must first price the Procuring Entity's design as described in the Tender Documents and shall further provide all information necessary for a complete evaluation of the alternative by the Procuring Entity, including drawings, design calculations, technical specifications, breakdown of prices, and proposed construction methodology and other relevant details. Only the technical alternatives, if any, of the Tenderer with the Winning Tender conforming to the basic technical requirements shall be considered by the Procuring Entity. When specified in the **TDS**, Tenderers are permitted to submit alternative technical solutions for specified parts of the Works, and such parts will be identified in the **TDS**, as will the method for their evaluating, and described in Section VII, Works' Requirements.

16. Tender Prices and Discounts

16.1 The prices and discounts (including any price reduction) quoted by the Tenderer in the Form of Tender and in the Bill of Quantities shall conform to the requirements specified below.

16.2 The Tenderer shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Items against which no rate or price is entered by the Tenderer shall be deemed covered by the rates for other items in the Bill of Quantities and will not be paid for separately by the Procuring Entity. An item not listed in the priced Bill of Quantities shall be assumed to be not included in the Tender, and provided that the Tender is determined substantially responsive notwithstanding this omission, the average price of the item quoted by substantially responsive Tenderers will be added to the Tender price and the equivalent total cost of the Tender so determined will be used for price comparison.

16.3 The price to be quoted in the Form of Tender, in accordance with ITT 14.1, shall be the total price of the Tender, including any discounts offered.

16.4 The Tenderer shall quote any discounts and the methodology for their application in the Form of Tender, in accordance with ITT 14.1.

- 16.5 It will be specified in the **TDS** if the rates and prices quoted by the Tenderer are or are not subject to adjustment during the performance of the Contract in accordance with the provisions of the Conditions of Contract, except in cases where the contract is subject to fluctuations and adjustments, not fixed price. In such a case, the Tenderer shall furnish the indices and weightings for the price adjustment formulae in the Schedule of Adjustment Data and the Procuring Entity may require the Tenderer to justify its proposed indices and weightings.
- 16.6 Where tenders are being invited for individual lots (contracts) or for any combination of lots (packages), tenderers wishing to offer discounts for the award of more than one Contract shall specify in their Tender the price reductions applicable to each package, or alternatively, to individual Contracts within the package. Discounts shall be submitted in accordance with ITT 16.4, provided the Tenders for all lots (contracts) are opened at the same time.
- 16.7 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 30 days prior to the deadline for submission of Tenders, shall be included in the rates and prices and the total Tender Price submitted by the Tenderer.

17. Currencies of Tender and Payment

- 17.1 Tenderers shall quote entirely in Kenya Shillings. The unit rates and the prices shall be quoted by the Tenderer in the Bill of Quantities, entirely in Kenya shillings. A Tenderer expecting to incur expenditures in other currencies for inputs to the Works supplied from outside Kenya shall devise own ways of getting foreign currency to meet those expenditures.

18. Documents Comprising the Technical Proposal

- 18.1 The Tenderer shall furnish a technical proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in Section IV, Tender Forms, in sufficient detail to demonstrate the adequacy of the Tenderer's proposal to meet the work's requirements and the completion time.

19. Documents Establishing the Eligibility and Qualifications of the Tenderer

- 19.1 Tenderers shall complete the Form of Tender, included in Section IV, Tender Forms, to establish Tenderer's eligibility in accordance with ITT 4.
- 19.2 In accordance with Section III, Evaluation and Qualification Criteria, to establish its qualifications to perform the Contract the Tenderer shall provide the information requested in the corresponding information sheets included in Section IV, Tender Forms.
- 19.3 A margin of preference will not be allowed. Preference and reservations will be allowed, individually or in joint ventures. Applying for eligibility for Preference and reservations shall supply all information required to satisfy the criteria for eligibility specified in accordance with ITT 33.1.
- 19.4 Tenderers shall be asked to provide, as part of the data for qualification, such information, including details of ownership, as shall be required to determine whether, according to the classification established by the Procuring Entity, a contractor or group of contractors qualifies for a margin of preference. Further the information will enable the Procuring Entity identify any actual or potential conflict of interest in relation to the procurement and/or contract management processes, or a possibility of collusion between tenderers, and thereby help to prevent any corrupt influence in relation to the procurement process or contract management.
- 19.5 The purpose of the information described in ITT 19.4 above overrides any claims to confidentiality which a tenderer may have. There can be no circumstances in which it would be justified for a tenderer to keep information relating to its ownership and control confidential where it is tendering to undertake public sector work and receive public sector funds. Thus, confidentiality will not be accepted by the Procuring Entity as a justification for a Tenderer's failure to disclose, or failure to provide required information on its ownership and control.
- 19.6 The Tenderer shall provide further documentary proof, information or authorizations that the Procuring Entity may request in relation to ownership and control which information on any changes to the information which was provided by the tenderer under ITT 6.3. The obligations to require this information shall continue for the duration

of the procurement process and contract performance and after completion of the contract, if any change to the information previously provided may reveal a conflict of interest in relation to the award or management of the contract.

- 19.7 All information provided by the tenderer pursuant to these requirements must be complete, current and accurate as at the date of provision to the Procuring Entity. In submitting the information required pursuant to these requirements, the Tenderer shall warrant that the information submitted is complete, current and accurate as at the date of submission to the Procuring Entity.
- 19.8 If a tenderer fails to submit the information required by these requirements, its tender will be rejected. Similarly, if the Procuring Entity is unable, after taking reasonable steps, to verify to a reasonable degree the information submitted by a tenderer pursuant to these requirements, then the tender will be rejected.
- 19.9 If information submitted by a tenderer pursuant to these requirements, or obtained by the Procuring Entity (whether through its own enquiries, through notification by the public or otherwise), shows any conflict of interest which could materially and improperly benefit the tenderer in relation to the procurement or contract management process, then:
- i) if the procurement process is still ongoing, the tenderer will be disqualified from the procurement process,
 - ii) if the contract has been awarded to that tenderer, the contract award will be set aside,
 - iii) the tenderer will be referred to the relevant law enforcement authorities for investigation of whether the tenderer or any other persons have committed any criminal offence.
- 19.10 If a tenderer submits information pursuant to these requirements that is incomplete, inaccurate or out-of-date, or attempts to obstruct the verification process, then the consequences ITT 6.7 will ensue unless the tenderer can show to the reasonable satisfaction of the Procuring Entity that any such act was not material, or was due to genuine error which was not attributable to the intentional act, negligence or recklessness of the tenderer.

20. Period of Validity of Tenders

- 20.1 Tenders shall remain valid for the Tender Validity period specified in the **TDS**. The Tender Validity period starts from the date fixed for the Tender submission deadline (as prescribed by the Procuring Entity in accordance with ITT 24). A Tender valid for a shorter period shall be rejected by the Procuring Entity as non-responsive.
- 20.2 In exceptional circumstances, prior to the expiration of the Tender validity period, the Procuring Entity may request Tenderers to extend the period of validity of their Tenders. The request and the responses shall be made in writing. If a Tender Security is requested in accordance with ITT 21.1, it shall also be extended for thirty (30) days beyond the deadline of the extended validity period. A Tenderer may refuse the request without forfeiting its Tender security. A Tenderer granting the request shall not be required or permitted to modify its Tender, except as provided in ITT 20.3.
- 20.3 If the award is delayed by a period exceeding the number of days to be specified in the **TDS** days beyond the expiry of the initial tender validity period, the Contract price shall be determined as follows:
- a) in the case of **fixed price** contracts, the Contract price shall be the tender price adjusted by the factor specified in the **TDS**;
 - b) in the case of **adjustable price** contracts, no adjustment shall be made; or in any case, tender evaluation shall be based on the tender price without taking into consideration the applicable correction from those indicated above.

21. Tender Security

- 21.1 The Tenderer shall furnish as part of its Tender, either a Tender-Securing Declaration or a Tender Security as specified in the **TDS**, in original form and, in the case of a Tender Security, in the amount and currency specified in the **TDS**. A Tender-Securing Declaration shall use the form included in Section IV, Tender Forms.
- 21.2 If a Tender Security is specified pursuant to ITT 19.1, the Tender Security shall be a demand guarantee in any of the following forms at the Tenderer's option:
- a) an unconditional Bank Guarantee issued by reputable commercial bank); or

- b) an irrevocable letter of credit;
- c) a Banker's cheque issued by a reputable commercial bank; or
- d) another security specified **in the TDS**,

- 21.3 If an unconditional bank guarantee is issued by a bank located outside Kenya, the issuing bank shall have a correspondent bank located in Kenya to make it enforceable. The Tender Security shall be valid for thirty (30) days beyond the original validity period of the Tender, or beyond any period of extension if requested under ITT 20.2.
- 21.4 If a Tender Security or Tender-Securing Declaration is specified pursuant to ITT 19.1, any Tender not accompanied by a substantially responsive Tender Security or Tender-Securing Declaration shall be rejected by the Procuring Entity as non-responsive.
- 21.5 If a Tender Security is specified pursuant to ITT 21.1, the Tender Security of unsuccessful Tenderers shall be returned as promptly as possible upon the successful Tenderer's signing the Contract and furnishing the Performance Security and any other documents required in the **TDS**. The Procuring Entity shall also promptly return the tender security to the tenderers where the procurement proceedings are terminated, all tenders were determined nonresponsive or a bidder declines to extend tender validity period.
- 21.6 The Tender Security of the successful Tenderer shall be returned as promptly as possible once the successful Tenderer has signed the Contract and furnished the required Performance Security, and any other documents required in the **TDS**.
- 21.7 The Tender Security may be forfeited or the Tender-Securing Declaration executed:
- e) if a Tenderer withdraws its Tender during the period of Tender validity specified by the Tenderer on the Form of Tender, or any extension thereto provided by the Tenderer; or
 - f) if the successful Tenderer fails to:
 - i) sign the Contract in accordance with ITT 50; or
 - ii) furnish a Performance Security and if required in the **TDS**, and any other documents required in the **TDS**.
- 21.8 Where tender securing declaration is executed, the Procuring Entity shall recommend to the PPRA that PPRA debars the Tenderer from participating in public procurement as provided in the law.
- 21.9 The Tender Security or the Tender-Securing Declaration of a JV shall be in the name of the JV that submits the Tender. If the JV has not been legally constituted into a legally enforceable JV at the time of tendering, the Tender Security or the Tender-Securing Declaration shall be in the names of all future members as named in the letter of intent referred to in ITT 4.1 and ITT 11.2.
- 21.10 A tenderer shall not issue a tender security to guarantee itself.

22. Format and Signing of Tender

- 22.1 The Tenderer shall prepare one original of the documents comprising the Tender as described in ITT 13 and clearly mark it "ORIGINAL." Alternative Tenders, if permitted in accordance with ITT 15, shall be clearly marked "ALTERNATIVE." In addition, the Tenderer shall submit copies of the Tender, in the number specified in the **TDS** and clearly mark them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail.
- 22.2 Tenderers shall mark as "CONFIDENTIAL" all information in their Tenders which is confidential to their business. This may include proprietary information, trade secrets, or commercial or financially sensitive information.
- 22.3 The original and all copies of the Tender shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Tenderer. This authorization shall consist of a written confirmation as specified in the **TDS** and shall be attached to the Tender. The name and position held by each person signing the authorization must be typed or printed below the signature. All pages of the Tender where entries or amendments have been made shall be signed or initialed by the person signing the Tender.

- 22.4 In case the Tenderer is a JV, the Tender shall be signed by an authorized representative of the JV on behalf of the JV, and to be legally binding on all the members as evidenced by a power of attorney signed by their legally authorized representatives.
- 22.5 Any inter-lineation, erasures, or overwriting shall be valid only if they are signed or initialed by the person signing the Tender.

D. Submission and Opening of Tenders

23. Sealing and Marking of Tenders

- 23.1 Depending on the sizes or quantities or weight of the tender documents, a tenderer may use an envelope, package or container. The Tenderer shall deliver the Tender in a single sealed envelope, or in a single sealed package, or in a single sealed container bearing the name and Reference number of the Tender, addressed to the Procuring Entity and a warning not to open before the time and date for Tender opening date. Within the single envelope, package or container, the Tenderer shall place the following separate, sealed envelopes:
- a) in an envelope or package or container marked “ORIGINAL”, all documents comprising the Tender, as described in ITT 11; and
 - b) in an envelope or package or container marked “COPIES”, all required copies of the Tender; and
 - c) if alternative Tenders are permitted in accordance with ITT 15, and if relevant:
 - i) in an envelope or package or container marked “ORIGINAL –ALTERNATIVE TENDER”, the alternative Tender; and
 - ii) in the envelope or package or container marked “COPIES- ALTERNATIVE TENDER”, all required copies of the alternative Tender.

The inner envelopes or packages or containers shall:

- a) bear the name and address of the Procuring Entity.
 - b) bear the name and address of the Tenderer; and
 - c) bear the name and Reference number of the Tender.
- 23.2 If an envelope or package or container is not sealed and marked as required, the *Procuring Entity* will assume no responsibility for the misplacement or premature opening of the Tender. Tenders that are misplaced or opened prematurely will not be accepted.

24. Deadline for Submission of Tenders

- 24.1 Tenders must be received by the Procuring Entity at the address specified in the **TDS** and no later than the date and time also specified in the **TDS**. When so specified in the **TDS**, Tenderers shall have the option of submitting their Tenders electronically. Tenderers submitting Tenders electronically shall follow the electronic Tender submission procedures specified in the **TDS**.
- 24.2 The Procuring Entity may, at its discretion, extend the deadline for the submission of Tenders by amending the Tender Documents in accordance with ITT 8, in which case all rights and obligations of the Procuring Entity and Tenderers previously subject to the deadline shall thereafter be subject to the deadline as extended.

25. Late Tenders

- 25.1 The Procuring Entity shall not consider any Tender that arrives after the deadline for submission of tenders, in accordance with ITT 24. Any Tender received by the Procuring Entity after the deadline for submission of Tenders shall be declared late, rejected, and returned unopened to the Tenderer.

26. Withdrawal, Substitution, and Modification of Tenders

- 26.1 A Tenderer may withdraw, substitute, or modify its Tender after it has been submitted by sending a written notice, duly signed by an authorized representative, and shall include a copy of the authorization in accordance with ITT

22.3, (except that withdrawal notices do not require copies). The corresponding substitution or modification of the Tender must accompany the respective written notice. All notices must be:

- a) prepared and submitted in accordance with ITT 22 and ITT 23 (except that withdrawals notices do not require copies), and in addition, the respective envelopes shall be clearly marked “WITHDRAWAL,” “SUBSTITUTION,” “MODIFICATION;” and
- b) received by the Procuring Entity prior to the deadline prescribed for submission of Tenders, in accordance with ITT 24.

26.2 Tenders requested to be withdrawn in accordance with ITT 26.1 shall be returned unopened to the Tenderers.

26.3 No Tender may be withdrawn, substituted, or modified in the interval between the deadline for submission of Tenders and the expiration of the period of Tender validity specified by the Tenderer on the Form of Tender or any extension thereof.

27. Tender Opening

27.1 Except in the cases specified in ITT 23 and ITT 26.2, the Procuring Entity shall publicly open and read out all Tenders received by the deadline, at the date, time and place specified in the **TDS**, in the presence of Tenderers' designated representatives who chooses to attend. Any specific electronic Tender opening procedures required if electronic Tendering is permitted in accordance with ITT 24.1, shall be as specified in the **TDS**.

27.2 First, envelopes marked “WITHDRAWAL” shall be opened and read out and the envelopes with the corresponding Tender shall not be opened, but returned to the Tenderer. No Tender withdrawal shall be permitted unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is read out at Tender opening.

27.3 Next, envelopes marked “SUBSTITUTION” shall be opened and read out and exchanged with the corresponding Tender being substituted, and the substituted Tender shall not be opened, but returned to the Tenderer. No Tender substitution shall be permitted unless the corresponding substitution notice contains a valid authorization to request the substitution and is read out at Tender opening.

27.4 Next, envelopes marked “MODIFICATION” shall be opened and read out with the corresponding Tender. No Tender modification shall be permitted unless the corresponding modification notice contains a valid authorization to request the modification and is read out at Tender opening.

27.5 Next, all remaining envelopes shall be opened one at a time, reading out: the name of the Tenderer and whether there is a modification; the total Tender Price, per lot (contract) if applicable, including any discounts and alternative Tenders; the presence or absence of a Tender Security or Tender-Securing Declaration, if required; and any other details as the Procuring Entity may consider appropriate.

27.6 Only Tenders, alternative Tenders and discounts that are opened and read out at Tender opening shall be considered further for evaluation. The Form of Tender and pages of the Bills of Quantities are to be initialed by the members of the tender opening committee attending the opening. The number of representatives of the Procuring Entity to sign shall be specified in the **TDS**.

27.7 At the Tender Opening, the Procuring Entity shall neither discuss the merits of any Tender nor reject any Tender (except for late Tenders, in accordance with ITT 25.1).

27.8 The Procuring Entity shall prepare minutes of the Tender Opening that shall include, as a minimum:

- a) the name of the Tenderer and whether there is a withdrawal, substitution, or modification;
- b) the Tender Price, per lot (contract) if applicable, including any discounts;
- c) any alternative Tenders;
- d) the presence or absence of a Tender Security, if one was required.
- e) number of pages of each tender document submitted.

27.9 The Tenderers' representatives who are present shall be requested to sign the minutes. The omission of a Tenderer's signature on the minutes shall not invalidate the contents and effect of the minutes. A copy of the tender opening register shall be distributed to all Tenderers upon request.

E. Evaluation and Comparison of Tenders

28. Confidentiality

28.1 Information relating to the evaluation of Tenders and recommendation of contract award shall not be disclosed to Tenderers or any other persons not officially concerned with the Tender process until information on Intention to Award the Contract is transmitted to all Tenderers in accordance with ITT 46.

28.2 Any effort by a Tenderer to influence the Procuring Entity in the evaluation of the Tenders or Contract award decisions may result in the rejection of its tender.

28.3 Notwithstanding ITT 28.2, from the time of tender opening to the time of contract award, if a tenderer wishes to contact the Procuring Entity on any **matter related to the tendering process, it shall do so in writing.**

29. Clarification of Tenders

29.1 To assist in the examination, evaluation, and comparison of the tenders, and qualification of the tenderers, the Procuring Entity may, at its discretion, ask any tenderer for a clarification of its tender, given a reasonable time for a response. Any clarification submitted by a tenderer that is not in response to a request by the Procuring Entity shall not be considered. The Procuring Entity's request for clarification and the response shall be in writing. No change, including any voluntary increase or decrease, in the prices or substance of the tender shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Procuring Entity in the evaluation of the tenders, in accordance with ITT 33.

29.2 If a tenderer does not provide clarifications of its tender by the date and time set in the Procuring Entity's request for clarification, its Tender may be rejected.

30. Deviations, Reservations, and Omissions

30.1 During the evaluation of tenders, the following definitions apply:

- a) "Deviation" is a departure from the requirements specified in the tender document;
- b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the tender document; and
- c) "Omission" is the failure to submit part or all of the information or documentation required in the Tender document.

31. Determination of Responsiveness

31.1 The Procuring Entity's determination of a Tender's responsiveness is to be based on the contents of the tender itself, as defined in ITT 13.

31.2 A substantially responsive Tender is one that meets the requirements of the Tender document without material deviation, **reservation, or omission. A material deviation, reservation, or omission is one that, if accepted, would:**

- a) affect in any substantial way the scope, quality, or performance of the Works specified in the Contract; or
- b) limit in any substantial way, inconsistent with the tender document, the Procuring Entity's rights or the tenderer's obligations under the proposed contract; or
- c) if rectified, would unfairly affect the competitive position of other tenderers presenting substantially responsive tenders.

31.3 The Procuring Entity shall examine the technical aspects of the tender submitted in accordance with ITT 18, to confirm that all requirements of Section VII, Works' Requirements have been met without any material deviation, reservation or omission.

31.4 If a tender is not substantially responsive to the requirements of the tender document, it shall be rejected by the Procuring Entity and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

32. Non-material Non-conformities

32.1 Provided that a tender is substantially responsive, the Procuring Entity may waive any non-conformities in the tender.

32.2 Provided that a Tender is substantially responsive, the Procuring Entity may request that the tenderer submit the necessary information or documentation, within a reasonable period, to rectify nonmaterial non-conformities in the tender related to documentation requirements. Requesting information or documentation on such non-conformities shall not be related to any aspect of the price of the tender. Failure of the tenderer to comply with the request may result in the rejection of its tender.

32.3 Provided that a tender is substantially responsive, the Procuring Entity shall rectify quantifiable nonmaterial non-conformities related to the Tender Price. To this effect, the Tender Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component in the manner specified in the **TDS**.

33. Arithmetical Errors

33.1 The tender sum as submitted and read out during the tender opening shall be absolute and final and shall not be the subject of correction, adjustment or amendment in any way by any person or entity.

33.2 Provided that the Tender is substantially responsive, the Procuring Entity shall handle errors on the following basis:

- a) Any error detected if considered a major deviation that affects the substance of the tender, shall lead to disqualification of the tender as non-responsive.
- b) Any errors in the submitted tender arising from a miscalculation of unit price, quantity, and subtotal and total bid price shall be considered as a major deviation that affects the substance of the tender and shall lead to disqualification of the tender as non-responsive. and
- c) if there is a discrepancy between words and figures, the amount in words shall prevail

33.3 Tenderers shall be notified of any error detected in their bid during the notification of a ward.

34. Currency provisions

34.1 Tenders will be priced in Kenya Shillings only. Tenderers quoting in currencies other than in Kenya shillings will be determined non-responsive and rejected.

35. Margin of Preference and Reservations

35.1 No margin of preference shall be allowed on contracts for small works.

35.2 Where it is intended to reserve the contract to specific groups under Small and Medium Enterprises, or enterprise of women, youth and/or persons living with disability, who are appropriately registered as such by the authority to be specified in the **TDS**, a procuring entity shall ensure that the invitation to tender specifically indicates that only businesses/firms belonging to those specified groups are the only ones eligible to tender. Otherwise if no so stated, the invitation will be open to all tenderers.

36. Nominated Subcontractors

- 36.1 Unless otherwise stated in the **TDS**, the Procuring Entity does not intend to execute any specific elements of the Works by subcontractors selected in advance by the Procuring Entity.
- 36.2 Tenderers may propose subcontracting up to the percentage of total value of contracts or the volume of works as specified in the **TDS**. Subcontractors proposed by the Tenderer shall be fully qualified for their parts of the Works.
- 36.3 The subcontractor's qualifications shall not be used by the Tenderer to qualify for the Works unless their specialized parts of the Works were previously designated by the Procuring Entity in the **TDS** as can be met by subcontractors referred to hereafter as 'Specialized Subcontractors', in which case, the qualifications of the Specialized Subcontractors proposed by the Tenderer may be added to the qualifications of the Tenderer.

37. Evaluation of Tenders

- 37.1 The Procuring Entity shall use the criteria and methodologies listed in this ITT and Section III, Evaluation and Qualification Criteria. No other evaluation criteria or methodologies shall be permitted. By applying the criteria and methodologies the Procuring Entity shall determine the Best Evaluated Tender in accordance with ITT 40.
- 37.2 To evaluate a Tender, the Procuring Entity shall consider the following:
- a) price adjustment due to discounts offered in accordance with ITT 16;
 - b) converting the amount resulting from applying (a) and (b) above, if relevant, to a single currency in accordance with ITT 39;
 - c) price adjustment due to quantifiable nonmaterial non-conformities in accordance with ITT 30.3; and
 - d) any additional evaluation factors specified in the **TDS** and Section III, Evaluation and Qualification Criteria.
- 37.3 The estimated effect of the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract, shall not be considered in Tender evaluation.
- 37.4 In the case of multiple contracts or lots, Tenderers shall be allowed to tender for one or more lots and the methodology to determine the lowest evaluated cost of the lot (contract) combinations, including any discounts offered in the **Form of Tender, is specified in Section III, Evaluation and Qualification Criteria.**

38. Comparison of Tenders

- 38.1 The Procuring Entity shall compare the evaluated costs of all substantially responsive Tenders established in accordance with ITT 38.2 to determine the Tender that has the lowest evaluated cost.

39. Abnormally Low Tenders

- 39.1 An Abnormally Low Tender is one where the Tender price, in combination with other elements of the Tender, appears so low that it raises material concerns as to the capability of the Tenderer in regards to the Tenderer's ability to perform the Contract for the offered Tender Price or that genuine competition between Tenderers is compromised. 39.2 In the event of identification of a potentially Abnormally Low Tender, the Procuring Entity shall seek written clarifications from the Tenderer, including detailed price analyses of its Tender price in relation to the subject matter of the contract, scope, proposed methodology, schedule, allocation of risks and responsibilities and any other requirements of the Tender document.
- 39.3 After evaluation of the price analyses, in the event that the Procuring Entity determines that the Tenderer has failed to demonstrate its capability to perform the Contract for the offered Tender Price, the Procuring Entity shall reject the Tender.

40. Abnormally High Tenders

- 40.1 An abnormally high price is one where the tender price, in combination with other constituent elements of the Tender, appears unreasonably too high to the extent that the Procuring Entity is concerned that it (the Procuring Entity) may not be getting value for money or it may be paying too high a price for the contract compared with market prices or that genuine competition between Tenderers is compromised.

- 40.2 In case of an abnormally high tender price, the Procuring Entity shall make a survey of the market prices, check if the estimated cost of the contract is correct and review the Tender Documents to check if the specifications, scope of work and conditions of contract are contributory to the abnormally high tenders. The Procuring Entity may also seek written clarification from the tenderer on the reason for the high tender price. The Procuring Entity shall proceed as follows:
- i) If the tender price is abnormally high based on wrong estimated cost of the contract, the Procuring Entity may accept or not accept the tender depending on the Procuring Entity's budget considerations.
 - ii) If specifications, scope of work and/or conditions of contract are contributory to the abnormally high tender prices, the Procuring Entity shall reject all tenders and may retender for the contract based on revised estimates, specifications, scope of work and conditions of contract, as the case may be.
- 40.3 If the Procuring Entity determines that the Tender Price is abnormally too high because genuine competition between tenderers is compromised (*often due to collusion, corruption or other manipulations*), the Procuring Entity shall reject all Tenders and shall institute or cause competent Government Agencies to institute an investigation on the cause of the compromise, before retendering.

41. Unbalanced and/or Front-Loaded Tenders

- 41.1 If in the Procuring Entity's opinion, the Tender that is evaluated as the lowest evaluated price is seriously unbalanced and/or front loaded, the Procuring Entity may require the Tenderer to provide written clarifications. Clarifications may include detailed price analyses to demonstrate the consistency of the tender prices with the scope of works, proposed methodology, schedule and any other requirements of the Tender document.
- 41.2 After the evaluation of the information and detailed price analyses presented by the Tenderer, the Procuring Entity may as appropriate:
- a) accept the Tender; or
 - b) require that the total amount of the Performance Security be increased at the expense of the Tenderer to a level not exceeding a 30% of the Contract Price; or
 - c) agree on a payment mode that eliminates the inherent risk of the Procuring Entity paying too much for undelivered works; or
 - d) reject the Tender,

42. Qualifications of the Tenderer

- 42.1 The Procuring Entity shall determine to its satisfaction whether the eligible Tenderer that is selected as having submitted the lowest evaluated cost and substantially responsive Tender, meets the qualifying criteria specified in Section III, Evaluation and Qualification Criteria.
- 42.2 The determination shall be based upon an examination of the documentary evidence of the Tenderer's qualifications submitted by the Tenderer, pursuant to ITT 19. The determination shall not take into consideration the qualifications of other firms such as the Tenderer's subsidiaries, parent entities, affiliates, subcontractors (other than Specialized Subcontractors if permitted in the Tender document), or any other firm(s) different from the Tenderer. 42.3 An affirmative determination shall be a prerequisite for award of the Contract to the Tenderer. A negative determination shall result in disqualification of the Tender, in which event the Procuring Entity shall proceed to the Tenderer who offers a substantially responsive Tender with the next lowest evaluated price to make a similar determination of that Tenderer's qualifications to perform satisfactorily.
- 42.4 An Abnormally Low Tender is one where the Tender price, in combination with other elements of the Tender, appears so low that it raises material concerns as to the capability of the Tenderer in regards to the Tenderer's ability to perform the Contract for the offered Tender Price.
- 42.5 In the event of identification of a potentially Abnormally Low Tender, the Procuring Entity shall seek written clarifications from the Tenderer, including detailed price analyses of its Tender price in relation to the subject matter of the contract, scope, proposed methodology, schedule, allocation of risks and responsibilities and any other requirements of the Tender document.

- 42.6 After evaluation of the price analyses, if the Procuring Entity determines that the Tenderer has failed to demonstrate its capability to perform the Contract for the offered Tender Price, the Procuring Entity shall reject the Tender.

43. Best Evaluated Tender

- 43.1 Having compared the evaluated prices of Tenders, the Procuring Entity shall determine the Best Evaluated Tender. The Best Evaluated Tender is the Tender of the Tenderer that meets the Qualification Criteria and whose Tender has been determined to be:
- a) Most responsive to the Tender document; and
 - b) the lowest evaluated price.

44. Procuring Entity's Right to Accept Any Tender, and to Reject Any or All Tenders.

- 44.1 The Procuring Entity reserves the right to accept or reject any Tender and to annul the Tender process and reject all Tenders at any time prior to Contract Award, without thereby incurring any liability to Tenderers. In case of annulment, all Tenderers shall be notified with reasons and all Tenders submitted and specifically, Tender securities, shall be promptly returned to the Tenderers.

F. Award of Contract 45. Award Criteria

- 45.1 The Procuring Entity shall award the Contract to the successful tenderer whose tender has been determined to be the Lowest Evaluated Tender.

46. Notice of Intention to enter into a Contract

- 46.1 Upon award of the contract and Prior to the expiry of the Tender Validity Period the Procuring Entity shall issue a Notification of Intention to Enter into a Contract / Notification of award to all tenderers which shall contain, at a minimum, the following information:
- a) the name and address of the Tenderer submitting the successful tender;
 - b) the Contract price of the successful tender;
 - c) a statement of the reason(s) the tender of the unsuccessful tenderer to whom the letter is addressed was unsuccessful, unless the price information in (c) above already reveals the reason;
 - d) the expiry date of the Standstill Period; and
 - e) instructions on how to request a debriefing and/or submit a complaint during the standstill period;

47. Standstill Period

- 47.1 The Contract shall not be signed earlier than the expiry of a Standstill Period of 14 days to allow any dissatisfied tender to launch a complaint. Where only one Tender is submitted, the Standstill Period shall not apply.
- 47.2 Where a Standstill Period applies, it shall commence when the Procuring Entity has transmitted to each Tenderer the Notification of Intention to Enter **into a Contract with the successful Tenderer**.

48. Debriefing by the Procuring Entity

- 48.1 On receipt of the Procuring Entity's Notification of Intention to Enter into a Contract referred to in ITT 46, an unsuccessful tenderer may make a written request to the Procuring Entity for a debriefing on specific issues or concerns regarding their tender. The Procuring Entity shall provide the debriefing within five days of receipt of the request.
- 48.2 Debriefings of unsuccessful Tenderers may be done in writing or verbally. The Tenderer shall bear its own costs of attending **such a debriefing meeting**.

49. Letter of Award

- 49.1 Prior to the expiry of the Tender Validity Period and upon expiry of the Standstill Period specified in ITT 42.1, upon addressing a complaint that has been filed within the Standstill Period, the Procuring Entity shall transmit the Letter of Award to the successful Tenderer. The letter of award shall request the successful tenderer to furnish the Performance Security within 21 days of the date of the letter.

50. Signing of Contract

- 50.1 Upon the expiry of the fourteen days of the Notification of Intention to enter into contract and upon the parties meeting their respective statutory requirements, the Procuring Entity shall send the successful Tenderer the Contract Agreement.
- 50.2 Within fourteen (14) days of receipt of the Contract Agreement, the successful Tenderer shall sign, date, and return it to the Procuring Entity.
- 50.3 The written contract shall be entered into within the period specified in the notification of award and before expiry of the tender validity period

51. Appointment of Adjudicator

- 51.1 The Procuring Entity proposes the person named in the **TDS** to be appointed as Adjudicator under the Contract, at the hourly fee specified in the **TDS**, plus reimbursable expenses. If the Tenderer disagrees with this proposal, the Tenderer should so state in his Tender. If, in the Letter of Acceptance, the Procuring Entity does not agree on the appointment of the Adjudicator, the Procuring Entity will request the Appointing Authority designated in the Special Conditions of Contract (SCC) pursuant to Clause 23.1 of the General Conditions of Contract (GCC), to appoint the Adjudicator.

52. Performance Security

- 52.1 Within twenty-one (21) days of the receipt of the Letter of Acceptance from the Procuring Entity, the successful Tenderer shall furnish the Performance Security and, any other documents required in the **TDS**, in accordance with the General Conditions of Contract, subject to ITT 40.2 (b), using the Performance Security and other Forms included in Section X, Contract Forms, or another form acceptable to the Procuring Entity. A foreign institution providing a bank guarantee shall have a correspondent financial institution located in Kenya, unless the Procuring Entity has agreed in writing that a correspondent bank is not required.
- 52.2 Failure of the successful Tenderer to submit the above-mentioned Performance Security and other documents required in the **TDS**, or sign the Contract shall constitute sufficient grounds for the annulment of the award and forfeiture of the Tender Security. In that event the Procuring Entity may award the Contract to the Tenderer offering the next Best Evaluated Tender.
- 52.3 Performance security shall not be required for contracts estimated to cost less than Kenya shillings five million shillings.

53. Publication of Procurement Contract

- 53.1 Within fourteen days after signing the contract, the Procuring Entity shall publish the awarded contract at its notice boards and websites; and on the Website of the Authority. At the minimum, the notice shall contain the following information:
- a) name and address of the Procuring Entity;
 - b) name and reference number of the contract being awarded, a summary of its scope and the selection method used;
 - c) the name of the successful Tenderer, the final total contract price, the contract duration.
 - d) dates of signature, commencement and completion of contract;
 - e) names of all Tenderers that submitted Tenders, and their Tender prices as read out at Tender opening.

54. Procurement Related Complaints and Administrative Review

54.1 The procedures for making Procurement-related Complaints are as specified in the **TDS**.

54.2 A request for administrative review shall be made in the form provided under contract forms.

Section II - Tender Data Sheet (TDS)

The following specific data shall complement, supplement, or amend the provisions in the Instructions to Tenderers (ITT). Whenever there is a conflict, the provisions herein shall prevail over those in ITT.

ITT Reference	PARTICULARS OF APPENDIX TO INSTRUCTIONS TO TENDERS
	A. General
ITT 1.1	<p>The name of the contract is Borehole Equipping & Construction of Elevated Steel tank at Magana Primary School</p> <p>The reference number of the Contract is THIWASCO/031/BCEST/2023-2024</p> <p>The number and identification of lots (contracts) comprising this Tender are: Not Applicable</p>
ITT 2.3	The Information made available on competing firms is as follows: Not Applicable
ITT 2.4	The firms that provided consulting services for the contract being tendered for are: no firm provided consultancy services
ITT 3.1	Maximum number of members in the Joint Venture (JV) shall be: Two
B. Contents of Tender Document	
8.1	<p>(A) A pre-arranged pretender site visit shall take place. Date: Tuesday, November 28, 2023 Time: 10:00am Place: Members to meet at head office, then proceed to site.</p> <p>(B) Pre-Tender meeting shall not take place.</p>
ITT 8.2	<p>The Tenderer will submit any questions in writing, to reach the Procuring Entity</p> <p>not later than 29th November 2023 at 5.00pm</p>
ITT 8.4	The Procuring Entity's website where Minutes of the pre-Tender meeting and the pre-arranged pretender site visit will be published is www.thikawater.co.ke
ITT 9.1	<p>For Clarification of Tender purposes, for obtaining further information and for purchasing tender documents, the Procuring Entity's address is:</p> <p>Name of Procuring Entity: Thika Water & Sewerage Company Ltd</p> <p>Physical address for hand Courier Delivery to an office or Tender THIWASCO Head Office, Haile Sellasie Road Near BluePost Hotel Room No.1 Postal Address: P.O. Box 6103-01000 Thika</p> <p>name, telephone number and e-mail address of the officer to be contacted: Procurement Department, 0720-418444, procurement@thikawater.co.ke</p>
C. Preparation of Tenders	
ITP 13.1 (h)	The Tenderer shall submit the following additional documents in its Tender: No other additional documents required.
ITT 15.1	Alternative Tenders shall not be considered

ITT 15.2	Alternative times for completion shall not be permitted.
ITT 15.4	Alternative technical solutions shall be permitted for the following parts of the Works: not Applicable
ITT Reference	PARTICULARS OF APPENDIX TO INSTRUCTIONS TO TENDERS
ITT 16.5	The prices quoted by the Tenderer shall be fixed
ITT 20.1	The Tender validity period shall be 182 days.
ITT 20.3 (a)	<p>(a) The delayed to exceeding None number of days.</p> <p>(b) The Tender price shall be adjusted by the following percentages of the tender price:</p> <p>(i) By None% of the local currency portion of the Contract price adjusted to reflect local inflation during the period of extension, and</p> <p>(ii) By None% the foreign currency portion of the Contract price adjusted to reflect the international inflation during the period of extension.</p>
ITT 21.1	<p>A Tender Security shall be required of kshs.200,000.00,original from approved institutions by PPRA</p> <p>A Tender-Securing Declaration shall not be required.</p>
ITT 21.2 (d)	The other Tender Security shall be none
ITT 21.5	<p>On the Performance Security, other documents required shall be:</p> <p>programme of works</p> <p>Performance security shall be 10% of the total quoted amount (contract price).</p> <hr/>
ITT 22.1	In addition to the original of the Tender, the number of copies is: the tenderer shall provide one (1) original and one (1) copy
ITT 22.3	The written confirmation of authorization to sign on behalf of the Tenderer shall consist of: Confidential business questionnaire duly completed detailing directors/partners/sole proprietorship, MUST disclose power of attorney of the signatory.
D. Submission and Opening of Tenders	
ITT 24.1	<p>For <u>Tender submission purposes</u> only, the Procuring Entity's address is:</p> <p>Name of Procuring Entity: Thika Water & Sewerage Company Ltd</p> <p>Postal Address Managing Director, P.O. Box 6103-01000 Thika,</p> <p>Physical address for hand Courier Delivery to an office or Tender Box: THIWASCO Main Offices, haile Sellasie Road near BluePost Hotel, Procurement Office, Room No. 1</p>

	Date and time for submission of Tenders: Tuesday, December 05, 2023 at 12.00noon Tenders shall not submit tenders electronically.		
ITT 27.1	The Tender opening shall take place at the time and the address for Opening of Tenders provided below: Name of Procuring Entity: Thika Water & Sewerage Company Ltd		
ITT Reference	PARTICULARS OF APPENDIX TO INSTRUCTIONS TO TENDERS		
	Physical address for the location THIWASCO Main Offices, haile Sellasie Road near BluePost Hotel.		
	State date and time of tender opening:	Tuesday, December 05, 2023 at 12.00noon	
ITT 27.1	If Tenderers are not allowed to submit Tenders electronically.		
ITT 27.6	The number of representatives of the Procuring Entity to sign is: as per the appointed members of the tender opening/closing committee		
E. Evaluation, and Comparison of Tenders			
ITT 32.3	The adjustment shall be based on the average price of the item or component as quoted in other substantially responsive Tenders. If the price of the item or component cannot be derived from the price of other substantially responsive Tenders, the Procuring Entity shall use its best estimate.		
ITT 33.2	Any errors in the submitted tender arising from a miscalculation of unit price, quantity, and subtotal and total bid price shall be considered as a major deviation that affects the substance of the tender and shall lead to disqualification of the tender as non-responsive		
ITT 35.2	The invitation to tender is open to all eligible bidders who wishes to participate		
ITT 36.1	At this time, the Procuring Entity does not intend to execute certain specific parts of the Works by subcontractors selected in advance.		
ITT 36.2	Contractor’s may propose subcontracting: Not Permitted		
ITT 36.3	not applicable		
ITT 37.2 (d)	Additional requirements apply. These are detailed in the evaluation criteria in Section III, Evaluation and Qualification Criteria.		
	F. Award of Contract Award shall be made to the lowest evaluated most responsive bidder with quoted prices which are within the market range.		
ITT 51.1	The person named to be appointed as Adjudicator is: NCIA		
ITT 52.2	Other documents required are: Programme of works		

ITT 54.1	<p>The procedures for making a Procurement-related Complaints are detailed in the “Regulations” available from the PPRA Website www.ppra.go.ke or email complaints@ppra.go.ke.</p> <p>If a Tenderer wishes to make a Procurement-related Complaint, the Tenderer should submit its complaint following these procedures, in writing (by the quickest means available, that is either by hand delivery or email to:</p> <p>For the attention: Dr. Moses Kinya</p> <p>Title/position: Managing Director</p> <p>Procuring Entity: Thika Water & Sewerage Company Ltd</p> <p>Email address: thikawater.co.ke</p> <p>In summary, a Procurement-related Complaint may challenge any of the following (among others):</p> <ul style="list-style-type: none"> (i) the terms of the Tender Documents; and (ii) the Procuring Entity’s decision to award the contract.
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SECTION III - EVALUATION AND QUALIFICATION CRITERIA

Particulars to the appendix of evaluation and qualification criteria below shall be used to determine the lowest evaluated responsive bidder who shall be awarded the contract;

No.				
1.0	Mandatory Eligibility criteria		Responsiveness	Indicate reference no. where evidence is provided
	1	Attach certified copies of incorporation or certificate of registration certificate		
	2	Dully filled, signed and stamped form of tender and price schedule in the format provided for in the tender document		
	3	Duly filled, signed and stamped confidential business questionnaire in the format provided for in the tender document		
	4	Provide certified copy of Proof of NCA5 and above registration and a valid practicing License (for, roads, water and other civil works		

	5	Attach certified Valid copy of Tax Compliance certificate		
	6	Attach certified copy of valid business permit		
	7	Attach certified copy of CR12 /Partnership deed		
	8	Attach certified Copies of IDs of Directors		
	9	Provide proof of physical address (attach copy of rental or lease agreement)		
	10	Provide original valid bid bond from institutions approved by PPRA of kshs.200,0000 valid for 182 days		
	11	Bidders must serialize every page of the bid document submitted from page one to the last page in the format of 1,2,3,4.....		
	12	Bidders shall prepare and submit two copies of bid documents marked clearly "ORIGINAL and COPY bid"		
	13	Filled site visit form to ascertain understanding the scope of works		

2.0		Technical Evaluation Criteria	points	Indicate reference no. where evidence is provided
	1	Provide a minimum number of three (3) similar certified copies of contracts substantially completed in the last five (5) years. Attach certified prove copies of completion certificates, letters of awards, LPOs/LSOs, recommendation letters, signed contracts e.t.c.	16mrks	
	2	Submission of certified audited financial statements for the last three years (2020,2021,2022) to demonstrate the current soundness of the	15mrks	
	3	Minimum average annual construction turnover of Kenya Shillings 12,000,000.00 equivalent calculated as total certified payments received for contracts in progress and/or completed within the last five (5) years, divided by five (5) years	15mrks	
	4	The tenderer shall demonstrate that it has access to or has available, liquid assets, unencumbered real assets, lines of credit and other financial means (independent of any contractual advance payment) sufficient to meet the supply cash flow requirements estimated as Kenya shillings 12,000,000)-provide proof	10mrks	

	5	<p>Key Technical staff Provide detailed proposal of key technical members for the proposed project, copies and CV of the proposed team, Enclose detailed certificate</p> <p>Project Manager Degree in Quantity Surveying/Construction Management/ Civil Engineering with 5years minimum relevant experience(5mks)</p> <p>Site Agent (Minimum qualification Higher Diploma in Quantity Surveying/Construction Management/ Civil Engineering with 5 years minimum relevant experience. (5mks)</p> <p>Civil Engineering Foreman 1No. (Minimum qualification is diploma in Civil Engineering) with 3 years relevant experience in building works (5mks)</p>	15mrks	
	7	<p>Equipment (proof of valid ownership / lease agreement)</p> <p>Backhoe excavator complete with rock breaker</p> <p>1 No. Concrete mixer 350 litres</p> <p>1 No. Plate compactor</p> <p>2 No. Concrete poker vibrators</p> <p>1 No. Truck</p>	10mrks	
	8	Submit a draft methodology of specific to construction in built up urban areas and a 6-month program of works which shall form part of the contract if the bid is accepted. Any change in the program or schedule shall be subjected to the approval of the Client	10mrks	
	9	provide evidence that non-performance of a contract did not occur as a result of contractor default since 1st January 2022-provide proof-fill form CON-2	3mrks	
	10	Provide evidence that there is no pending litigation	3mrks	
	11	Provide evidence that there is no consistent history of court/arbitral award decisions against the Tenderer since 1st January 2022-fill form CON-	3mrks	
		Total Marks	100mrks	
		<p>Note:</p> <p>a)Only bidders who attain 75% and above will be considered technically responsive and shall be subjected to financial evaluation/Price Comparison. Tenderers that will pass technical evaluation criteria will be further subjected to arithmetical corrections.</p> <p>b)A bid with an arithmetic error committed that will have some deviations with the form of tender and the detailed financial proposal will lead to automatic disqualification.</p>		

3.0 Tender Evaluation (ITT 35) Price evaluation	
4. Multiple Contracts	Multiple contracts: Not Permitted
5. Alternative Tenders	Alternative Tenders: Not Permitted
6. Margin of preference	Margin of preference: AGPO group
7. Post qualification and Contract award more specifically	<p>Tender will be subjected to post qualification criteria</p> <p>a. The Tenderer shall demonstrate that it has access to, or has available, liquid assets, unencumbered real assets, lines of credit, and other financial means (independent of any contractual advance payment) sufficient to meet the construction cash flow of Kenya shillings 12,000,000.00</p> <p>b. Minimum average annual construction turnover of Kenya Shillings [12,000,000.00], equivalent calculated as total certified payments received for contracts in progress and/or completed within the last [5] years</p> <p>c. Confirm at least (two) of contract(s) of a similar nature executed within Kenya, or the East African Community or abroad, that have been satisfactorily and substantially completed as a prime contractor, or joint venture member or sub-contractor each of minimum value Kenya shillings equivalent</p> <p>d. Confirm history of non-performance of the previous works awarded.</p> <p>e. THIWASCO may conduct due diligence prior to contract award to confirm successful bidders eligibility any time during the process.</p>
Qualification form summary	Qualification form summary :Stick to evaluation criteria referenced 2.0 above.

QUALIFICATION FORMS

FORM EQU: EQUIPMENT

The Tenderer shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section III, Evaluation and Qualification Criteria. A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Tenderer.

Item of equipment		
Equipment information	Name of manufacturer	Model and power rating

	Capacity	Year of manufacture
Current status	Current location	
	Details of current commitments	
Source	Indicate source of the equipment <input type="checkbox"/> Owned <input type="checkbox"/> Rented <input type="checkbox"/> Leased <input type="checkbox"/> Specially manufactured	

Omit the following information for equipment owned by the Tenderer.

Owner	Name of owner	
	Address of owner	
	Telephone	Contact name and title
	Fax	Telex
Agreements	Details of rental / lease / manufacture agreements specific to the project	

FORM PER -1

Contractor's Representative and Key Personnel Schedule

Tenderers should provide the names and details of the suitably qualified Contractor's Representative and Key Personnel to perform the Contract. The data on their experience should be supplied using the Form PER-2 below for each candidate.

Contractor' Representative and Key Personnel

1.	Title of position: Contractor's Representative	
	Name of candidate:	
	Duration of appointment:	<i>[insert the whole period (start and end dates) for which this position will be engaged]</i>
	Time commitment: for this position:	<i>[insert the number of days/week/months/ that has been scheduled for this position]</i>
	Expected time schedule for this position:	<i>[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]</i>
2.	Title of position: [_____]	
	Name of candidate:	
	Duration of appointment:	<i>[insert the whole period (start and end dates) for which this position will be engaged]</i>
	Time commitment: for this position:	<i>[insert the number of days/week/months/ that has been scheduled for this position]</i>
	Expected time schedule for this position:	<i>[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]</i>
3.	Title of position: [_____]	
	Name of candidate:	
	Duration of appointment:	<i>[insert the whole period (start and end dates) for which this position will be engaged]</i>
	Time commitment: for this position:	<i>[insert the number of days/week/months/ that has been scheduled for this position]</i>
	Expected time schedule for this position:	<i>[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]</i>
4.	Title of position: [_____]	
	Name of candidate:	
	Duration of appointment:	<i>[insert the whole period (start and end dates) for which this position will be engaged]</i>
	Time commitment: for this position:	<i>[insert the number of days/week/months/ that has been scheduled for this position]</i>
	Expected time schedule for this position:	<i>[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]</i>
5.	Title of position: [insert title]	
	Name of candidate	
	Duration of appointment:	<i>[insert the whole period (start and end dates) for which this position will be engaged]</i>
	Time commitment: for this position:	<i>[insert the number of days/week/months/ that has been scheduled for this position]</i>
	Expected time schedule for this position:	<i>[insert the expected time schedule for this position (e.g. attach high level Gantt chart)]</i>

FORM PER-2:

Resume and Declaration - Contractor's Representative and Key Personnel.

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

Name of Tenderer

Position [#1]: <i>[title of position from Form PER-1]</i>		
Personnel information	Name:	Date of birth:
	Address:	E-mail:
	Professional qualifications:	
	Academic qualifications:	
	Language proficiency: <i>[language and levels of speaking, reading and writing skills]</i>	
Details		
	Address of Procuring Entity:	
	Telephone:	Contact (manager / personnel officer):
	Fax:	
	Job title:	Years with present Procuring Entity:

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

Project	Role	Duration of involvement	Relevant experience
<i>[main project details]</i>	<i>[role and responsibilities on the project]</i>	<i>[time in role]</i>	<i>[describe the experience relevant to this position]</i>

Declaration

I, the undersigned *[insert either "Contractor's Representative" or "Key Personnel" as applicable]*, certify that to the best of my knowledge and belief, the information contained in this Form PER-2 correctly describes myself, my qualifications and my experience.

I confirm that I am available as certified in the following table and throughout the expected time schedule for this position as provided in the Tender:

Commitment	Details
Commitment to duration of contract:	<i>[insert period (start and end dates) for which this Contractor's Representative or Key Personnel is available to work on this contract]</i>
Time commitment:	<i>[insert period (start and end dates) for which this Contractor's Representative or Key Personnel is available to work on this contract]</i>

I understand that any misrepresentation or omission in this Form may:
be taken into consideration during Tender evaluation; result in my disqualification from participating in the Tender;
result in my dismissal from the contract.

Name of Contractor's Representative or Key Personnel: *[insert name]*

Signature: _____

Date: (day month year): _____

Countersignature

of authorized representative of the Tenderer:

Signature: _____ Date: (day month

year): _____

TENDERER'S QUALIFICATION WITHOUT PRE-QUALIFICATION

To establish its qualifications to perform the contract in accordance with Section III, Evaluation and Qualification Criteria the Tenderer shall provide the information requested in the corresponding Information Sheets included hereunder.

4.1 FORM ELI -1.1

Tenderer Information Form

Date: _____

ITT No. and title: _____

Tenderer's name
In case of Joint Venture (JV), name of each member:
Tenderer's actual or intended country of registration: <i>[indicate country of Constitution]</i>
Tenderer's actual or intended year of incorporation:
Tenderer's legal address [in country of registration]:
Tenderer's authorized representative information Name: _____ Address: _____ Telephone/Fax numbers: _____ E-mail address: _____
1. Attached are copies of original documents of <input type="checkbox"/> Articles of Incorporation (or equivalent documents of constitution or association), and/or documents of registration of the legal entity named above, in accordance with ITT 3.6 <input type="checkbox"/> In case of JV, letter of intent to form JV or JV agreement, in accordance with ITT 3.5 <input type="checkbox"/> In case of state-owned enterprise or institution, in accordance with ITT 3.8, documents establishing: Legal and financial autonomy Operation under commercial law Establishing that the Tenderer is not under the supervision of the Procuring Entity 2. Included are the organizational chart and a list of Board of Directors.

4.2 FORM ELI -1.2

Tenderer's JV Information Form

(to be completed for each member of Tenderer's JV)

Date: _____

ITT No. and title: _____

Tenderer's JV name:

JV member's name:

JV member's country of registration:

JV member's year of constitution:

JV member's legal address in country of constitution:

JV member's authorized representative information

Name: _____

Address: _____

Telephone/Fax numbers: _____

E-mail address: _____

1. Attached are copies of original documents of

☐ Articles of Incorporation (or equivalent documents of constitution or association), and/or registration documents of the legal entity named above, in accordance with ITT 3.6.

☐ In case of a state-owned enterprise or institution, documents establishing legal and financial autonomy, operation in accordance with commercial law, and that they are not under the supervision of the Procuring Entity, in accordance with ITT 3.8.

2. Included are the organizational chart and a list of Board of Directors.

FORM CON – 2

Historical Contract Non-Performance, Pending Litigation and Litigation History

Tenderer's Name: _____

Date: _____

JV Member's Name _____

ITT No. and title: _____

Non-Performed Contracts in accordance with Section III, Evaluation and Qualification Criteria

☐ Contract non-performance did not occur since 1st January *[insert year]* specified in Section III, Evaluation and Qualification Criteria, Sub-Factor 2.1.

☐ Contract(s) not performed since 1st January *[insert year]* specified in Section III, Evaluation and Qualification Criteria, requirement 2.1

Year	Non- performed portion of contract	Contract Identification	Total Contract Amount (current value, currency, exchange rate and Kenya Shilling equivalent)
<i>[insert year]</i>	<i>[insert amount and percentage]</i>	Contract Identification: <i>[indicate complete contract name/ number, and any other identification]</i> Name of Procuring Entity: <i>[insert full name]</i> Address of Procuring Entity: <i>[insert street/city/country]</i> Reason(s) for nonperformance: <i>[indicate main reason(s)]</i>	<i>[insert amount]</i>

Pending Litigation, in accordance with Section III, Evaluation and Qualification Criteria

☐ No pending litigation in accordance with Section III, Evaluation and Qualification Criteria, SubFactor 2.3.

☐ Pending litigation in accordance with Section III, Evaluation and Qualification Criteria, Sub-Factor 2.3 as indicated below.

Year of dispute	Amount in dispute (currency)	Contract Identification	Total Contract Amount (currency), Kenya Shilling Equivalent (exchange rate)
		Contract Identification: _____ Name of Procuring Entity: _____ Address of Procuring Entity: _____ Matter in dispute: _____ Party who initiated the dispute: _____ Status of dispute: _____	
		Contract Identification: _____ Name of Procuring Entity: _____ Address of Procuring Entity: _____ Matter in dispute: _____ Party who initiated the dispute: _____ Status of dispute: _____	

Litigation History in accordance with Section III, Evaluation and Qualification Criteria

☐ No Litigation History in accordance with Section III, Evaluation and Qualification Criteria, Sub-Factor

2.4.

☐ Litigation History in accordance with Section III, Evaluation and Qualification Criteria, Sub-Factor 2.4 as indicated below.

Year of award	Outcome as percentage of Net Worth	Contract Identification	Total Contract Amount (currency), Kenya Shilling Equivalent (exchange rate)
<i>[insert year]</i>	<i>[insert percentage]</i>	Contract Identification: [indicate complete contract name, number, and any other identification] Name of Procuring Entity: <i>[insert full name]</i> Address of Procuring Entity: <i>[insert street/city/country]</i> Matter in dispute: <i>[indicate main issues in dispute]</i> Party who initiated the dispute: <i>[indicate "Procuring Entity" or "Contractor"]</i> Reason(s) for Litigation and award decision <i>[indicate main reason(s)]</i>	<i>[insert amount]</i>

4.4 FORM FIN – 3.1:

Financial Situation and Performance

Tenderer's Name: _____ Date: _____

JV Member's Name _____

ITT No. and title: _____

4.4.1. Financial Data

Type of Financial information in _____ (currency)	Historic information for previous _____ years, _____ (amount in currency, currency, exchange rate*, USD equivalent)				
	Year 1	Year 2	Year 3	Year 4	Year 5
Statement of Financial Position (Information from Balance Sheet)					
Total Assets (TA)					
Total Liabilities (TL)					
Total Equity/Net Worth (NW)					
Current Assets (CA)					
Current Liabilities (CL)					
Working Capital (WC)					
Type of Financial information in _____ (currency)	Historic information for previous _____ years, _____ (amount in currency, currency, exchange rate*, USD equivalent)				
	Year 1	Year 2	Year 3	Year 4	Year 5
Information from Income Statement					
Total Revenue (TR)					
Profits Before Taxes (PBT)					
Cash Flow Information					
Cash Flow from Operating Activities					

*Refer to ITT 15 for the exchange rate

4.4.2 Sources of Finance

Specify sources of finance to meet the cash flow requirements on works currently in progress and for future contract commitments.

No.	Source of finance	Amount (Kenya Shilling equivalent)
1		
2		
3		

4.4.3 Financial documents

The Tenderer and its parties shall provide copies of financial statements for _____ years pursuant Section III, Evaluation and Qualifications Criteria, Sub-factor 3.1. The financial statements shall:

- (a) reflect the financial situation of the Tenderer or in case of JV member, and not an affiliated entity (such as parent company or group member).
- (b) be independently audited or certified in accordance with local legislation.
- (c) be complete, including all notes to the financial statements.
- (d) correspond to accounting periods already completed and audited.

☐ Attached are copies of financial statements¹ for the _____ years required above; and complying with the requirements

¹ If the most recent set of financial statements is for a period earlier than 12 months from the date of Tender, the reason for this should be justified.

4.5 FORM FIN – 3.2:

Average Annual Construction Turnover

Tenderer's Name: _____

Date: _____

JV Member's Name _____

ITT No. and title: _____

		Annual turnover data (construction only)	
Year	Amount Currency	Exchange rate	Kenya Shilling equivalent
<i>[indicate year]</i>	<i>[insert amount and indicate currency]</i>		
Average Annual Construction Turnover *			

* See Section III, Evaluation and Qualification Criteria, Sub-Factor 3.2.

4.6 FORM FIN – 3.3:

Financial Resources

Specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject contract or contracts as specified in Section III, Evaluation and Qualification Criteria

Financial Resources		
No.	Source of financing	Amount (Kenya Shilling equivalent)
1		
2		
3		

4.7 FORM FIN – 3.4:

Current Contract Commitments / Works in Progress

Tenderers and each member to a JV should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Current Contract Commitments

No.	Name of Contract	Procuring Entity's Contact Address, Tel,	Value of Outstanding Work [Current Kenya Shilling /month Equivalent]	Estimated Completion Date	Average Monthly Invoicing Over Last Six Months [Kenya Shilling /month)]
1					
2					
3					
4					
5					

4.8 FORM EXP - 4.1

General Construction Experience

Tenderer's Name: _____

Date: _____

JV Member's Name _____

ITT No. and title: _____

Page _____ of _____ pages

Starting Year	Ending Year	Contract Identification	Role of Tenderer
		Contract name: _____ Brief Description of the Works performed by the Tenderer: _____ Amount of contract: _____ Name of Procuring Entity: _____ Address: _____	
		Contract name: _____ Brief Description of the Works performed by the Tenderer: _____ Amount of contract: _____ Name of Procuring Entity: _____ Address: _____	
		Contract name: _____ Brief Description of the Works performed by the Tenderer: _____ Amount of contract: _____ Name of Procuring Entity: _____ Address: _____	

4.9 FORM EXP - 4.2(a)**Specific Construction and Contract Management Experience**

Tenderer's Name: _____

Date: _____

JV Member's Name _____

ITT No. and title: _____

Similar Contract No.	Information			
Contract Identification				
Award date				
Completion date				
Role in Contract	Prime Contractor <input type="checkbox"/>	Member in JV <input type="checkbox"/>	Management Contractor <input type="checkbox"/>	Sub-contractor <input type="checkbox"/>
Total Contract Amount			Kenya Shilling	
If member in a JV or sub-contractor, specify participation in total Contract amount				
Procuring Entity's Name:				
Address: Telephone/fax number E-mail:				

4.10 FORM EXP - 4.2 (a) (cont.)**Specific Construction and Contract Management Experience (cont.)**

Similar Contract No.	Information
Description of the similarity in accordance with Sub-Factor 4.2(a) of Section III:	
1. Amount	
2. Physical size of required works items	
3. Complexity	
4. Methods/Technology	
5. Construction rate for key activities	
6. Other Characteristics	

4.11 FORM EXP - 4.2(b)

Construction Experience in Key Activities

Tenderer's Name: _____

Date: _____

Tenderer's JV Member Name: _____

Sub-contractor's Name² (as per ITT 34): _____

ITT No. and title: _____

All Sub-contractors for key activities must complete the information in this form as per ITT 34 and Section III, Evaluation and Qualification Criteria, Sub-Factor 4.2.

1. Key Activity No One: _

Information				
Contract Identification				
Award date				
Completion date				
Role in Contract	Prime Contractor <input type="checkbox"/>	Member in JV <input type="checkbox"/>	Management Contractor <input type="checkbox"/>	Sub-contractor <input type="checkbox"/>
Total Contract Amount				Kenya Shilling
Quantity (Volume, number or rate of production, as applicable) performed under the contract per year or part of the year	Total quantity in the contract (i)	Percentage participation (ii)	Actual Quantity Performed (i) x (ii)	
Year 1				
Year 2				
Year 3				
Year 4				
Procuring Entity's Name:				
Address: Telephone/fax number E-mail:				

Information	
Description of the key activities in accordance with Sub-Factor 4.2(b) of Section III:	

² If applicable

- 2. Activity No. Two
- 3.

OTHER FORMS

5 FORM OF TENDER (Amended and issued pursuant to PPRA CIRCULAR No. 02/2022)

INSTRUCTIONS TO TENDERERS

- i) *All italicized text is to help the Tenderer in preparing this form.*
- ii) *The Tenderer must prepare this Form of Tender on stationery with its letterhead clearly showing the Tenderer's complete name and business address. Tenderers are reminded that this is a mandatory requirement.*
- iii) *Tenderer must complete and sign CERTIFICATE OF INDEPENDENT TENDER DETERMINATION and the SELF DECLARATION FORMS OF THE TENDERER as listed under (s) below.*

Date of this Tender submission:.....[insert date (as day, month and year) of Tender submission] **Tender**

Name **and** **Identification:**.....[insert identification] **Alternative**

No.:.....[insert identification No if this is a Tender for an alternative]

To: [Insert complete name of Procuring Entity]

Dear Sirs,

1. In accordance with the Conditions of Contract, Specifications, Drawings and Bills of Quantities for the execution of the above named Works, we, the undersigned offer to construct and complete the Works and remedy any defects therein for the sum of Kenya Shillings *[[Amount in figures]_____Kenya Shillings [amount in words] _____*. The above amount includes foreign currency amount (s) of *[state figure or a percentage and currency]* *[figures]_____ [words] _____*. The percentage or amount quoted above does not include provisional sums, and only allows not more than two foreign currencies.
2. We undertake, if our tender is accepted, to commence the Works as soon as is reasonably possible after the receipt of the Engineer's notice to commence, and to complete the whole of the Works comprised in the Contract within the time stated in the Special Conditions of Contract.
3. We agree to adhere by this tender until *[Insert date]*, and it shall remain binding upon us and may be accepted at any time before that date.
4. Unless and until a formal Agreement is prepared and executed this tender together with your written acceptance thereof, shall constitute a binding Contract between us. We further understand that you are not bound to accept the lowest or any tender you may receive.
5. We, the undersigned, further declare that:
 - i) No reservations: We have examined and have no reservations to the tender document, including Addenda issued in accordance with ITT 28;
 - ii) Eligibility: We meet the eligibility requirements and have no conflict of interest in accordance with ITT 3 and 4;
 - iii) Tender-Securing Declaration: We have not been suspended nor declared ineligible by the Procuring Entity based on execution of a Tender-Securing or Proposal-Securing Declaration in the Procuring Entity's Country in accordance with ITT 19.8;
 - iv) Conformity: We offer to execute in conformity with the tendering documents and in accordance with the implementation and completion specified in the construction schedule, the following Works: *[insert a brief description of the Works]*;

- v) Tender Price: The total price of our Tender, excluding any discounts offered in item 1 above is: *[Insert one of the options below as appropriate]*
- vi) Option 1, in case of one lot: Total price is: *[insert the total price of the Tender in words and figures, indicating the various amounts and the respective currencies]*; Or

Option 2, in case of multiple lots:

- a) Total price of each lot *[insert the total price of each lot in words and figures, indicating the various amounts and the respective currencies]*; and
- b) Total price of all lots (sum of all lots) *[insert the total price of all lots in words and figures, indicating the various amounts and the respective currencies]*;

vii) Discounts: The discounts offered and the methodology for their application are:

viii) The discounts offered are: *[Specify in detail each discount offered.]*

ix) The exact method of calculations to determine the net price after application of discounts is shown below: *[Specify in detail the method that shall be used to apply the discounts]*;

x) Tender Validity Period: Our Tender shall be valid for the period specified in TDS 18.1 (as amended, if applicable) from the date fixed for the Tender submission deadline specified in TDS 22.1 (as amended, if applicable), and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

xi) Performance Security: If our Tender is accepted, we commit to obtain a Performance Security in accordance with the Tendering document;

xii) One Tender Per Tender: We are not submitting any other Tender(s) as an individual Tender, and we are not participating in any other Tender(s) as a Joint Venture member or as a subcontractor, and meet the requirements of ITT 3.4, other than alternative Tenders submitted in accordance with ITT 13.3;

xiii) Suspension and Debarment: We, along with any of our subcontractors, suppliers, Engineer, manufacturers, or service providers for any part of the contract, are not subject to, and not controlled by any entity or individual that is subject to, a temporary suspension or a debarment imposed by the Public Procurement Regulatory Authority or any other entity of the Government of Kenya, or any international organization.

xiv) State-owned enterprise or institution: *[select the appropriate option and delete the other]* *[We are not a state-owned enterprise or institution]* / *[We are a state-owned enterprise or institution but meet the requirements of ITT 3.8]*;

xv) Commissions, gratuities, fees: We have paid, or will pay the following commissions, gratuities, or fees with respect to the tender process or execution of the Contract: *[insert complete name of each Recipient, its full address, the reason for which each commission or gratuity was paid and the amount and currency of each such commission or gratuity]*.

Name of Recipient	Address	Reason	Amount

(If none has been paid or is to be paid, indicate "none.")

xvi) Binding Contract: We understand that this Tender, together with your written acceptance thereof included in your Letter of Acceptance, shall constitute a binding contract between us, until a formal contract is prepared and executed;

xvii) Not Bound to Accept: We understand that you are not bound to accept the lowest evaluated cost Tender, the Most Advantageous Tender or any other Tender that you may receive;

- xviii) **Fraud and Corruption:** We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf engages in any type of Fraud and Corruption;
- xix) **Collusive practices:** We hereby certify and confirm that the tender is genuine, non-collusive and made with the intention of accepting the contract if awarded. To this effect we have signed the “Certificate of Independent Tender Determination” attached below. We undertake to adhere by the Code of Ethics for Persons Participating in Public Procurement and Asset Disposal, copy available from __(*specify website*) during the procurement process and the execution of any resulting contract.
- xx) **Beneficial Ownership Information:** We commit to provide to the procuring entity the Beneficial Ownership Information in conformity with the Beneficial Ownership Disclosure Form upon receipt of notification of intention to enter into a contract in the event we are the successful tenderer in this subject procurement proceeding.
- xxi) We, the Tenderer, have duly completed, signed and stamped the following Forms as part of our Tender:
- Tenderer's Eligibility; Confidential Business Questionnaire – to establish we are not in any conflict to interest.
 - Certificate of Independent Tender Determination – to declare that we completed the tender without colluding with other tenderers.
 - Self-Declaration of the Tenderer – to declare that we will, if awarded a contract, not engage in any form of fraud and corruption.
 - Declaration and commitment to the Code of Ethics for Persons Participating in Public Procurement and Asset Disposal

Further, we confirm that we have read and understood the full content and scope of fraud and corruption as informed in “**Appendix 1- Fraud and Corruption**” attached to the Form of Tender.

Name of the Tenderer: *[*insert complete name of person signing the Tender*]

Name of the person duly authorized to sign the Tender on behalf of the Tenderer: **[*insert complete name of person duly authorized to sign the Tender*]

Title of the person signing the Tender: [*insert complete title of the person signing the Tender*]

Signature of the person named above: [*insert signature of person whose name and capacity are shown above*] **Date signed** [*insert date of signing*] day of [*insert month*], [*insert year*]

Date signed _____ day of _____, _____

Notes

* *In the case of the Tender submitted by joint venture specify the name of the Joint Venture as Tenderer* ** *Person signing the Tender shall have the power of attorney given by the Tenderer to be attached with the Tender.*

A. TENDERER'S ELIGIBILITY- CONFIDENTIAL BUSINESS QUESTIONNAIRE

Instruction to Tenderer

Tender is instructed to complete the particulars required in this Form, *one form for each entity if Tender is a JV*. Tenderer is further reminded that it is an offence to give false information on this Form.

(a) Tenderer's details

	ITEM	DESCRIPTION
1	Name of the Procuring Entity	
2	Reference Number of the Tender	
3	Date and Time of Tender Opening	
4	Name of the Tenderer	
5	Full Address and Contact Details of the Tenderer.	Country City Location Building Floor Postal Address Name and email of contact person.
6	Current Trade License Registration Number and Expiring date	
7	Name, country and full address (<i>postal and physical addresses, email, and telephone number</i>) of Registering Body/Agency	
8	Description of Nature of Business	
9	Maximum value of business which the Tenderer handles.	
10	State if Tenders Company is listed in stock exchange, give name and full address (<i>postal and physical addresses, email, and telephone number</i>) of state which stock exchange	

General and Specific Details

Sole Proprietor, provide the following details.

Name in full _____ Age _____ Nationality _____
_____ Country of Origin _____ Citizenship _____

Partnership, provide the following details.

	Names of Partners	Nationality	Citizenship	% Shares owned
1				
2				
3				

Registered Company, provide the following details.

Private or public Company _____

State the nominal and issued capital of the Company _____

Nominal Kenya Shillings (Equivalent)..... Issued Kenya Shillings
(Equivalent).....

Give details of Directors as follows.

	Names of Director	Nationality	Citizenship	% Shares owned
1				
2				
3				

DISCLOSURE OF INTEREST- Interest of the Firm in the Procuring Entity.

Are there any person/persons in (Name of Procuring Entity) who has/have an interest or relationship in this firm? Yes/No.....

If yes, provide details as follows.

	Names of Person	Designation in the Procuring Entity	Interest or Relationship with Tenderer
1			
2			
3			

Conflict of interest disclosure

	Type of Conflict	Disclosure YES OR NO	If YES provide details of the relationship with Tenderer
1	Tenderer is directly or indirectly controls, is controlled by or is under common control with another tenderer.		
2	Tenderer receives or has received any direct or indirect subsidy from another tenderer.		
3	Tenderer has the same legal representative as another tenderer		

4	Tender has a relationship with another tenderer, directly or through common third parties, that puts it in a position to		
	Type of Conflict	Disclosure YES OR NO	If YES provide details of the relationship with Tenderer
	influence the tender of another tenderer, or influence the decisions of the Procuring Entity regarding this tendering process.		
5	Any of the Tenderer's affiliates participated as a consultant in the preparation of the design or technical specifications of the works that are the subject of the tender.		
6	Tenderer would be providing goods, works, non-consulting services or consulting services during implementation of the contract specified in this Tender Document.		
7	Tenderer has a close business or family relationship with a professional staff of the Procuring Entity who are directly or indirectly involved in the preparation of the Tender document or specifications of the Contract, and/or the Tender evaluation process of such contract.		
8	Tenderer has a close business or family relationship with a professional staff of the Procuring Entity who would be involved in the implementation or supervision of the such Contract.		
9	Has the conflict stemming from such relationship stated in item 7 and 8 above been resolved in a manner acceptable to the Procuring Entity throughout the tendering process and execution of the Contract.		

f) Certification

On behalf of the Tenderer, I certify that the information given above is complete, current and accurate as at the date of submission.

Full Name _____ Title or

Designation _____

(Signature)

(Date)

B. CERTIFICATE OF INDEPENDENT TENDER DETERMINATION

I, the undersigned, in submitting the accompanying Letter of Tender to the _____ [Name of Procuring Entity] for: _____ [Name and number of tender] in response to the request for tenders made by: _____ [Name of Tenderer] do hereby make the following statements that I certify to be true and complete in every respect:

I certify, on behalf of _____ [Name of Tenderer] that:

I have read and I understand the contents of this Certificate;

I understand that the Tender will be disqualified if this Certificate is found not to be true and complete in every respect;

I am the authorized representative of the Tenderer with authority to sign this Certificate, and to submit the Tender on behalf of the Tenderer;

For the purposes of this Certificate and the Tender, I understand that the word “competitor” shall include any individual or organization, other than the Tenderer, whether or not affiliated with the Tenderer, who: has been requested to submit a Tender in response to this request for tenders;

could potentially submit a tender in response to this request for tenders, based on their qualifications, abilities or experience;

The Tenderer discloses that [check one of the following, as applicable:

The Tenderer has arrived at the Tender independently from, and without consultation, communication, agreement or arrangement with, any competitor;

the Tenderer has entered into consultations, communications, agreements or arrangements with one or more competitors regarding this request for tenders, and the Tenderer discloses, in the attached document(s), complete details thereof, including the names of the competitors and the nature of, and reasons for, such consultations, communications, agreements or arrangements;

In particular, without limiting the generality of paragraphs (5)(a) or (5)(b) above, there has been no consultation, communication, agreement or arrangement with any competitor regarding:

prices;

methods, factors or formulas used to calculate prices; the intention or decision to submit, or not to submit, a tender; or the submission of a tender which does not meet the specifications of the request for Tenders; except as specifically disclosed pursuant to paragraph (5)(b) above;

In addition, there has been no consultation, communication, agreement or arrangement with any competitor regarding the quality, quantity, specifications or delivery particulars of the works or services to which this request for tenders relates, except as specifically authorized by the procuring authority or as specifically disclosed pursuant to paragraph (5)(b) above;

the terms of the Tender have not been, and will not be, knowingly disclosed by the Tenderer, directly or indirectly, to any competitor, prior to the date and time of the official tender opening, or of the awarding of the Contract, whichever comes first, unless otherwise required by law or as specifically disclosed pursuant to paragraph (5)(b) above.

Name _____ Title _____ Date _____

[Name, title and signature of authorized agent of Tenderer and Date].

C. SELF - DECLARATION FORMS

FORM SD1

SELF DECLARATION THAT THE PERSON/TENDERER IS NOT DEBARRED IN THE MATTER OF THE PUBLIC PROCUREMENT AND ASSET DISPOSAL ACT 2015.

I,, of Post Office Box being a resident of in the Republic of do hereby make a statement as follows: -

THAT I am the Company Secretary/ Chief Executive/Managing Director/Principal Officer/Director of (*insert name of the Company*) who is a Bidder in respect of Tender No. for (*insert tender title/description*) for (*insert name of the Procuring entity*) and duly authorized and competent to make this statement.

THAT the aforesaid Bidder, its Directors and subcontractors have not been debarred from participating in procurement proceeding under Part IV of the Act. THAT what is deposed to herein above is true to the best of my knowledge, information and belief.

..... (Title)
..... (Signature) (Date)

Bidder Official Stamp

FORM SD2

SELF DECLARATION THAT THE PERSON/TENDERER WILL NOT ENGAGE IN ANY CORRUPT OR FRAUDULENT PRACTICE

I, of P. O. Box being a resident of in the Republic of do hereby make a statement as follows: -

1. THAT I am the Chief Executive/Managing Director/Principal Officer/Director of (*insert name of the Company*) who is a Bidder in respect of Tender No. for (*insert tender title/description*) for (*insert name of the Procuring entity*) and duly authorized and competent to make this statement.
2. THAT the aforesaid Bidder, its servants and/or agents /subcontractors will not engage in any corrupt or fraudulent practice and has not been requested to pay any inducement to any member of the Board, Management, Staff and/or employees and/or agents of (*insert name of the Procuring entity*) which is the procuring entity.
3. THAT the aforesaid Bidder, its servants and/or agents /subcontractors have not offered any inducement to any member of the Board, Management, Staff and/or employees and/or agents of (name of the procuring entity)
4. THAT the aforesaid Bidder will not engage /has not engaged in any corrosive practice with other bidders participating in the subject tender
5. THAT what is deponed to herein above is true to the best of my knowledge information and belief.

.....
(Title)

.....
(Signature)

.....
(Date)

Bidder's Official Stamp

DECLARATION AND COMMITMENT TO THE CODE OF ETHICS

I (person) on behalf of (*Name of the Business/ Company/Firm*)

..... declare that I have read and fully understood the contents of the Public Procurement & Asset Disposal Act, 2015, Regulations and the Code of Ethics for persons participating in Public Procurement and Asset Disposal and my responsibilities under the Code.

I do hereby commit to abide by the provisions of the Code of Ethics for persons participating in Public Procurement and Asset Disposal. Name of Authorized signatory.....
Sign.....

Position.....

Office address..... Telephone..... E-mail.....

Name of the Firm/Company.....

Date..... (Company Seal/ Rubber Stamp where applicable)

Witness

Name Sign.....

Date.....

D. APPENDIX 1- FRAUD AND CORRUPTION

(Appendix 1 shall not be modified)

1. Purpose

The Government of Kenya's Anti-Corruption and Economic Crime laws and their sanction's policies and procedures, Public Procurement and Asset Disposal Act (*no. 33 of 2015*) and its Regulation, and any other Kenya's Acts or Regulations related to Fraud and Corruption, and similar offences, shall apply with respect to Public Procurement Processes and Contracts that are governed by the laws of Kenya.

2. Requirements

The Government of Kenya requires that all parties including Procuring Entities, Tenderers, (applicants/proposers), Consultants, Contractors and Suppliers; any Sub-contractors, Sub-consultants, Service providers or Suppliers; any Agents (whether declared or not); and any of their Personnel, involved and engaged in procurement under Kenya's Laws and Regulation, observe the highest standard of ethics during the procurement process, selection and contract execution of all contracts, and refrain from Fraud and Corruption and fully comply with Kenya's laws and Regulations as per paragraphs 1.1 above.

Kenya's public procurement and asset disposal act (*no. 33 of 2015*) under Section 66 describes rules to be followed and actions to be taken in dealing with Corrupt, Coercive, Obstructive, Collusive or Fraudulent practices, and Conflicts of Interest in procurement including consequences for offences committed. A few of the provisions noted below highlight Kenya's policy of no tolerance for such practices and behavior: -

1. a person to whom this Act applies shall not be involved in any corrupt, coercive, obstructive, collusive or fraudulent practice; or conflicts of interest in any procurement or asset disposal proceeding;
2. A person referred to under subsection (1) who contravenes the provisions of that sub-section commits an offence;
3. Without limiting the generality of the subsection (1) and (2), the person shall be:
 - a) disqualified from entering into a contract for a procurement or asset disposal proceeding; or
 - b) if a contract has already been entered into with the person, the contract shall be voidable;
4. The voiding of a contract by the procuring entity under subsection (7) does not limit any legal remedy the procuring entity may have;
5. An employee or agent of the procuring entity or a member of the Board or committee of the procuring entity who has a conflict of interest with respect to a procurement:
 - a) shall not take part in the procurement proceedings;
 - b) shall not, after a procurement contract has been entered into, take part in any decision relating to the procurement or contract; and
 - c) shall not be a subcontractor for the bidder to whom was awarded contract, or a member of the group of bidders to whom the contract was awarded, but the subcontractor appointed shall meet all the requirements of this Act.
6. An employee, agent or member described in subsection (1) who refrains from doing anything prohibited under that subsection, but for that subsection, would have been within his or her duties shall disclose the conflict of interest to the procuring entity;
7. If a person contravenes subsection (1) with respect to a conflict of interest described in subsection (5)(a) and the contract is awarded to the person or his relative or to another person in whom one of them had a direct or indirect pecuniary interest, the contract shall be terminated and all costs incurred by the public entity shall be made good by the awarding officer. Etc.

In compliance with Kenya's laws, regulations and policies mentioned above, the Procuring Entity:

- a) Defines broadly, for the purposes of the above provisions, the terms set forth below as follows:
 - i) "corrupt practice" is the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;

- ii) “fraudulent practice” is any act or omission, including misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain financial or other benefit or to avoid an obligation;
- iii) “collusive practice” is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;
- iv) “coercive practice” is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;
- v) “obstructive practice” is: deliberately destroying, falsifying, altering, or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede investigation by Public Procurement Regulatory Authority (PPRA) or any other appropriate authority appointed by Government of Kenya into allegations of a corrupt, fraudulent, coercive, or collusive practice; and/or threatening, harassing, or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or acts intended to materially impede the exercise of the PPRA's or the appointed authority's inspection and audit rights provided for under paragraph 2.3 e. below.

- b) Defines more specifically, in accordance with the above procurement Act provisions set forth for fraudulent and collusive practices as follows:

"fraudulent practice" includes a misrepresentation of fact in order to influence a procurement or disposal process or the exercise of a contract to the detriment of the procuring entity or the tenderer or the contractor, and includes collusive practices amongst tenderers prior to or after tender submission designed to establish tender prices at artificial noncompetitive levels and to deprive the procuring entity of the benefits of free and open competition.

- c) Rejects a proposal for award¹ of a contract if PPRA determines that the firm or individual recommended for award, any of its personnel, or its agents, or its sub-consultants, sub-contractors, service providers, suppliers and/ or their employees, has, directly or indirectly, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices in competing for the contract in question;
- d) Pursuant to the Kenya's above stated Acts and Regulations, may sanction or recommend to appropriate authority (ies) for sanctioning and debarment of a firm or individual, as applicable under the Acts and Regulations;
- e) Requires that a clause be included in Tender documents and Request for Proposal documents requiring (i) Tenderers (applicants/proposers), Consultants, Contractors, and Suppliers, and their Sub-contractors, Sub-consultants, Service providers, Suppliers, Agents personnel, permit the PPRA or any other appropriate authority appointed by Government of Kenya to inspect² all accounts, records and other documents relating to the procurement process, selection and/or contract execution, and to have them audited by auditors appointed by the PPRA or any other appropriate authority appointed by Government of Kenya; and
- f) Pursuant to Section 62 of the above Act, requires Applicants/Tenderers to submit along with their Applications/Tenders/Proposals a “Self-Declaration Form” as included in the procurement document declaring that they and all parties involved in the procurement process and contract execution have not engaged/will not engage in any corrupt or fraudulent practices.

FORM OF TENDER SECURITY-[Option 1–Demand Bank Guarantee]

Beneficiary:_____

Request for Tenders No:

Date:_____

TENDER GUARANTEE No.:_____

Guarantor: _____

We have been informed that _____ (here inafter called "the Applicant") has submitted or will submit to the Beneficiary its Tender (here inafter called" the Tender") for the execution of _____ under Request for Tenders No. _____ ("the ITT").

Furthermore, we understand that, according to the Beneficiary's conditions, Tenders must be supported by a Tender guarantee.

At the request of the Applicant, we, as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of_() upon receipt by us of the Beneficiary's complying demand, supported by the Beneficiary's statement, whether in the demand itself or a separate signed document accompanying or identifying the demand, stating that either the Applicant:

(a) has withdrawn its Tender during the period of Tender validity set forth in the Applicant's Letter of Tender ("the Tender Validity Period"), or any extension thereto provided by the Applicant; or

b) having been notified of the acceptance of its Tender by the Beneficiary during the Tender Validity Period or any extension there to provided by the Applicant, (i) has failed to execute the contract agreement, or (ii) has failed to furnish the Performance.

This guarantee will expire: (a) if the Applicant is the successful Tenderer, upon our receipt of copies of the contract agreement signed by the Applicant and the Performance Security and, or (b) if the Applicant is not the successful Tenderer, upon the earlier of (i) our receipt of a copy of the Beneficiary's notification to the Applicant of the results of the Tendering process; or (ii) thirty days after the end of the Tender Validity Period.

Consequently, any demand for payment under this guarantee must be received by us at the office indicated above onor before that date.

[signature(s)]

Note: All italicized text is for use in preparing this form and shall be deleted from the final product.

FORMAT OF TENDER SECURITY [Option 2–Insurance Guarantee]

TENDER GUARANTEE No.:

1. Whereas [*Name of the tenderer*] (hereinafter called “the tenderer”) has submitted its tender dated [*Date of submission of tender*] for the [*Name and/or description of the tender*] (hereinafter called “the Tender”) for the execution of_ under Request for Tenders No. _____ (“the ITT”).
2. KNOW ALL PEOPLE by these presents that WE of [**Name of Insurance Company**] having our registered office at (hereinafter called “the Guarantor”), are bound unto [*Name of Procuring Entity*] (hereinafter called “the Procuring Entity”) in the sum of (Currency and guarantee amount) for which payment well and truly to be made to the said Procuring Entity, the Guarantor binds itself, its successors and assigns, jointly and severally, firmly by these presents.

Sealed with the Common Seal of the said Guarantor this ____ day of _____ 20 ____.

3. NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Applicant:
 - a) has withdrawn its Tender during the period of Tender validity set forth in the Principal's Letter of Tender (“the Tender Validity Period”), or any extension thereto provided by the Principal; or
 - b) having been notified of the acceptance of its Tender by the Procuring Entity during the Tender Validity Period or any extension thereto provided by the Principal; (i) failed to execute the Contract agreement; or (ii) has failed to furnish the Performance Security, in accordance with the Instructions to tenderers (“ITT”) of the Procuring Entity's Tendering document.

then the guarantee undertakes to immediately pay to the Procuring Entity up to the above amount upon receipt of the Procuring Entity's first written demand, without the Procuring Entity having to substantiate its demand, provided that in its demand the Procuring Entity shall state that the demand arises from the occurrence of any of the above events, specifying which event(s) has occurred.

4. This guarantee will expire: (a) if the Applicant is the successful Tenderer, upon our receipt of copies of the contract agreement signed by the Applicant and the Performance Security and, or (b) if the Applicant is not the successful Tenderer, upon the earlier of (i) our receipt of a copy of the Beneficiary's notification to the Applicant of the results of the Tendering process; or (ii) twenty-eight days after the end of the Tender Validity Period.
5. Consequently, any demand for payment under this guarantee must be received by us at the office indicated above on or before that date.

[Date]

[Witness]

[Signature of the Guarantor]

[Seal]

Note: All italicized text is for use in preparing this form and shall be deleted from the final product.

TENDER-SECURING DECLARATION FORM

[The Bidder shall complete this Form in accordance with the instructions indicated]

Date:.....*[insert date (as day, month and year) of Tender Submission]*

Tender No.:.....*[insert number of tendering process]*

To:..... *[insert complete name of Purchaser]* I/We, the undersigned, declare that:

1. I/We understand that, according to your conditions, bids must be supported by a Tender-Securing Declaration.
2. I/We accept that I/we will automatically be suspended from being eligible for tendering in any contract with the Purchaser for the period of time of *[insert number of months or years]* starting on *[insert date]*, if we are in breach of our obligation(s) under the bid conditions, because we – (a) have withdrawn our tender during the period of tender validity specified by us in the Tendering Data Sheet; or (b) having been notified of the acceptance of our Bid by the Purchaser during the period of bid validity, (i) fail or refuse to execute the Contract, if required, or (ii) fail or refuse to furnish the Performance Security, in accordance with the instructions to tenders.
3. I/We understand that this Tender Securing Declaration shall expire if we are not the successful Tenderer(s), upon the earlier of: our receipt of a copy of your notification of the name of the successful Tenderer; or thirty days after the expiration of our Tender.
4. I/We understand that if I am/we are/in a Joint Venture, the Tender Securing Declaration must be in the name of the Joint Venture that submits the bid, and the Joint Venture has not been legally constituted at the time of bidding, the Tender Securing Declaration shall be in the names of all future partners as named in the letter of intent.

Signed:..... Capacity / title (director or partner

or sole proprietor, etc.) Name:

..... Duly authorized to sign the bid for and

on behalf of: *[insert complete name of Tenderer]*

Dated on day of *[Insert date of signing]* Seal or stamp

Appendix to Tender

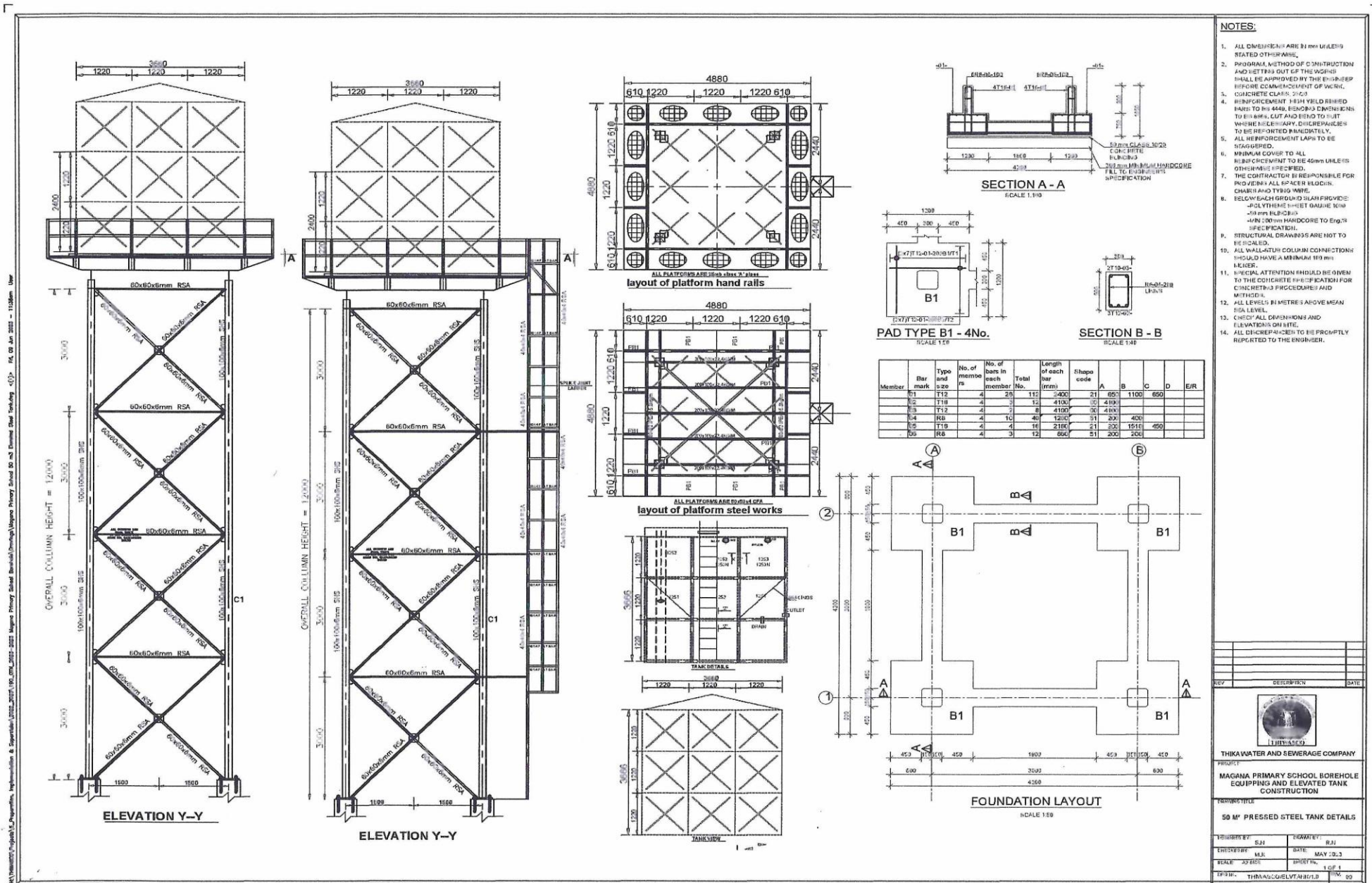
Schedule of Currency requirements


Summary of currencies of the Tender for _____ *[insert name of Section of the Works]*

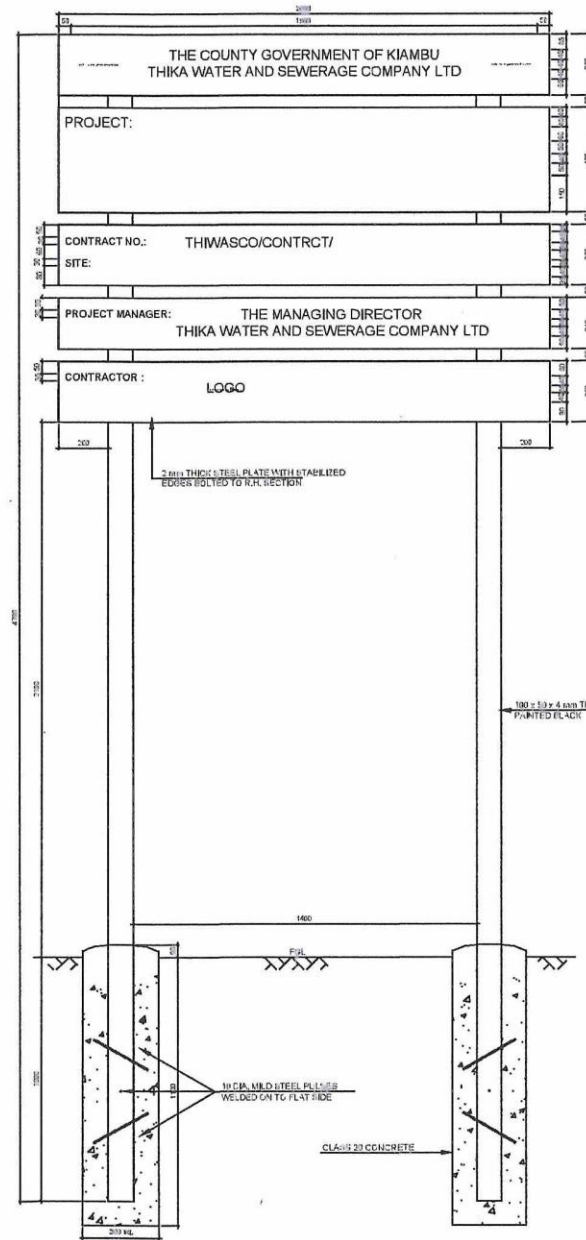
<i>Name of currency</i>	<i>Amounts payable</i>
Local currency:	
Foreign currency #1:	
Foreign currency #2:	
Foreign currency #3:	
Provisional sums expressed in local currency	[To be entered by the Procuring Entity]

PART II - WORK REQUIREMENTS

SECTION V - DRAWINGS



 THIWA CO THIWA WATER AND SEWERAGE COMPANY	
PROJECT:	
EQUIPPING & CONSTRUCTION OF ELEVATED STEEL TANK	
DRAWING TITLE:	
BOREHOLE DETAILS	
DESIGNED BY:	DATE:
CHECKED BY:	DATE:
SCALE:	SHEET NO.
PROJECT:	1 OF 1



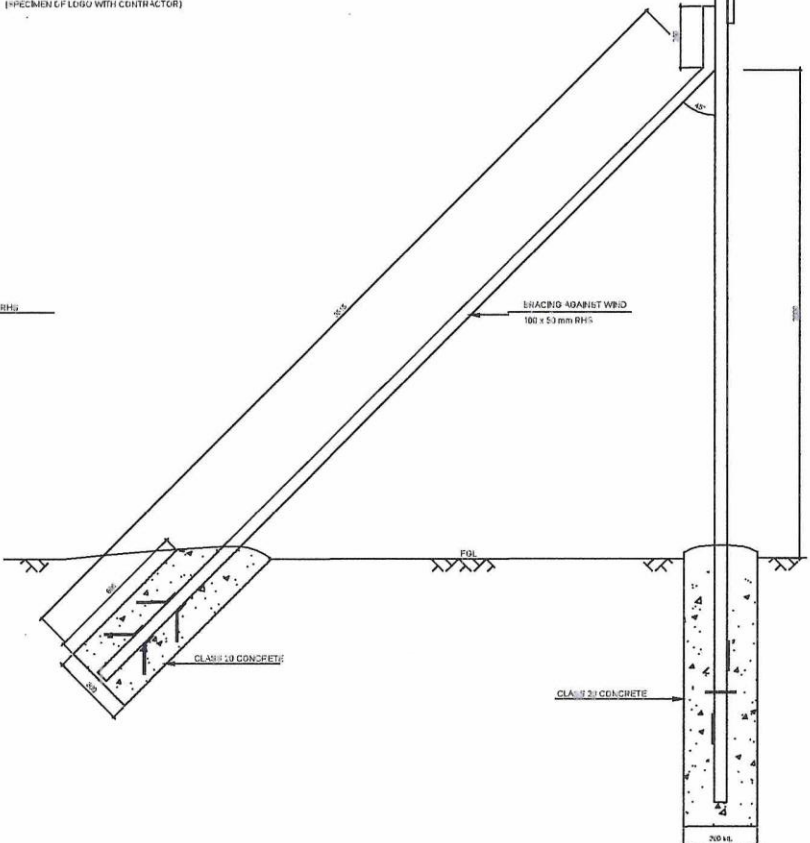
TEXT IS BLACK ON WHITE BACKGROUND
(LOGO IS IN COLOUR)

TEXT IS BLACK ON WHITE BACKGROUND

TEXT IS BLACK ON WHITE BACKGROUND

TEXT IS BLACK ON WHITE BACKGROUND

TEXT IS BLACK ON WHITE BACKGROUND
(SPECIMEN OF LOGO WITH CONTRACTOR)



NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED
2. EXCEPT WHERE NOTED OTHERWISE, CONCRETE CLASS: B45/45 (F280) = 15/20 LEAN CONCRETE = 15/20

LEGEND:

FOL FINISHED GROUND LEVEL
RHS RECTANGULAR HOLLOW SECTION

SPECIFICATIONS:

1. ALL TEXT TO BE HELVETICA (ARIAL) FONT TO THE SATISFACTION OF THE ENGINEER
2. COLOUR SPECIFICATION
 - WHITE: R.S. 2575 PART 1 - CLAUSE 5.3.2
 - BLACK: R.S. 2575 PART 1 - CLAUSE 5.3.2
 - BLUE: R.S. 4890 No. 18 E 53
 - RED: R.S. 2575 No. 237
 - YELLOW: R.S. 2575 No. 215
 - GREEN: R.S. 4890 No. 14 C 59
3. THE COLOUR OF THE PAINT MUST CONFORM TO THE REQUIREMENTS OF THE STANDARD SPECIFICATIONS R.S. 2575 No. 213
4. THE PAINT MUST BE DURABLE PAINT QUALITY
5. DURING THE DURATION OF THE PROJECT THE SIGN BOARD MUST BE MAINTAINED IN GOOD CONDITION AND REMOVED UPON PROJECT COMPLETION.

REV	DESCRIPTION	DATE

THIKWA

THIKA WATER AND SEWERAGE COMPANY

PROJECT: MAGANA PRIMARY SCHOOL BOREHOLE EQUIPPING & CONSTRUCTION OF ELEVATED STEEL TANK

DRAWING TITLE: GENERAL DRAWINGS SIGNBOARD DETAILS

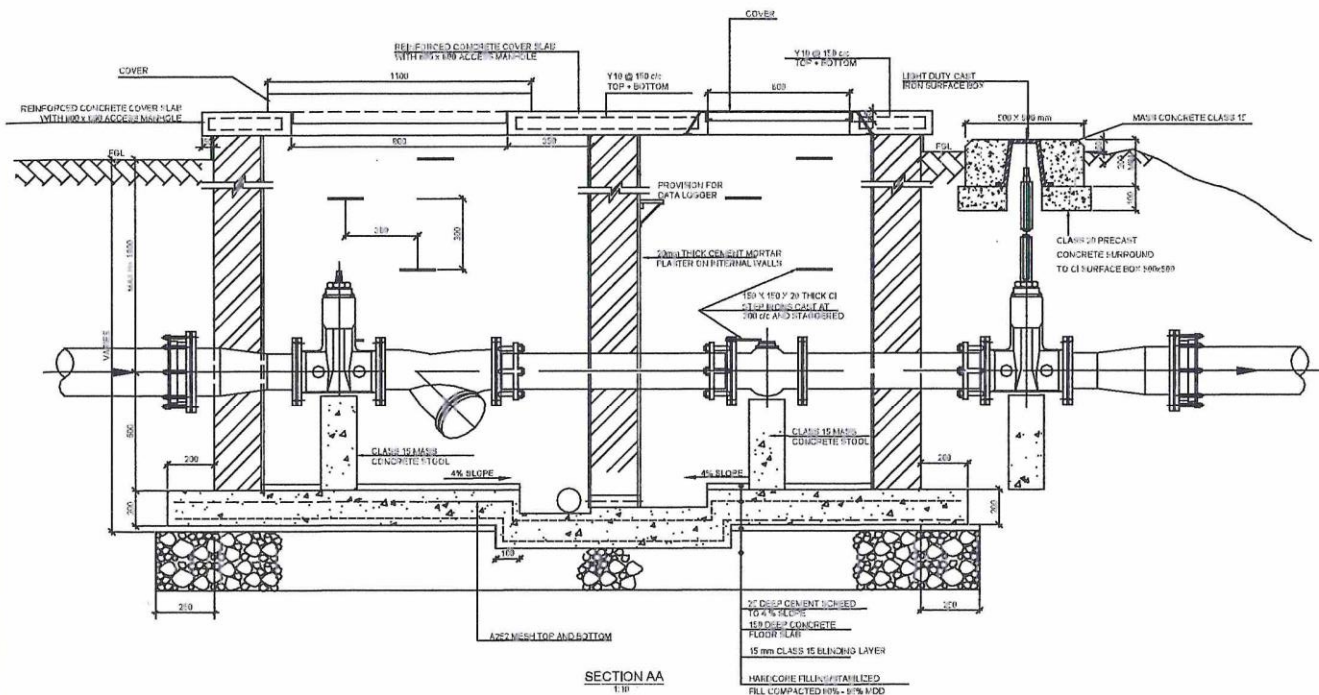
DESCRIPTION	BY	CHECKED BY	DATE
DESIGNED BY	SH	DR	
CHECKED BY			
DATE			

SCALE: AS SHOWN

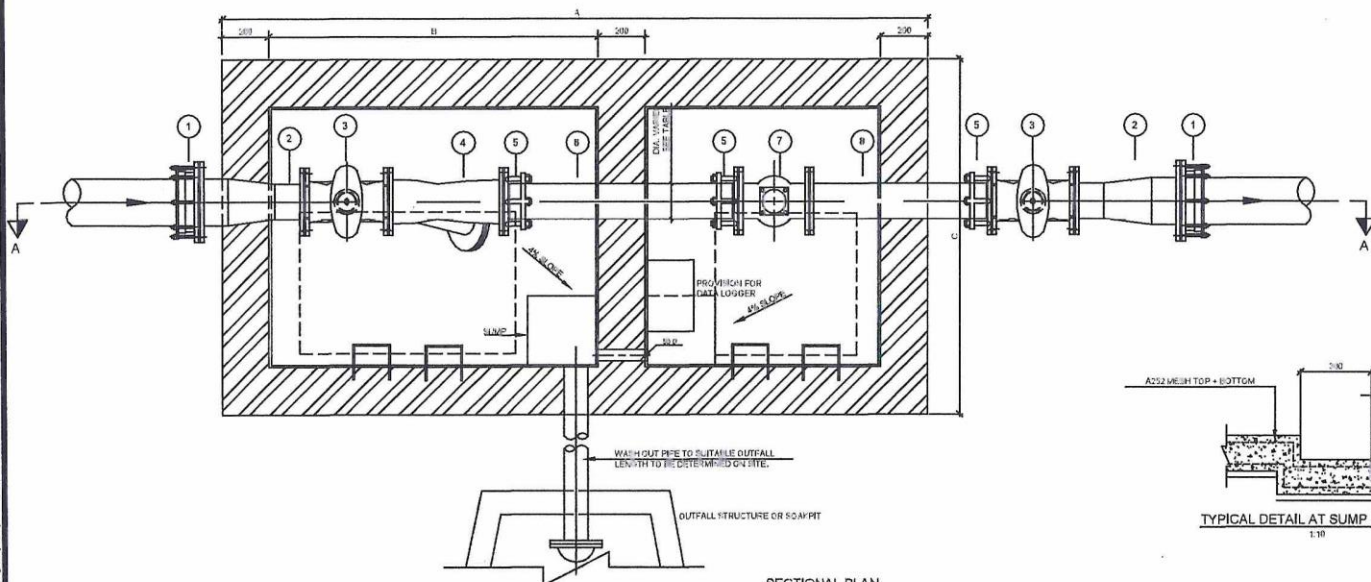
DATE: 23/05/2023

BY: THIKWASCO/SD/1.0

REV: 0



SECTION AA



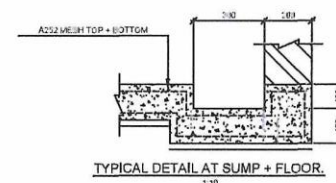
SECTIONAL PLAN

SCHEDULE OF PIPEWORK & FITTINGS

ID	DESCRIPTION	UNIT
1	FLY-WHEEL FLANGE ADAPTOR TO SUIT 8" ENDING PIPE MATERIAL	
2	DOUBLE FLANGED CONCENTRIC TAPER	
3	DOUBLE FLANGED GATE VALVE	
4	DOUBLE FLANGED "Y" W/TAPE JOINT	
5	FLANGE ADAPTOR	
6	STRAIGHT FLANG ENDING PIPE PIECE = 5' DIA	
7	DOUBLE FLANGED ELECTROMAGNETIC RUM METER	
8	SINGLE FLANGED PIPE PIECE, LENGTH = 5' x DIA	

CHAMBER DIMENSIONS

DIA. OF METER	LENGTH (A)	LENGTH (B)	WIDTH (C)
80	2400	1200	1500
100	2400	1250	1500
150	3000	1485	1500
200	3200	1625	1500
250	3300	1830	1500



TYPICAL DETAIL AT SUMP + FLOOR

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH OTHER LAYOUT DRAWINGS.
3. CONCRETE CLASS:
BASES AND BEAMS = M20
SLABbing CONCRETE = M25
4. CONCRETE COVER = 40 mm

REV	DESCRIPTION	



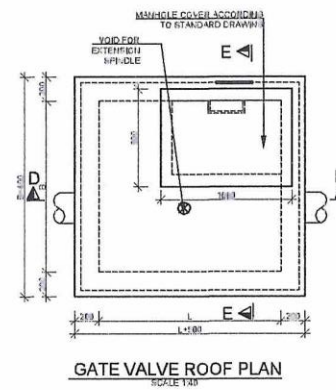
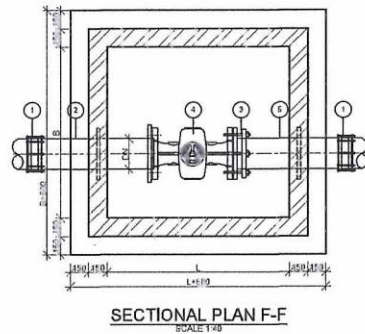
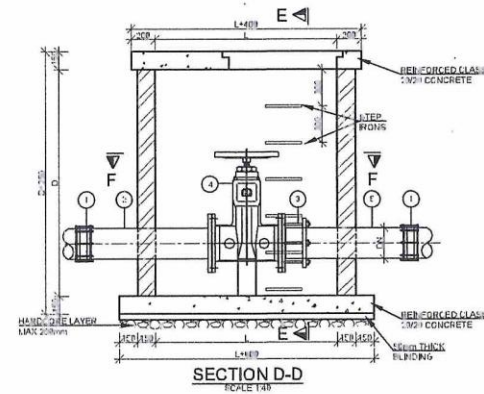
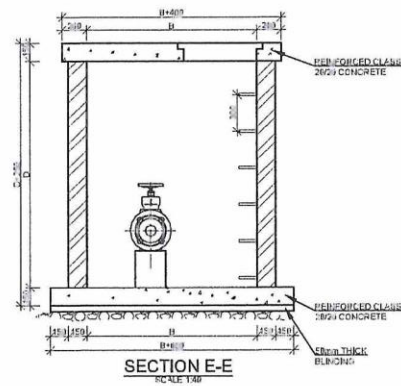
THIKA WATER AND SEWERAGE COMPANY

**MAGANA PRIMARY SCHOOL BOREHOLE
EQUIPPING & CONSTRUCTION OF
ELEVATED STEEL TANK**

DRAWING TITLE	BULK METER DETAIL
	10150-7501

DESIGNED BY: S.J.H.	DRAWN BY: R.J.H.
CHECKED BY: M.J.H.	DATE: MAY 2023
SCALE: AS SHOWN	SHEET: 1 OF 1
DRAWN: THEVALECON/D2.8	

AS SHOWN	1 OF 1
DATE: 11/1/00	REV.
THI WASCO/SD/4.0	



GATE VALVE SCHEDULE OF PIPEWORK & FITTINGS

ITEM	DESCRIPTION	No.
1.	COUPLING TO SUIT WATER MAIN SIZE AND MATERIAL	2
2.	FLANGE ADAPTOR	1
3.	DOUBLE FLANGED GATE VALVE	1
4.	DOUBLE FLANGED PIPE PIECE CW PUDDLE FLANGE, L = 1500	1
5.	SINGLE FLANGED PIPE PIECE CW PUDDLE FLANGE, L = 1500	1

DN	L (m)	R (m)
100	1.50	1.50

GATE VALVE CHAMBER 100 ≤ DN ≤ 250

NOTES:

1. HEIGHT OF THE CHAMBER TO DEPEND ON PIPE DEPTH, DRAINAGE TO BE DETERMINED ON THE SITE AND APPROVED BY THE ENGINEER.
2. DIMENSIONS "L" AND "W" DEPENDS ON PIPE DIAMETER, DIMENSION "L" AND "W" TO BE DETERMINED ON SITE AND APPROVED BY THE ENGINEER.
3. PIPE WORK AND VALVE SUPPORT TO BE CONSTRUCTED AS INSTRUCTED BY THE ENGINEER.
4. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
5. FOR DN ≥ 400 BUTT WELDS TO BE USED TO JOIN PIPE PIECES INSTEAD OF COUPLING.
6. VENT PIPES INCLUDED FOR CHAMBERS ≥ 1.5m DEEP.
7. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS STATED OTHERWISE.
8. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH OTHER LAYOUT DRAWINGS.
9. CONCRETE CLASS:
 - BASES AND BARS = C25/20
 - BLINDING CONCRETE = C15/10
10. CONCRETE COVER = 25 mm

THIKA WATER AND SEWERAGE COMPANY	
PROJECT: MAGANA PRIMARY SCHOOL BOREHOLE EQUIPPING & CONSTRUCTION OF ELEVATED STEEL TANK	
DRAWING TITLE: STANDARD DRAWINGS GATE VALVE CHAMBER DETAILS	
DESIGNED BY: DJJ	DRAWN BY: DJJ
CHECKED BY: MJK	DATE: MAY 2023
SCALE: 1:20	SHEET NO. 1 OF 1
DRAWN BY: THIKASCO/SD/3.0	



THIKA WATER AND SEWERAGE COMPANY LIMITED

TENDER DOCUMENTS

TECHNICAL SPECIFICATIONS

CHAPTER 1	GENERAL
CHAPTER 2	EARTHWORKS
CHAPTER 3	CONCRETE, REINFORCEMENT AND SHUTTERING
CHAPTER 4	BUILDINGS AND ASSOCIATED WORKS
CHAPTER 5	PIPEWORK
CHAPTER 6	MISCELLANEOUS ITEMS
CHAPTER 7	SEWERAGE, DRAINAGE AND ROAD PAVEMENT WORKS
CHAPTER 8	ELECTRO-MECHANICAL WORKS
CHAPTER 9	STANDARD SPECIFICATION REFERENCE NUMBERS
CHAPTER 10	CIVIL ENGINEERING STANDARD METHOD OF MEASUREMENT
CHAPTER 11	INSPECTION FORMS & CHECK LISTS

OCTOBER 2023

Thika Water and Sewerage Company
P.O. Box 6103
00100 Thika
Kenya
Tel: +254-20-4445288
Fax: +254-20-4446124

CHAPTER 1

GENERAL

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104	PROGRAMME AND WORK SEQUENCE	1
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106	PROVISION OF LABOUR FOR ENGINEER'S REPRESENTATIVE	2
107	FACILITIES FOR THE ENGINEER'S REPRESENTATIVE TO TAKE SAMPLES	2
108	CONTRACTOR'S OFFICE	2
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111	PRECAUTIONS AGAINST CONTAMINATION OF THE WORKS	3
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113	SUPPLY OF WATER	3
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CHAPTER 1 - GENERAL**101 DRAWINGS**

The Drawings for this Contract are listed in Volume 1 of the Contract Document. The Book of Drawings form Volume 3 of the Contract Documents. Where the Contractor is required to furnish drawings, they shall be provided in accordance with the Conditions of Contract and Contract Data.

The Contractor shall be responsible to supply as built drawings of the constructed works. To this extent he will be required to provide the necessary survey and other data to mark-up the drawings and will provide one draughtsman (proficient in the use of AutoCAD) on a continuous basis throughout the contract period to update the electronic copy drawings, under the direction of the Engineer's Representative.

102 BENCH MARKS

Benchmarks and points of origin for survey will on request be indicated to the Contractor on site by the Engineer's Representative. Where deemed appropriate or necessary the Engineer or Engineer's Representative may place Temporary Bench Marks (TBMs) to direct the Contractor in setting out the works. Upon the Contractor being shown the location on site of any TBM, the responsibility of protecting and preserving the same shall from that time onwards rest with the Contractor and the Contractor shall at his own expense re-locate and replace any such TBM which shall for any reason be displaced or removed from its original location.

103 LEVELS AND DIMENSIONS

The levels of the ground and the levels and dimensions of the natural features are believed but are not guaranteed to be correct. Wherever dimensions or levels are marked on the Drawings, such dimensions or levels shall take precedence over dimensions scaled from Drawings and scaled dimensions shall be used only in the absence from the Drawings and/or elsewhere of other information and then only on the written instruction to do so from the Engineer or Engineer's Representative. Large scale Drawings shall be taken in preference to Drawings of a smaller scale.

104 PROGRAMME AND WORK SEQUENCE

The Programme shall be drawn up in accordance with the Conditions of Contract using the Programme Evaluation and Review Technique (PERT) or the Critical Path Method (CPM). No other form of Programme shall be allowed or approved.

In addition and as a compliment to the Programme the Contractor shall submit at the same time schedules of Contractor's Equipment and labour indicating the projected numbers and types of Contractor's Equipment and labour to be utilised on the Works to enable compliance with the Programme. The schedules shall be itemised under the same heads of items of work as are used in the Programme.

The Programme shall include as a minimum the following activities:

- Confirmation of Quantities and Placing of Orders
- Erection of materials storage facilities
- Local procurement of major materials
- Offshore procurement of major materials
 - (i) Manufacture/Preparation for shipping
 - (ii) Shipping
 - (iii) Clearing at Port, transport to site and offloading to appropriate storage facilities.
- Mobilisation to commence Works on Site

- Sequence of work
- Major elements of work on Site, in sufficient itemisation to allow for continuous monitoring of progress of Works
- Tests on Completion

The Contractor shall construct the works as summarised in the Invitation to Tender and as detailed in the drawings, Bill of Quantities and Technical Specifications upon mobilisation on site.

Those works that do not interfere with the existing operations shall be executed with maximum expedition, to the satisfaction of the Engineer, utilising such levels of Contractor's Equipment and labour as shall be necessary for the most rapid completion. Those works that interfere with the existing operations or require temporary closure of the existing supply will only commence once the final extent is agreed between the Engineer and the Contractor and all necessary materials have been received on site. In this regard attention is drawn to Clause 552 of these Technical Specifications with regard to interconnections between existing and new pipework.

The Contractor shall be deemed to have allowed for the above in all aspects of the tender.

105 PROVISION OF FACILITIES FOR ENGINEER'S INSPECTION

The Contractor shall provide the necessary tackle, access and labour to enable the Engineer and/or the Engineer's Representative conveniently to carry out such inspections as they deem necessary at all times during the currency of the Contract.

106 PROVISION OF LABOUR FOR ENGINEER'S REPRESENTATIVE

The Contractor shall provide all such labour and assistance as required by the Engineer or the Engineer's Representative and his staff and payment of the same shall be made through the appropriate items in the Bills of Quantities.

107 FACILITIES FOR THE ENGINEER'S REPRESENTATIVE TO TAKE SAMPLES

The Contractor shall provide all facilities and equipment for the Engineer's Representative to take samples for testing of any of the materials. Such samples may be taken before incorporation into the works or at any time during Construction, at the discretion of the Engineer's Representative.

No claims for delays due to the taking of samples by the Engineer's Representative will be allowed.

The taking of any samples by the Engineer's Representative shall not relieve the Contractor of his responsibility that all materials and workmanship comply with the specification, nor shall it relieve the Contractor for any of his duties under the Contract.

108 CONTRACTOR'S OFFICE

The Contractor shall provide and maintain an office on or near the Works on Site approved by the Engineer for the use of his Agent, where written instructions may be delivered by the Engineer's Representative and in such cases, will be deemed to have been delivered to the Contractor. This office shall be open during the Contractor's working hours and shall when open have at least one person present whom the Contractor has authorised to receive on his behalf correspondence or written messages.

109 WORKING HOURS

The Engineer's normal working hours shall be defined as 7.00 to 17.00 on weekdays and 8.00 to 12.00 on Saturdays. Sundays shall be set aside for rest. If the Contractor wishes to execute permanent works outside these hours, he shall obtain written permission from the Engineer at least one full working day in advance to enable the Engineer to make provision for supervision of such work. Payment for the overtime of the Engineer's staff

shall then be reimbursed in full by the Contractor to the Engineer, including the approved percentage for administrative overheads.

If the Contractor wishes to execute works on a regular basis outside the Engineer's normal working hours over a prolonged period, the Engineer may, if he deems necessary, employ additional supervisory staff for which the required salaries including the approved percentage for administrative overheads shall be reimbursed in full by the Contractor to the Engineer and the Contractor shall provide the required adequate accommodation facilities for such staff at his own cost.

The Contractor shall not be reimbursed any of these costs.

110 ACCOMMODATION FOR EMPLOYEES

The Contractor shall provide and maintain sufficient suitable adequately ventilated and weather-proof shelters and mess rooms for his workmen, together with a sufficient number of proper latrines which shall be properly and regularly cleansed and kept in thoroughly sanitary conditions and adequately screened from public view.

Camps for workmen, if provided, shall comply with all relevant Government Regulations and shall be laid out in an approved and orderly manner.

Proper provision shall be made for the disposal of all waste and refuse, and there shall be an adequate supply of water for washing, cooking and drinking purposes. Quarters shall be properly ventilated and lighted, and the whole camp shall be maintained and cleansed at all times to the satisfaction of the Government Medical Officer of Health and the Employer.

111 PRECAUTIONS AGAINST CONTAMINATION OF THE WORKS

The Contractor shall at all times take every precaution against contamination of the Works. He shall give strict instructions to all persons employed by him to use the sanitary accommodation provided. the Conditions of Contract will be rigidly enforced in any case where these instructions are disobeyed.

112 SUPPLY OF ELECTRICITY

The Contractor shall supply and maintain an adequate and permanent (continuous) source of electricity to the offices, laboratories and accommodation to be provided for the Engineer's staff under this Contract.

Save as is otherwise provided for in the Contract, the Contractor shall make his own arrangements for the provision of electricity for use in the execution of the Works, both Temporary and Permanent, for the work of any Sub-Contractors.

113 SUPPLY OF WATER

The Contractor shall supply and maintain an adequate and permanent (continuous) source of potable water to the offices, laboratories and accommodation to be provided for the Engineer's staff under this Contract.

Save as is otherwise provided for in the Contract, the Contractor shall provide at his cost and arrange for all water required for the execution of the Works and ensure that is of a quality such that it will have no deleterious effects on the Works.

The Contractor shall submit proposals to the Engineer for the provision and maintenance of the supply of potable water and these proposals shall be approved by the Engineer before any Works are commenced.

114 TELEPHONE

The Contractor shall provide and maintain on the Site for the duration of the Contract a telephone for the exclusive use of the Engineer's Representative and his staff.

The Contractor shall pay the cost of all incurred expenses through installations, hire or purchase, and usage by the Engineer or his staff for the duration of the Contract period, and four weeks thereafter, and for the subsequent removal or reinstallation, and all of these costs shall be reimbursed to the Contractor, together with the percentage adjustment applicable, under the relevant Bill of Quantities Items.

115 FIRST AID OUTFITS

During the progress of the Works the Contractor shall at each place of work provide an adequate First Aid Outfit which shall be easily accessible at all times, and which shall include the following:-

Range of bandage sizes	plasters
Antiseptic ointment	thermometers
Scissors	cotton wool
Aspirins	safety pins
Anti-malaria tablets	sticking plasters.

and shall replenish and maintain as use demands, at his own cost. The provision of these kits shall be considered part of the Contractor's obligations in setting up his camp. The first aid kits shall be available for use by the Engineer's staff as well as the Contractor's staff on site of the works, at camps and wherever the Contractor's staff may regularly live and work. The Contractor shall ensure that there are persons available to all such places with knowledge of simple first aid procedures.

116 ACCESS ROADS

Having regard to the Conditions of Contract, the Contractor shall at his own cost undertake such improvements to or construction of drainage culverts on the unsurfaced roads and shall be responsible for maintaining these roads for the duration of the Contract in so far as these improvements or the maintenance is necessary for compliance with the relevant Clause.

All such improvements, constructions and maintenance shall be to the satisfaction of the Engineer's Representative and the relevant authorities, and no improvement or construction shall be carried out without prior approval by the Engineer's Representative of the Contractor's proposals. At the end of the Contract, the unsurfaced roads shall be brought back to a standard not less than that existing at the beginning of the Contract.

The Contractor shall construct and maintain such additional temporary access roads and shall make any improvements to the standards of existing roads (subject to the approval of the relevant authorities) as may be necessary for carrying out the Works, the cost of which is to be included in his rates.

117 FLAGGING, LIGHTING AND WATCHING

The Contractor shall be responsible for properly watching and lighting the Works even where they are on enclosed land, and shall allow for the same within his rates.

In this matter and as to flagging and traffic control he shall comply with the requirements of the Employer, the Police and/or the competent Authority. Prior to the commencement of any works across or alongside public roads the Contractor shall obtain the approval of the Engineer's Representative of his plans for flagging and traffic control.

118 TEMPORARY WORKS

The Contractor shall provide, maintain and remove on completion of the Works all temporary Works including roadways, sleeper tracks and staging, etc. over roads, footpaths, streams or unstable ground and he shall make them safe and suitable in every respect to carry all Plant required for the Work or for providing access or for any other purpose.

Details of temporary Works shall be submitted in advance to the Engineer for his approval, which when approved, shall not relieve the Contractor of complete responsibility for their safety and satisfactory operation.

119 SURVEY BEACONS

During the progress of the Works, the Contractor shall not remove, damage, alter or destroy in any way whatsoever, any plot or survey beacons. He shall notify the Engineer of the need to interfere with any beacon. The Engineer shall be responsible for any removal and reinstatement that he considers necessary. Should any beacon be found to be above or below the level of the finished Work, the Contractor shall immediately report the same to the Engineer.

Should any beacon be damaged or destroyed by the Contractor he shall forthwith report the damage to the Engineer and the relevant authorities and shall be held liable for the cost of reinstatement thereof.

120 DAMAGE TO LANDS

Except where necessary for the proper execution of the Works, the Contractor shall not interfere with any fence, hedge, tree, land or crops within, upon or forming the boundary of the Site, or elsewhere. In the event the Contractor encounters conditions under which he considers such interference necessary, he shall forthwith notify the Engineer's Representative who shall direct the Contractor either on the manner of execution of the Works such as to avoid or render negligible such interference, or otherwise make the necessary arrangements with the owners of the property in question and thereafter give approval to the Contractor to proceed with the interference but to the minimum extent possible given the nature of the works and the usual or customary methods of executing such works.

Where damage or interference as above is occasioned to crops, trees, buildings or shelters, or other things and improvements to the land of economic value and not readily reinstated, the Engineer shall liaise with the relevant authorities for evaluation of the damage and thereafter, the owner shall be compensated by the Contractor, and the Contractor reimbursed under the relevant item in the Bills of Quantities. However interference with fences, grass, unlined channels etc. shall be made good with due dispatch and to the satisfaction of the owner and the Engineer and the Contractor shall allow for the same within his rates.

121 REINSTATEMENT OF ROADS AND FOOTWAYS

The opening up of public roads and reinstatement of the same shall in all respects be carried out to the requirements of the relevant authority. The Contractor shall be responsible for liaison, co-ordination and arrangements with the relevant authority in the obtaining of consents, payment of fees and all manner of things necessary to comply with the lawful orders of the relevant authorities and the Contractor shall allow for the same within his rates.

122 PRIVATELY OWNED SERVICES

If any privately owned service, on, about or through the Site will be affected by the Works, the Contractor shall provide a satisfactory alternative service in full working order to the satisfaction of the owner of the service and the Engineer, before the cutting off of the existing services.

123 ADDITIONAL LAND

The Contractor shall select and arrange at his own expense for any temporary occupation of land outside the Site which he requires for the efficient execution of the Works. The Contractor must comply fully with all Bye-Laws and Regulations currently in force in the area.

124 SUBMISSION OF SAMPLES

Before the supply of any materials or articles which he intends to incorporate into the Permanent Works, the Contractor shall submit to the Engineers Representative for his approval a sample of each respective material or article, and such samples shall be delivered to and kept at his Office for reference. Should the samples be considered by the Engineer's Representative to be unsuitable for the purpose intended, or not to comply with the Specification or the nominated Standard Specification the Contractor shall submit samples of the materials or articles from a different source for approval. All the respective kinds of materials and articles used in and upon the Works, shall be at least equal in quality to the approved samples. Each and every sample shall be a fair average of the bulk material or of the article it represents. The Engineer's Representative may decide the method by which each sample to be taken from the bulk shall be obtained and the number of such samples. The Contractor shall allow for complying with the provisions of this Clause within his rates.

125 PROCUREMENT OF MATERIALS AND MANUFACTURED ARTICLES

The responsibility for so ordering and delivering materials and manufactured articles and samples so that they may be tested sufficiently far in advance of the Work so as not to delay it, shall rest upon the Contractor, and he shall not be entitled to any time credit for delay occasioned by his neglect to order sufficiently well in advance or to payment of any costs he may incur as the result thereof.

With regard to any item in the Bills of Quantities which is the subject of a Provisional Sum, the Engineer shall notify the Contractor of his requirements in ample time for the Contractor to make any necessary arrangements so that no delay occurs in the progress of the Works. The Contractor shall be deemed to have allowed for compliance with the provisions of this clause within his Tender.

126 TESTING OF MATERIALS AND MANUFACTURED ARTICLES BEFORE USE

Any or all of the materials and manufactured articles supplied by the Contractor for use on any of the Works shall be subject in advance to such tests as may be specified in the relevant Specification or as may from time to time be deemed necessary by the Engineer who may choose to witness the same. All costs (incl. business class flights for 3 persons, accommodation, transport, subsistence allowance) incurred during witness testing shall be borne by the Contractor and paid for under the relevant bill item.

Samples of materials and manufactured articles together with all the necessary labour, materials, equipment and apparatus for sampling and carrying out of tests on the Site shall be supplied by the Contractor at his own expense. The cost of special tests ordered by the Engineer to be carried out by an independent person at a place other than the Site or place of manufacture or fabrication shall be borne by the Employer, provided the tests show that the materials, articles or workmanship are in accordance with the Specification, otherwise the cost of such special tests shall be borne by the Contractor.

127 REJECTED MATERIALS

Should any materials or manufactured articles be brought on to the Site of the Works by the Contractor which are in the judgement of the Engineer unsound or of inferior quality including defects or damage sustained in transit or in any way unsuited for the Works in which it is proposed to employ them, such materials or manufactured articles shall not be used upon the Works but shall be branded if, in the opinion of the Engineer this is necessary, and shall forthwith be removed from the Site of the Works, all at the Contractor's expense and in each case as the Engineer shall direct.

128 QUALITY OF MATERIALS AND WORKMANSHIP

The materials and workmanship shall be of the best of their respective kinds and shall be to the approval of the Engineer. In the reading of this Specification the word "to the approval of the Engineer" shall be deemed to be included in the description of all materials incorporated in the Works, whether manufactured or natural and in the description of all operations for the due execution of the Works.

129 STANDARDS

The Contractor shall observe these Specifications and shall carry out all work in a skilled and workmanlike manner in keeping with the customs of the trade, and modern methods of construction engineering. In addition, the Contractor shall conform with all conditions, regulations, laws and by-laws currently in force in the country with regard to the execution of construction work and shall follow all instructions issued by the competent Authorities and the Engineer.

The Tenderer shall at his discretion base his tender on Standard Specifications generally used or approved save that where a relevant Standard Specification issued by the local Bureau of Standard exists at the date of submission of tenders such a Standard should as a minimum be complied with. Where no local Standard Specification exists, then the relevant standard specification issued by the International Standard Organisation (ISO), if any, shall be the minimum to be complied with. Where a national standard other than a local Standard is referred to in addition to ISO this indicates that such national standard may expand or strengthen further the requirements of ISO. Where Standard Specifications are referred to in the Text of this Specification this is done by reference to a Standard Specification Reference Number (SSRN).

A table of comparison is provided in Chapter 10 of this Section where the SSRN is cross-referenced to ISO and to national standards that will be accepted in their English version by the Employer as providing for the quality of workmanship etc. required.

The Contractor shall have indicated in his tender the Standard Specification to which the particular item to be supplied complies, or where it meets the requirements of a national standard not so specified, this standard shall be indicated. In this event two copies in English of the alternative standard offered should have accompanied the tender and shall be subject to the approval of the Engineer.

In the event that at the time of tender the Contractor had neglected to nominate the Standard Specification to which any particular item to be supplied shall comply, and there is no relevant local standard or ISO standard for the item, then the Engineer may at his sole discretion and without extra cost to the Employer instruct the Contractor on the national standard to be adopted in the manufacture supply and erection etc. of the item and the works associated with the item.

130 INSPECTION BY ENGINEER DURING DEFECTS NOTIFICATION PERIOD

The Engineer will give the Contractor due notice of his intention to carry out any inspection during the Defects Notification Period and the Contractor shall upon receipt of such notice arrange for a responsible representative to be present at the times and dates named by the Engineer. This representative shall render all necessary assistance and take notice of all matters and things to which his attention is directed by the Engineer. Provided however that no notice shall be required in the event that at the time of the inspection there shall be any part of the Works that have yet to be Taken Over.

131 OFFICE ACCOMMODATION FOR ENGINEER'S REPRESENTATIVE

The Contractor shall, if so required, provide suitable office accommodation in an approved position on the Site, for the sole use of the Engineer's Representative and his

Staff. The offices shall be established at the commencement of the Works and shall be occupied by the Engineer's Representative until one month after issue of the Taking-Over Certificate.

The office shall be constructed as per the drawing and/or bill item description, and shall be ready for occupation within 9 weeks of the order to commence issued by the Engineer.

The Contractor shall provide within the office in the appropriate rooms a water closet complete, wash hand basin, towel and toilet roll holder, kitchen sink and formica topped working surface. The facilities shall be connected to a potable supply of piped water and suitable sewerage collection or disposal facility.

All doors shall be lockable and supplied with at least two keys. The external main door shall be fitted with a "Yale" type lock.

The whole of the accommodation shall be water tight and weather- proof and shall be adequately ventilated, insulated, lighted, painted, burglar-proof and fitted with secure doors and window fastenings. It shall be adequately wired for electric light and power. Suitable access for vehicles shall be provided, including a parking space with a light roof to hold not less than two cars.

All of the facilities provided as herein above described shall be paid for under the item in the Bills of Quantity for provision of office accommodation for the Engineer's staff.

The Contractor shall ensure the regular supply of water and electricity services to the office. The office, including lavatory, shall be cleaned daily and shall be provided and maintained for the duration of the Contract. A supply of lavatory paper, soap and towels is to be provided and maintained, clean towels to be supplied each day. Two portable fire extinguishers (5 litres) and two first aid kits shall be provided and maintained. Day and night security shall be provided for the office as well as a secretary who can speak and write English and use MS Office software. The Contractor will be paid for these services under the item for maintenance of offices in the Bills of Quantities.

The Contractor is also to provide the office furniture and equipment as directed by the Engineer's Representative. These items shall be reimbursed at cost together with the appropriate adjustment in the Bills of Quantities.

The Contractor shall also supply stationery as required by the Engineer's Representative, and be reimbursed the costs in this respect together with the appropriate adjustment in the Bills of Quantities.

The site office, furniture and equipment shall revert to the Employer one month after completion of the Works, unless stated otherwise in the relevant bill items.

132 HOUSING FOR RESIDENT ENGINEER

If so required, the Contractor shall rent approved furnished accommodation, and acquire, refurbish and furnish houses, for the exclusive use of the Resident Engineer and his staff, which shall be ready for occupation within 4 weeks of the order to commence work by the Engineer.

Alternatively if so required the Contractor shall construct accommodation to the dimensions shown on the drawings which shall be ready for occupation within 12 weeks of the order to commence work by the Engineer.

Prior to completion of such accommodation the Contractor shall rent approved furnished accommodation the cost of which shall be paid for from the Contract up until the due occupation date calculated as above.

The Contractor shall, if called upon to do so, provide security for the houses by night and a day servant and shall pay all costs of water, telephone, electricity and cooking gas for the houses. All minor maintenance to such of the Employer's houses as shall be in such use shall be carried out by the Contractor.

If so required, the Contractor shall provide field allowances to employees of the Employer seconded to the Resident Engineer's staff, at rates determined by the Engineer.

The above accommodation, services and allowances shall be provided up to one month after Taking-Over of the Works and the costs thereof shall be reimbursed to the Contractor, together with the appropriate adjustment, under the relevant items in the Bills of Quantities.

133 INSURANCE OF RESIDENT ENGINEER'S OFFICE, FURNITURE AND EQUIPMENT

The buildings, furniture and equipment provided by the Contractor for the Resident Engineer's offices and accommodation shall be insured by the Contractor against loss or damage by accident, fire, and theft, for the duration of the Contract. Such insurance will be part of the "Insurance of the Works" provided for in the Conditions of Contract.

134 TRANSPORTATION FOR THE RESIDENT ENGINEER AND HIS STAFF

If so instructed, the Contractor shall procure vehicles for the use of the Resident Engineer and his staff. The Contractor shall pay all costs arising out of the running and maintenance of the vehicles until one month after completion of the Works, and as directed by the Engineer.

The costs of complying with this clause shall be reimbursed under the relevant Prime Cost Item.

If so instructed, the Contractor shall also provide qualified drivers exclusively for the Resident Engineer, and the rate for this service shall include for payment of all overtime, allowances, etc. to the drivers.

135 SURVEY INSTRUMENTS AND EQUIPMENT

If so instructed, the Contractor shall provide for the exclusive use of the Engineer and his staff the following equipment:

	<u>Item</u>	<u>No</u>
(a)	Total Station c/w Tripod	1
(b)	Automatic Level and Tripod	1
(c)	Steel tapes, 100 m. long	2
(d)	Steel tapes, 50 m. long	2
(e)	Spirit Levels	1
(f)	Plumb bobs	1
(g)	Pocket tapes	2
(h)	Survey staff and ranging rods	2 each
(i)	Survey umbrellas	2

Other or additional equipment shall be provided by the Contractor if so requested for the occasional use of the Engineer without additional payment. In addition, experienced chainmen and if necessary labour for clearance of survey lines shall be provided by the Contractor when requested by the Engineer, at no extra cost.

The equipment shall revert to the Employer on completion of the Works and shall be properly maintained and replaced as necessary, by the Contractor.

136 GPS SURVEY SYSTEM

If required and indicated in the bills of quantities, the Contractor is to provide a compact, lightweight, and entry-level GPS survey system providing centimetre-level accuracy plus real-time navigation tools for job-site location and point reconnaissance (ProMark3 or similar approved) for use by the Engineer. The system should be capable of GPS Satellite Tracking with 10 Independent Channels, L1 C/A code and full wavelength carrier,

WAAS/EGNOS Satellite Tracking, and 2 Additional independent channels. The system should be supplied complete with post-processing software with a user-friendly Windows interface capable of survey mission planning, automatic vector processing, coordinate transformations and reporting. The static configuration will comprise two number receiver units and post processing software together with necessary tripods, survey rods, clamps and accessories.

137 CLEANING UP OF SITE

The Sites of all permanent and temporary works, including borrow areas and tips in connection with this Contract, are to be carefully cleaned up, and trimmed, and the Site is to be handed over to the Employer in a neat and clean condition to the satisfaction of the Engineer. Compliance with this Clause shall be a prerequisite condition for the issue of a Taking-Over Certificate.

138 BLASTING

Where the Contractor removes rock by blasting, the prior approval of the Engineer shall be obtained. In using explosives the Contractor shall abide by and conform to all the requirements of the Explosives Act of the country. He shall employ personnel licensed to handle explosives. He shall take all practical precautions for the protection of person's properties and the Works.

If, in the opinion of the Engineer, further blasting will cause damage to natural strata or in situ material, or otherwise be detrimental to the works, blasting shall be stopped and excavation shall be completed by other suitable means. Great care shall be taken to see that any surrounding rock is not shattered, particularly in the bottoms of trenches and foundations. All loose and shaken pieces of rock shall be removed.

In the event of explosives being required for the Work, the Contractor shall provide suitable magazines for the storage of all explosives, and in compliance with the relevant Explosives Act.

139 SIGN BOARDS

The Contractor shall provide, sign-write, erect and maintain until the expiry of the Defects Notification Period sign boards of sound steel construction and hollow section steel uprights to the dimensions, sign-written and painted in durable colours, as directed by the Engineer. Such signboards shall be removed upon expiry of the Defects Notification Period, such removal being a pre-requisite for release of final retention money.

The signboards shall be as per the relevant standard drawing. The steel uprights shall be imbedded in Class 20 concrete of sufficient volume to give the whole assembly adequate stability.

140 COMPENSATION FOR LAND AND ENTRY UPON LAND

All land permanently used or occupied by the Works, as shown on the Drawings will be provided by the Employer, save that working width for pipe laying may be restricted to such areas as the Engineer may direct to minimise disruption of existing services and facilities.

The Contractors shall, subject to the approval of the Engineer, make his own arrangements for the acquisition of the land required for provision of his own offices, and for camp houses, workshops, stores, borrow pits, etc.

The Contractor shall not enter onto any land or commence any operations until such time that all necessary compensation formalities have been completed and permission has been obtained from the landowner to enter the land and commence operations. Should the Contractor enter into any land or commence any operations without first obtaining this confirmation, he shall be liable in whole or in part at the sole discretion of the Engineer, for all additional costs and/or legal charges which might arise therefrom.

141 ALTERATION AND PRESERVATION OF SERVICES

The Contractor shall acquaint himself with the position of all existing works, such as sewers, water drains, cables for electricity and telephone line, telephone and lighting poles, water mains, etc. before any excavation or other work likely to affect the existing services is commenced.

Where work is being carried in the vicinity of overhead power lines, the Contractor is responsible for ensuring that all persons working in such areas are aware of the relatively large distance that high voltage can "short" to earth when cranes or other large masses of steel are in the vicinity of the power line. The Contractor's attention is drawn to SSRN 027 which gives safe clearance to the various voltages.

The Contractor shall be held responsible for injury to existing works or services, and shall indemnify the Employer against any claims in this respect (including consequential damages).

In all cases where such existing works are exposed, they shall be properly shored or hung up. Special care must be exercised in re-filling to consolidate the ground under any main cables, etc. exposed and not to cover up water meters and surface boxes, etc. Poles supporting cables, adjacent to the Works, shall be kept securely in place until the work is completed, and shall then be made as safe and as permanent as before.

Notwithstanding the foregoing requirements, and without lessening the Contractor's responsibility, the Contractor shall inform the Engineer immediately of any existing works that are exposed.

The Contractor shall be responsible for arranging for the moving of services, subject to the agreement of the Engineer, where necessitated by the Works, and shall pay for the moving of services or alteration to services such as power lines, telephone lines, water pipes, etc. A Provisional Sum for this work has been allowed for in the Bills of Quantities. The utilisation of that item shall be at the discretion of the Engineer who may direct that the work be done by others, or that the Contractor shall execute the work and be compensated on a daywork basis. Where the Contractor encounters conditions where the alteration and preservation of existing services is necessary, he shall at once inform the Engineer's Representative who shall then direct the Contractor on the means and methods of so doing.

142 CLOSURE OF ROADS

Where a road used by the Contractor for delivery of any material to be used in the Works is closed by order of the Traffic Authorities, the Contractor shall obey such closure order and shall suspend operations or use an alternative route. The fact that the Contractor is performing work for the Government, will not give him any special privileges in this respect.

143 LIAISON WITH GOVERNMENT AND POLICE OFFICIALS

The Contractor shall keep in close contact with the Police and other Government officials of the area regarding their requirements in the control of traffic and other matters and shall provide all assistance or facilities which may be required by such officials in the execution of their duties, and shall provide in the unit rates or elsewhere in the Bills of Quantities for any expenses arising out of compliance with this Clause.

144 REGULATIONS OF LOCAL AUTHORITIES

The Contractor shall at all times conform to the lawful provisions of any ordinance and of any order, proclamation, rule or notice made under any ordinance relating to the Works, employment of labour, etc., and to any regulation and/or by-law of any local authority and of the water or electricity undertaker within whose area and jurisdiction the Works are to be executed.

145 BUILDING REGULATIONS

All buildings erected by the Contractor upon the Site and campsite or sites, and the layout of the buildings and Sites shall comply with Laws of the country, and with all local by-laws in so far as they are applicable.

146 PHOTOGRAPHS

The Contractor shall, if required, provide a digital camera and portable data transfer devices (flash disks) to the Engineer, and shall further bear the cost of printing the photographs. The costs to the Contractor of complying with this clause shall be paid through the relevant Bills of Quantity items.

147 OPERATION AND MAINTENANCE MANUAL

The Engineer will be compiling changes, alterations and additions to existing operation and maintenance manuals for use of the Employer's staff. To this end, the Contractor is required to provide in triplicate and in English details of all the different manufactured new Plant, materials and components incorporated in the Works including but not limited to all pertinent manufacturers' brochures. Reference is to be made to the relevant clauses in the Conditions of Contract and the E&M Specifications.

Taking-Over will not be considered until such detailed information as is required has been submitted to and accepted by the Engineer.

148 TRAINING FOR THE EMPLOYER'S PERSONNEL

The Contractor shall, if required, provide training to a number of the Employer's personnel, nominated by the Engineer during the construction of the Works. This shall include but not necessarily be limited to:- provision of a work gang or gangs with gangers or foreman to work alongside the Contractors staff in the fields of pipeline repair and the installation of valves, replacement consumer connections.

The Contractor shall also train the Employer's nominated personnel, as well as supervise the operation of the Works until the operators are fully conversant with the Plant. This training phase shall be conducted by a competent instructor(s) and shall include instructions in the operations and maintenance of the Works in accordance with a programme previously submitted to and approved by the Engineer. Refer also to the relevant E&M Specification.

149 MISCELLANEOUS ACCOUNTS

The Contractor may be instructed by the Engineer to purchase and supply to the Engineer, or pay on his behalf for miscellaneous items including but not limited to stores, equipment, computer wares and training, hotel accommodation, services and the like. The Contractor shall submit, once a month, a miscellaneous account including receipts for all such items purchased or paid for, whose reimbursement is to be included in the Interim Certificate.

150 ADVERTISEMENTS

The Contractor shall not erect, cause to be erected or allow to be erected any plaque, sign, poster, banner or the like, intended to or having the effect of advertising the identity of the Contractor, his Subcontractors, or the manufacturers of Plant or materials for the Works on or about the site, without the authority of the Employer.

The provisions of this Clause shall not however apply to:

- a) Plaques affixed to Plant; or
- b) Inscriptions on Plant and materials

which are affixed and inscribed during manufacture in order to provide a means of identification of the brand and make of manufactured articles.

151 ACCESS TO EXISTING FACILITIES

Where necessary for the execution of the Works, the Contractor and his employees shall be granted access to enclosed and fenced off areas which belong to the Employer and are in use for the abstraction, treatment, storage and conveyance of water.

Such access shall be limited to the strict requirements for carrying out of the Works without delay, but shall not constitute free and unhindered access to any and all parts of such premises, nor shall it constitute authority for access at any and all times.

Access to such premises shall be limited to:-

- (i) The Contractor's senior and responsible staff not normally engaged upon the Works on site but who are employed by the Contractor in a capacity related to the Works;
- (ii) A reasonable number of site supervisory staff who shall oversee erection and construction work;
- (iii) Organised gangs of technicians, artisans, workmen and labour, who shall enter the premises, work therein and leave as a group or groups, each group being under the supervision of a previously nominated person; and
- (iv) Crews operating Contractor's Equipment who shall remain with their piece of equipment whilst upon such premises.

Unless otherwise specified, any authorities provided for access to such premises shall be deemed to be restricted to the Contractor's normal working hours, with the addition of reasonable times for entering the premises to prepare to start work, leaving the premises on close of work for the day, and for work which may continue during normal meal or recess breaks. Access at other times shall not however be unreasonably denied.

The Contractor shall apply for access during normal working hours (and such extensions thereto as shall not require specific approval as specified above) at least seven days before work commences on such premises, and provide in his application:-

- (i) The estimated duration of the need for such access, in weeks;
- (ii) The normal working hours which shall be in effect;
- (iii) The names of the supervisory staff who shall be responsible for and who shall enter and leave with the working gangs;
- (iv) The areas in which work shall be carried out; and
- (v) The approximate numbers of workmen in such working gangs.

Applications for access outside the above times shall be by at least three days notice, which notice shall be deemed to be approved if it is not rejected within two days of submission.

152 REMOVAL OF GOODS FROM EMPLOYER'S PREMISES

The Employer's staff at any of the Employer's premises shall be entitled to demand and to be provided with written descriptions of any goods removed from within the Employer's premises, whether the goods belong to the Employer or not.

The Employer's staff shall be permitted and assisted by the Contractor and his employees to determine that the description of such goods is true and accurate including the inspection of vehicles and the opening up of any containers, parcels or wrappings.

153 INTERRUPTION OF WATER SUPPLY

Where it is necessary for the supply of water by the Employer using existing facilities in and about the site to be reduced or interrupted in order for the Contractor to replace or repair existing facilities, or install new Plant or material, hereinafter called "Disruption",

then the Contractor shall only be permitted to use methods of work, types and numbers of Equipment and levels of staff and labour which will result in minimum Disruption.

The Contractor's proposals for the execution of such works shall be subject to the Engineer's approval, and the Engineer shall not be required to consider the costs to the Contractor, (including payments for overtime to the Contractor's personnel) or the convenience to the Contractor of particular sequencing of work, where such considerations conflict with the Employer's need to limit the extent of Disruption.

The Contractor shall indicate in the Programme submitted pursuant to Conditions of Contract Clause 27 the approximate dates and durations of Disruption, and shall, during the execution of the Works, notify the Engineer forthwith of any circumstances which arise which may affect the expected dates of such Disruptions.

At least 14 days before any Disruption proposed by the Contractor, the Contractor shall submit to the Engineer for his approval his plan for works associated with the Disruption and details of the dates and times intended for such Disruption. The Engineer shall within 7 days of such submissions:

- (i) Inform the Contractor of the dates and times when such Disruption will be permitted, which shall be not more than 3 days before or 7 days after the dates proposed by the Contractor;
- (ii) Instruct the Contractor on the methods of work and types and numbers of Equipment and labour to be employed on such works, or otherwise grant approval for the Contractor's plan; and
- (iii) Provide the Contractor with the text of a notice by the Employer to the public of the intended Disruption.

The Engineer may otherwise instruct the Contractor that the Disruption shall be on dates more than 7 days after the dates proposed by the Contractor in which case the period in excess of 7 days shall be deemed to be a Suspension.

Approval for Disruption may be withheld at the Contractor's responsibility, if in the opinion of the Engineer the Contractor cannot execute the works associated with the Disruption in accordance with the Engineer's requirements. Notification of such withholding of approval such be accompanied with a description of the reasons therefore, and instructions on the action to be taken by the Contractor before approval is given.

The Contractor shall publish the Employer's notice to the public on the dates one and two days before the commencement of the Disruption in three national newspapers at a minimum of quarter page size.

The costs and effects of compliance with this Clause (save for any Suspensions) shall be deemed to have been allowed for in the Contractor's rates and prices, and in the time for completion.

154 COPIES OF STANDARDS

Within 60 days of the acceptance of the Tender, the Contractor shall provide to the Engineer copies of all National and International Standards which are to apply to the Plant, materials and workmanship under the Contract, together with an Index cross- referencing these standards with the applicable aspects of the Works.

Three sets of such standards securely bound are to be provided.

155 SITE HEALTH AND SAFETY

The Contractor shall observe and cause his employees to observe health and safety standards commensurate with the nature of the Works and in accordance to health and safety regulations of the country. To this end the Contractor shall appoint as Safety Officer one of his senior staff who shall have specific knowledge of safety regulations and have

had experience of safety precautions on similar works and who shall advise the Contractor on all aspects of safety and health on Site.

The Contractor shall provide his employees with:

- (i) overalls, boots or shoes with reinforced toe caps
- (ii) hard hats suitable for a construction site
- (iii) other protective equipment such as gloves, earmuffs, goggles, etc. as are necessary for particular work
- (iv) adequate sanitary facilities and maintenance of these in a clean and hygienic state for use by all persons employed by the Employer, Engineer, Contractor or other contractors on the Site
- (v) reporting details of any accident to the Engineer as soon as possible after its occurrence
- (vi) reasonable prevention of non-site personnel from entering the work areas.

The Contractor shall further provide hard hats for the Resident Engineer and his staff, and for the use of site visitors up to ten in number.

The Contractor is required to produce a Health and Safety Plan covering the hazards that may apply during the Contract, the rules and standards to be used in assessing risk and in undertaking work and the methods that he will employ to ensure compliance with his plan.

The Health and Safety Plan shall include details of the following:

- (i) Details of all potential risks and the proposals for dealing with such hazards
- (ii) Controls to regulate risks which occur during all construction, testing and commissioning activities
- (iii) Measures to avoid health risk in connection with the use, handling, storage and transportation of hazardous and harmful substances
- (iv) Safety equipment and training proposals in respect of equipment referred to above

No work shall be permitted to be executed unless the Engineer is satisfied that appropriate safety measures are in place and that the Contractor's employees are wearing suitable safety gear. The costs and effects of compliance with this Clause shall be deemed to have been allowed for in the Contractor's rates and prices.

156 COUNTERPART CONTRIBUTIONS

The Employer may provide certain counterpart contributions to the Works but shall where the contributions would affect the progress of the Works receive from the Contractor ample notice in this regard. Such counterpart contributions may include the obtaining of way leaves and rights of way, and purchases of land.

157 LOCAL TECHNICAL AGENCY

The Manufacturer of the Pumps and Motors and of the Electrical Switchgear supplied under this contract will be expected to have, or shall prior to award undertake to appoint a local (based in the project country) representative with proven technical competence in the electro-mechanical field. The level of competence shall be such that if the Employer should decide to enter into a service or service/training contract for the maintenance of the equipment indicated here, then it would be practicable to do so. The Local Agents will be expected to have in their stores and workshop a sufficient quantity of the relevant spare parts, the necessary equipment and tools to service/ maintain the proposed Mechanical and Electrical Plant and suitably qualified and trained personnel to perform the required service/ maintenance works.

158 ENVIRONMENTAL PROTECTION

With reference to the Conditions of Contract and in order to mitigate the potentially adverse environmental impacts of the proposed rehabilitation works, the Contractor shall execute the Works in accordance with the Kenya National Environmental Management Agency (NEMA) requirements and the following technical and operational guidelines:

1. Waste Management, Health and Safety
 - The relevant national and local authority's approved disposal methods for wastes shall be used.
 - Waste dumping sites shall not be located in wildlife areas, wetlands, settled areas, cultural heritage and scenic sites
 - Waste in abandoned mobile camps shall be buried or incinerated
 - Training in the proper operation and maintenance of the extended and rehabilitated network facilities shall be an integral part of the programme
2. Water Resources Management
 - The Contractor shall at all costs avoid conflict with water demands of local communities
 - Abstraction of both surface and groundwater shall only be done in consultation with the local community and after obtaining a permit from the relevant water authority
 - Abstraction of water from wetlands shall be avoided
 - No construction water containing spills or site effluents especially cement and oil shall be allowed to flow into natural water draining courses
 - Wash water from washing out equipment shall not be discharged into water-course or road drains
 - Site spoils and temporary stockpiles shall be located away from drainage systems and surface runoff shall be directed away from stockpiles to prevent erosion
3. Site Installation
 - (a) Location
 - Work camp sites shall be located no less than 2.5 km from any surface water sources
 - The location of work camp sites within the boundaries of local authorities shall be done with permission from the authority and/or the local communities
 - Work camp sites shall not be located in cultural heritage sites. A management plan for restoration when abandoning the site shall be outlined
 - (b) Drainage
 - Work camp sites shall have perimeter drains. The perimeter drains shall be excavated outside the site fence
 - All drainage channels inside the site shall discharge the effluent into oil interceptors
 - All buildings shall be surrounded by spoon drains
 - All sheds shall have spoon drains
 - (c) Buildings
 - Buildings (which are to remain) shall be architected and constructed in a manner that will facilitate conversion to social service facilities such as schools, clinics, etc. at the end of the works.

- All Buildings in work and camp sites shall be approved by the Buildings Department
- All sheds shall have concrete floors
- (d) Labour Camp Facilities
 - Labour camps shall have approved rubbish bays
 - Labour camps shall have toilet facilities approved by the Local Council Health Authorities
 - Labour camps shall have one toilet for every 10-15 persons
 - Pit Latrines shall be located no less than 250m in clay soils and 500m in loam soils and no less than 1000m in sandy soils from any wetland or water source.
- (e) Community Education
 - The Contractor shall provide awareness education on STDs and HIV/AIDS to local communities where significant social interaction between project workers and local communities is envisaged (see separate clause).
 - The Contractor shall provide information about his activities to local communities
- 4. Petroleum Products Handling
 - (a) Transportation
 - Fuels shall be delivered to the sites by certified petroleum tankers
 - All petroleum tankers shall observe the regulations for transportation of petroleum products and the Traffic Act
 - (b) Storage
 - Petrol shall only be stored in underground tanks
 - Diesel may be stored in skid tanks positioned in a bund wall
 - Underground tanks shall undergo regular pressure checks
 - Oils shall be stored in oil sheds with concrete floors
 - (c) Dispensing and disposal
 - Petroleum kerb sites shall be located on concrete platforms and surrounded by spoon drains
 - Approved dispensing equipment shall be used for dispensing petroleum products
 - Used oil shall be reused, recycled or incinerated
 - Empty PVC containers of petroleum products shall be reused, recycled, or incinerated
 - Sludge from petroleum storage tanks shall be incinerated
- 5. Material Mobilisation
 - (a) Haulage
 - Haulage trucks carrying laterite or stone aggregate shall not exceed the speed limit of 60 km per hour on paved roads and 40 km per hour on gravel roads
 - The height of the loaded laterite or stone aggregate shall not exceed haulage truck sides
 - Haulage trucks carrying cement or lime shall be covered
 - (b) Storage
 - Stock piles of materials exceeding 10 tons and which are potentially polluting/ contaminating shall stand for no longer than 30 days

- The distance from the stock pile to the nearest community shall not be less than 2.5 km
 - The stock piles shall be located no less than 5 km from any surface water sources. The distance from the stockpile to the nearest wetland shall not be less than 5 km.
 - Stockpiles shall not be located on cultural heritage sites. The distance from the stock pile to the nearest cultural heritage site shall not be less than 5 km
 - Stock piles shall have perimeter drains and buffer vegetation
 - Cement and lime shall be stored in enclosed sheds
- (c) Material Handling
- Appropriate equipment shall be used in handling of materials
 - The Contractor shall provide appropriate protective clothing to the workers handling hazardous and corrosive materials
 - Safety techniques and accident emergency measures shall be outlined to all workers
6. Plant/Equipment Operations
- (a) Noise Control
- Noise from plant and equipment operations shall be limited to no more than 90 db in human settlements
 - Stationery Plant (generator) shall be noise masked
 - No plant and equipment (with noise levels exceeding 45 db) shall be operated after 18:00 hrs near human settlements (i.e. within 1 km)
 - No plant and equipment shall operate without exhaust silencers
 - Plant and equipment speeds shall be limited to 60 km per hour
- (b) Emission Control
- Plant and equipment exhaust pipes shall be fitted with catalytic converters
 - Plant and equipment shall meet the national emission standards
- (c) Safety Control
- Carrying of abnormal loads of plant and equipment shall be done when there is less traffic on the roads
 - All abnormal load carrying regulations shall be observed (Road Traffic Regulations)
7. Drainage, Excavations and Construction
- All public water points shall be provided with appropriate drainage
 - No major drainage excavations shall be done in the rainy season
 - No excavations shall be done in gazetted cultural heritage sites
8. Borrow Pits (where applicable)
- Borrow pits shall not be located near wetlands. The distance from the borrow pit to the nearest wetland shall not be less than 5 km
 - Contractors shall obtain licenses from the relevant authority to operate borrow pits
 - The location of borrow pits shall be subject to approval by relevant government departments and local communities in the areas in which they are located
 - Borrow pits shall preferably be located in less vegetated areas
 - Borrow pits shall be surrounded by perimeter drains

- Borrow pit restoration plans shall be provided and approved by relevant government departments and local communities affected
9. Energy Acquisition
- Firewood will be collected from dead wood
 - Permits for large quantities of firewood shall be obtained from the Forestry Department
10. Excess Materials
- Excess materials of laterite, stone aggregate, concrete blocks, etc shall be removed from the work sites no longer than 2 weeks after completion of rehabilitation
11. Drainage Systems
- Drainage systems shall not discharge into settled and cultivated areas
 - Drainage systems shall not discharge onto gazetted cultural heritage sites
12. De-vegetated Areas
- All de-vegetated areas shall be replanted by the Contractor at the end of the works
 - There shall be no vegetation clearing near surface water sources, catchment areas, wildlife habitats, cultural heritage and scenic sites. All relevant legislation to this effect shall be observed
13. Post Excavation Works
- Borrow pits shall be restored at the end of rehabilitation and construction works
 - Permanent borrow pits shall have embankments turfed
 - Borrow pits in wildlife areas shall be restored at the end of the works unless required as water reservoirs for wildlife
 - Restoration of borrow pits in settled areas shall be done only after consultations with local communities
 - Borrow pits left as community water reservoirs shall be drainable
 - Excavated and graded areas in cultural heritage and scenic sites shall be restored at the end of the works.
14. Abandoned Structures
- Permanent works buildings in settled areas shall be handed over to local communities for conversion into social service facilities such as schools, clinics, etc.
 - The above notwithstanding, the Contractor shall comply with all requirements of the national environmental laws.

No separate measurement and payment shall be made for complying with the environmental protection clauses. The cost of all work required by these clauses shall be included in the Contractor's rates for other items of work under this Contract.

159 HIV-AIDS PREVENTION

With reference to the Conditions of Contract HIV-AIDS Prevention the Contractor shall conduct an HIV-AIDS awareness programme via an approved service provider, and shall undertake such other measures to reduce the risk of the transfer of the HIV virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals.

The Contractor shall throughout the contract (including the Defects Notification Period):

- conduct Information, Education and Consultation Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labour (including all the Contractor's employees, all Sub-Contractors and Consultants' employees, and all truck drivers and crew making deliveries to

Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behaviour with respect to of Sexually Transmitted Diseases (STD)—or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular;

- provide male or female condoms for all Site staff and labour as appropriate; and
- provide for STI and HIV/AIDS screening, diagnosis, counselling and referral to a dedicated national STI and HIV/AIDS program, (unless otherwise agreed) of all Site staff and labour.

The Contractor shall include in the program to be submitted for the execution of the Works under Sub-Clause 8.3 of the Conditions of Contract an alleviation program for Site staff and labour and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation program shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Sub-Clause and the related specification. For each component, the program shall detail the resources to be provided or utilized and any related sub-contracting proposed. The program shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation this program shall not exceed the Provisional Sum dedicated for this purpose.

CHAPTER 2

EARTHWORKS

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CHAPTER 2 - EARTHWORKS

201 CLEARING OF THE SITE

Trees, hedges and undergrowth shall be taken down and grubbed up, together with all other obstructions on the Sites of the landfill, roads, sewers, ponds, drains, water mains and structures and disposed of as directed.

The limits of clearing on this project shall extend a distance of three metres from the centre line of pipelines and for a distance of three metres in plan from any foundations. Roots are to be destroyed or removed within this width. All timber removed remains the property of the Employer and the Contractor shall dispose of timber in a manner as instructed by the Engineer.

Brushwood, roots and refuse and other combustible material cleared shall be disposed of by strictly controlled burning which shall be approved in each instance by the Engineer provided care is taken to prevent contamination of trench bottoms or backfill material with charcoal or other products of combustion. Alternatively, the waste matter could be removed from the site of the works to a tip to be provided by the Contractor.

Trees, bushes and hedges at the Site shall not be cut down, damaged or destroyed without approval of the Engineer. Trees shall be defined as having a girth exceeding 500 mm measured 600 mm above ground level except where a tree has buttresses when measurement shall be taken immediately above the buttresses.

The Contractor shall carefully strip top soil over the width of pipe trenches, set it aside for bringing back after backfilling of trenches and replacing over the top of trenches to restore the ground to its near as possible original condition.

If, owing to excessive cross-falls, the Contractor requires to carry out general levelling to facilitate use of Contractor's Equipment, such levelling may only be carried out after stripping and setting aside of top soil over the full width of the area to be levelled

Where trees are felled, the roots shall be grubbed up and all removed from the Site by the Contractor. The holes shall be backfilled with approved materials and rammed in 30 cm layers.

202 TRIAL HOLES

The Contractor shall excavate, refill and restore in advance of his programme all such trial holes as he may require for the location of existing services (sewers, water supply pipes and cables, etc). The cost of these trial holes shall be included in his excavation rates.

203 FORMATION LEVEL

Formation level on embankments and in cutting shall be the surface level of the ground obtained after completion of the earthworks. Any excess depth unnecessarily excavated below formation level shall be backfilled with material acceptable for Construction and compacted as directed by the Engineer and no payment shall be made for the excess excavation or for its filling and compacting.

204 SURFACE SOIL

Unless otherwise directed by the Engineer all surface soil shall be removed from the area to be used for roads, structures, cuttings and embankments and stockpiled for re-use for any purposes such as the soiling of slopes of cuttings and embankments and the preparation of beds for the cultivation of trees and shrubs.

Surface soil shall be regarded as soil which on visual examination can be seen to have been broken down by natural processes, agricultural cultivation and/or is seen to be capable of supporting vegetation growth.

Surface soil shall be removed to an average depth as shown on the Drawings or as specified in the Bills of Quantities.

The Contractor shall make his own arrangements for temporary storage sites for heaps of surface soil either inside or outside the site of the Works to suit his convenience. The cost of all operations needed in excavation, loading, carting, depositing and stacking together with arranging for the storage Sites, the hire or purchase of land therefore and all necessary access roads for this purpose is to be included in the item in the Bills of Quantities for stripping surface soil and is to be quoted whatever the nature of the underlying sub-soil.

All unsuitable soil comprising of underlying surface soil shall be excavated and run to spoil in accordance with the appropriate Clause.

205 SOILING OF SIDE SLOPES AND VERGES

Soiling and compacting of side slopes to cuttings and embankments shall be carried out to an even surface with a thickness within the range of 10 cm - 20 cm, or in the case of verges as stated in the Bill of Quantities with surface soil as previously stockpiled or from an approved source.

206 CLASSIFICATION OF EXCAVATION

Excavation shall be paid for separately for the following three Classes of material:

Class I:

"Rock" or "Hard Material" shall include all material which, in the opinion of the Engineer, requires blasting or the use of metal wedges and sledge hammers or the use of compressed air drilling for its removal or cannot be extracted by ripping with a tractor of at least 180 h.p. and rear-mounted heavy-duty ripper. Individual boulders greater than 0.2 m³ in volume shall be included in this class when their nature and size are such that they cannot be removed without recourse to one of these methods.

Where a portion of excavation contains 50% or more by volume of boulders of this order, such portion shall be considered as Class 1 material throughout.

Class II:

"Compacted Gravel", "Slightly Decomposed" or "Altered Rock" shall include all material such as hard ferricrete and altered or stratified rock, stones, or boulders less than 0.2 m³ in volume, which are harder than "normal" or "soft" material in that they may be extracted by ripping, as defined in Class 1, or in confined spaces, by hand excavation by using compressor tools, providing all reasonable steps to the satisfaction of the Engineer, have been taken to facilitate the removal of the material by other methods.

Class III:

"Normal" or "Soft Material" shall include weathered or decomposed rock (incl. murrum) and all material which, in the opinion of the Engineer, does not require blasting or metal wedges and sledge hammers or compressed air drilling, ripping or rooting.

A detailed summary to aid this classification is given in Table 2 - 1.

No additional allowances will be made for any material being wet or dry.

The Engineer or his representative and the Contractor or his representative shall be present during classification of material in question for excavation.

All necessary precautions shall be taken to preserve the excavation material below and beyond the lines of all excavation in the soundest possible condition.

All damages to the Works due to the Contractors operations shall be repaired by and at the expense of the Contractor except when over excavation is ordered in writing by the Engineer.

In excavation of Class 1 (hard) material isolated edges of undisturbed material may extend up to 15 cm within the prescribed lines.

Excavation of Class 1 - Material beyond the established lines shall be re-filled with concrete (Class 10) at the expense of the Contractor.

All excavation shall be classified either as unsuitable material or as suitable material. Unsuitable material shall comprise:-

- (i) Material from swamps or marshes, silt, perishable material, slurry or mud, or
- (ii) Any Material:
 - (a) which is a highly organic clay or silt,
 - (b) which is clay having a liquid limit exceeding 80 and or a plasticity index exceeding 55;
 - (c) which is outside the limits of moisture content specified in the earthworks series of Clauses either when excavated or thereafter;
 - (d) which is susceptible to spontaneous combustion;
 - (e) consisting of such domestic refuse which by virtue of its physical or chemical composition or moisture content will not compact to form a stable fill.

Suitable material shall comprise all that are acceptable in accordance with the requirements of the Specification for use in the Works, whether obtained from within or without the Site. Any reference in this Specification to suitable material and unsuitable material shall have the meanings defined above.

For the purpose of selection for use in earthworks all common excavation shall be classified as either plastic or non-plastic. Non-plastic materials shall be those on which it is impossible to carry out a plasticity index test and shall include "coarse grained non-cohesive material" shown in Table 2 - 2, and in accordance with SSRN 650 and such shales, silts and other materials which in the opinion of the Engineer are readily self-draining.

Plastic materials shall be all other materials included in the above-mentioned Table as "fine grained cohesive materials", as defined in SSRN 650.

TABLE 2 - 1 : MATERIAL CLASSIFICATION

	Class I	Class II	Class III
Typical Material	Black Volcanic Rocks Trachyte, Phonolyte and Igmnibrite	Altered Rocks Agglo- merate and Tuff	Weathered Rock and Soils (incl. murrum)
Hammer Blow	Solid note from Ringing to a Dully sound	Drummy Noise or crushes pieces	Dents Sample
Pliers Crushing	Not possible for Grani Fracture	Fractures or Crushes small piece	
50 mm dia. Core in Hand	Cannot break 500 mm long piece	Can break 300 mm piece	Can be crushed into pieces
Soaked in water for One hour	No change	Some change on weaker pieces	Disintegrates in the hand after soaking
Expected Crushing Strength	Above 40N/mm ²	1.5 to 40N/mm ²	Below 1.5 N/mm ³

TABLE 2-2 IDENTIFICATION OF SOIL TYPES

	Basic Soil	Particle size	Visual Identification	Nature and	Composite Soil Types			
	Type	(mm)		Plasticity	(mixture of basic soil types)			
	BOULDERS	> 250	Only seen complete in pits or exposure	Particle shape: Angular Subangular Subrounded Rounded Flat Elongate Texture: Rough Smooth Polished	Scale of Secondary Constituents with coarse soils			
	COBBLES	60-250	Often difficult to recover from boreholes		Term	% of clay or silt		
	GRAVELS	coarse	Easily visible to naked eye; particle shape can be described; grading can be described		slightly clayey	GRAVEL	under 5%	
		20-60			slightly silty	SAND		
		medium			-clayey	GRAVEL	5 to 15%	
		fine			-silty	SAND	15 to 35%	
	SANDS	2-6	Well graded: wide range of grain sizes, well distributed. Poorly graded: not well graded. (May be uniform: size of most particles lies between narrow limits; or gap graded; an intermediate size of particle is markedly under represented)		Texture: Rough Smooth Polished	very clayey	GRAVEL	
		0.6-2	Visible to the naked eye; very little or no cohesion when dry; grading can be described			very silty	SAND	
		coarse				Sandy GRAVEL	Sand or Gravel and Important second constituent of the coarse fraction	
medium			Gravelly SAND					
	SILTS	fine	Only coarse silts barely visible to naked eye; exhibits little plasticity and marked dilatancy; slightly granular or silky to the touch. Disintegrates in water; lumps dry quickly; loose cohesion but can be powdered easily between fingers.	Non plastic or low plasticity	Scale of secondary constituents with fine soils			
		coarse			Term	% of sand or gravel		
		0.002-0.075			sandy	CLAY	35 to 65%	
	CLAYS	fine	Dry lumps can be broken but not powdered between the fingers; they can also disintegrate underwater but more slowly than silt; smooth to the touch; exhibits plasticity but no dilatancy; sticks to the fingers and dries slowly; shrinks appreciably on drying usually shows cracks. Intermediate and high plasticity clays show these properties to a moderate to high degree respectively.	Intermediate plasticity (Lean clay)	gravelly	SILT		
		0.002-0.0075			-CLAY SILT	under 35%		
					Examples of composite types			
					Loose, brown, subangular very sandy, fine to coarse GRAVEL with small pockets of soft clay.			
		ORGANIC CLAY-SILT or	Varies	Contains substantial amounts of organic	High plasticity (Fat clay)	Medium dense, light brown, clayey, fine and medium sand.		
PEATS		Varies	Predominantly plant remains usually dark brown or black in colour, often with distinctive smell; low bulk density.	Stiff, orange brown, fissured sandy CLAY.				
SAND			vegetable matter.	Firm, brown, thinly laminated SILT and CLAY				
PEATS			Varies	Plastic, brown, amorphous PEAT				

207 EXCAVATION - GENERAL

The excavation shall be taken out as nearly as possible to exact dimensions and shape so that the minimum of filling in will afterwards be necessary. The Contractor shall keep the sides of excavation true by struts, walings, poling-boards, sheeting, bracing or otherwise and the supporting timbering shall be of sound construction and be sufficiently watertight to permit the excavation, concreting, etc. being carried out satisfactorily. Water shall be removed by pumping and all temporary expedients required for dealing with water shall be the Contractor's liability. The Contractor shall be responsible for the stability of all excavations and trenches.

Excavated material shall be deposited in spoil heaps confined to areas approved by the Engineer, and shall be neatly finished off to the approval of the Engineer and other relevant authorities.

Top soil shall be stored separately from the main excavated material and on no account disposed of without the approval of the Engineer.

The Contractor shall at his own expense maintain the flow in all drains and water courses which may be encountered during the construction of works. Sewage shall not be allowed to flow onto open ground or into any watercourses, trench or sewers constructed under this contract except by permission of the Engineer's representative.

208 MECHANICAL EXCAVATION

- (i) A mechanical excavator shall be employed by the Contractor only if the sub-soil is suitable and will allow the timbering of the trenches or other excavations to be kept sufficiently closed up to ensure that no slips fall or disturbance of the ground takes place or there are no pipes, cables, mains or other services or property which may be disturbed or damaged by its use.
- (ii) When mechanical excavators are used, a sufficient depth of materials shall be left over the bottom of the excavations to ensure that the ground at finished excavation level is not damaged or disturbed in any way. The excavations shall then be completed by hand to the finished levels required.

209 BLASTING

The Contractor shall keep in his office at the Site copies of Laws applying to the transport, storage and use of explosives and shall supply one copy of each Law to the Engineer. The Contractor shall also submit to the Engineer a copy of any instructions or notices that the Contractor may issue to his staff or workmen or post about the Site in compliance with such Laws.

The Contractor shall submit to the Engineer details of the explosives that he proposes to use and of his proposals for the storage and transport of explosives to the Sites.

Explosives shall be used in accordance with the recommendations of SSRN 680.

The Contractor shall use explosives for blasting in connection with the work only at such times and places and in such a manner as the Engineer may approve, but such approval shall not relieve the Contractor from his responsibility for injury, loss, inconvenience and annoyance to persons, damage to the work and adjoining structures, consequent to the use of such explosives. The Contractor shall be entirely liable for any accident which may occur and shall hold the Employer harmless and indemnified from all claims arising from such. Where loss, inconvenience, injury or accident is likely to be caused to persons, animals, works, property, places or objects the Engineer shall have power to regulate or prohibit the blasting and in the event of such regulation or prohibition the Contractor shall have no claim against the Employer.

The Contractor shall give warning each time of his intention to blast and shall station men on the roads and elsewhere with flags, horns and whistles and prevent persons, animals and traffic going into or remaining within the danger zone. He shall arrange for control of

traffic on the main roads by the police during all blasting operations within 400 m of such main roads.

The Contractor's Personnel in charge of blasting operations shall have valid licences for all types of blasting required including restricted blasting, copies of which shall be made available to the Engineer.

The Contractor shall provide proper buildings in suitable positions for the storage of explosives to the satisfaction of the Engineer and the relevant Authority. The Contractor shall take all possible precautions and comply with all Laws or other regulations governing the handling and use of explosives including the display on the site of warning notices explaining the procedure to be used in blasting operations, such notices are to be displayed in all languages normally spoken by the personnel working on the Site.

In carrying out blasting the Contractor shall drill holes to the extent approved and in such number, position and direction and to such lengths and with loading of explosives of such quantity and power and means of detonating as will ensure that the excavation is taken out as neatly as possible to the required profile without shattering the rock remaining or causing injury to concrete or fill already deposited in the vicinity.

In certain areas it is necessary to restrict blasting in order to protect installations of major significance.

The Contractor shall, whenever he wishes to blast within 400 m of any public road, railway line, overhead power line or telephone line, draw this to the attention of the relevant authority concerned and ensure that all conditions imposed by them including attendance by the representatives of such authority are met. In all such cases, he will be required to provide cover to the area to be blasted, to the approval of the Engineer, to prevent damage to these services by flying debris.

The Contractor shall ensure, by limiting the amount of charge/delay or by the use of controlled detonations used at any blasting site, that the peak particle velocity at any existing building, structure or service, does not exceed 50 mm/s. The Contractor shall provide a suitable seismometer and whenever called upon to do so by the Engineer, demonstrate by the use of the seismometer that the charges he proposes to use comply with these Specifications.

Compliance with the restrictions will not, however, limit the Contractor's liability in the event of any damage to any existing building, structure or services.

Notwithstanding any of the above, the Contractor shall cease blasting and continue to excavate in rock by barring, wedging or other approved methods, whenever called upon to do so by the Engineer.

If firing is done electrically, all precautions shall be taken to prevent premature explosions. All men other than the responsible foreman and one skilled man shall be withdrawn to a safe distance before firing wires are connected to the firing cable. The connection of the firing cable to the firing battery shall be the last operation. No charging or firing will be permitted when there are electrical storms or thunder conditions at or near the Site, when the time delay between the flash of lightning and the thunder clap is less than 10s.

After blasting, no personnel shall approach the area until it has been examined by the foreman or other responsible person and in the case of misfires the proper precautions shall be taken.

The Contractor shall be deemed to have included in his rates for items covering excavation for the supply of all explosives, transport, storage, supervision and compliance with the conditions and restrictions set out above.

Prior to the initiation of blasting operations, the Contractor shall comply with the following:

- The Contractor will obtain all required state and local permits relating to the transportation, storage, handling, loading, and detonation of explosives

- Before performing any work on, or accessing the right-of-way, the Contractor shall verify to the Employer and Engineer that all property owners have been notified of the impending construction and blasting activities
- The Contractor shall submit to the Engineer's Representative his site-specific Blasting Plan for approval prior to execution of any blasting activity

For each area determined to require blasting, a site-specific blasting plan will be submitted. The Contractor's site-specific blasting plan shall include at a minimum the following information:

- Blaster's name, company, copy of license, and statement of qualifications; seismograph equipment and sensor location
- Site location, applicable drawing numbers, and associated rock type and geological structure (solid, layered, or fractured)
- Copies of all required permits
- Methods and materials including explosive type, product name and size, weight per unit, and density; stemming material; tamping method; blasting sequence; use of non-electrical initiation systems for all blasting operations; magazine type and locations and security for storage of explosives and detonating caps
- Site dimensions including explosive depth, distribution, and maximum charge and weight per delay; hole depth, diameter, pattern, and number of holes per delay
- Dates and hours of conducting blasting, distance and orientation to nearest aboveground and underground structures; schedule identifying when blasting would occur within each water body greater than 3 m wide
- Blasting procedures for:
 - Storing, handling, transporting, loading, and firing explosives
 - Prevention of misfires, flyrock, fire prevention, noise, and stray current accidental-detonation
 - Signs, flagmen, and warning signals prior to each blast
 - Those locations where the pipeline route parallels or crosses an electrical transmission corridor, cable or pipeline; parallels or crosses a highway or road; is within or adjacent to forested areas; approaches within 300 m of any residence, building or occupied structure
 - Local notification
 - Inspections after each blast
 - Disposal of waste blasting material

210 EXCAVATION OF CUTTINGS

The Contractor shall carry out the excavation of cuttings in accordance with the Drawings and shall adhere to the slopes, levels, depths and heights shown thereon.

The sloping sides of all cuttings shall be cleared off all rock fragments which move when pressed with a crowbar and are therefore, liable to cause injury or damage through falling.

Where excavation reveals a combination of suitable and unsuitable materials, the Contractor shall, wherever the Engineer Considers it practicable, carry out the excavation in such a manner that the suitable materials are excavated separately for use in the Works without contamination by the unsuitable materials.

If any suitable material excavated from within the Site is, with the agreement of the Engineer, taken by the Contractor for his use (i.e. as material for pavement courses) and

not in consequence for the forming of embankment, or soiling of slopes of cuttings and embankments or verges, sufficient suitable filling material to occupy, after full compaction, a volume corresponding to that which the excavated material occupied, shall, unless otherwise directed by the Engineer, be provided by the Contractor from his own resources.

No excavated material shall be dumped or run to spoil except on the direction or with the permission of the Engineer, who may require material which is unsuitable to be retained on Site. Materials used for haul roads shall not be re-used in embankment, or elsewhere without the permission of the Engineer.

The completion of cuttings shall, unless otherwise permitted by the Engineer, be undertaken in two stages. First the area including verges shall be excavated to a level 30 cm above formation level whereupon constructional traffic may continue to be allowed to use the surface so formed.

Secondly, when it is necessary to complete to formation level, this excess of material shall be trimmed off as a single operation and disposed off either elsewhere in the Works if regarded by the Engineer as suitable material or if not run to spoil. When the height above formation level has been reduced below 30 cm, the movement and use of Constructional Plant other than that used to complete this operation shall be in accordance with the requirements of the Engineer. This trimming operation shall be regarded (for access roads) as the commencement of Construction of the pavement.

211 EXCAVATION FOR PIPE LAYING

- (i) The excavation shall be made in open cutting unless tunnelling or heading is specified or approved by the Engineer.
- (ii) Trenches for pipes shall be excavated to the lines and depths shown on the Drawings, or as directed by the Engineer, and shall be of sufficient width to give an equal clearance on both sides of the barrel of the pipe or pipes such that the total trench width is $3/2 'D'$ where 'D' is the outside diameter of the pipe or the average outside diameter of the group of pipes or will be equal to the outside diameter of the pipe plus 30 cm on each side. For pipes bedded in concrete sections, the breadth of concrete bedding for the pipes will be equal to the width of the trench. Excavation for fire hydrants, valve chambers or any other water works structure shall be carried out to the levels and outlines of such structures, and the rates shall include for any additional excavation or other temporary Works required.
- (iii) If in the opinion of the Engineer due to the fault of the Contractor the ground becomes weathered prior to the laying of the pipes, the Contractor shall remove the weathered soil and replace it with suitable compacted material to the original formation level at his own expense.
- (iv) Where pipes are not laid on concrete the bottoms of the trenches as excavated, shall be smooth and shall be free from stones or other projections. Holes cut out at the joints shall be of as small a size as possible throughout their entire length. The trench shall be dug to within 15 cm of its formation and proper grade pegs shall then be set in the bottom of the trench by the Contractor for the accurate taking out of the rest of the excavation. Grooves about two inches deep shall be cut across the trench at the required positions to enable the easy removal of pipe slings.
- (v) If instructed to do so by the Engineer, the pipe trench shall be excavated to a depth of 10 cm below the invert of the pipe and be refilled with suitable material free from stones and well rammed in order to provide a smooth bed for the pipes.
- (vi) The materials excavated from trenches shall be laid completely and neatly on the sides of the trench except where in the opinion of the Engineer this would so obstruct a road or footpath as to prevent the passage of traffic or pedestrians. In such cases the Contractor must dig out the pipe trench in such lengths as directed and keep his

excavated material at such a distance as may seem advisable, and the rates shall be deemed to cover for this.

- (vii) During excavation, the Contractor shall ensure that all material suitable for re-use and which he intends for re-use are kept separate and set aside and protected as necessary to prevent loss or deterioration. Materials forming the surface and foundations of roads shall when excavated and if required for further use, be carefully separated. Paving slabs, bricks and similar surfaces shall be carefully removed and stacked for re-use, or as otherwise instructed by the Engineer.
- (viii) No pipes shall be laid and no excavation filled in or covered with concrete until the formation has been inspected and the permission to proceed with the Work obtained.
- (ix) Where pipes are to be laid under a road formation or in open country, or in cutting, trenches shall generally be excavated after the earthwork is completed. The Engineer may permit these pipe trenches to be excavated before the earthwork is complete, but payment for the excavation of the trench will only be made upon the volume excavated below the road formation.
- (x) The unit of measurement for the excavation of trenches shall be per linear metre or per m³ of void calculated from the deemed width of the trench, and the average depth of excavation as mentioned in the Bills of Quantities. No allowance will be made for bulking. Unless otherwise indicated, for valve chambers and other water works structures, the unit of excavation will be per number or per m³ of excavated material calculated to the exact outer dimensions and depths of the Permanent Works. No allowance will be made for bulking.
- (xi) The rates for excavation of trenches in "normal" material shall include removal of all material except "rock", selecting and segregating material to be backfilled in special layers, supporting or sheeting, shoring and strutting, any additional working space or room for timbering or sheeting required, dealing with water, maintenance of the trench, and all labour, tools, materials, plants, supervision, overheads and profit.
- (xii) The provisions of above Clause shall apply to the rates of excavation in "rock" and in addition the Contractor shall also allow in his rates for backfilling the invert with Class 15 concrete or other materials as directed by the Engineer and removing to a spoil dump all "rock" excavated.

212 EXCAVATION FOR FOUNDATIONS

- (i) Foundations shall be excavated to such depths as the Engineer may direct and no concrete or other material shall be placed until the foundations have been examined and approved. Due notice shall be given to the Engineer to enable him to examine foundations well in advance.
- (ii) The Engineer may direct that a layer of excavation of not less than 75 mm thickness shall be left undisturbed and subsequently taken out by hand immediately before the concrete or other work is placed.
- (iii) If in the opinion of the Engineer due to the fault of the Contractor the ground becomes weathered prior to the placing of concrete or other material the Contractor shall remove the weathered soil and replace it with concrete (Class 15) to the original formation level at his own expense.
- (iv) The Contractor shall draw the attention of the Engineer to any patches of soft ground in the excavations and he shall excavate to such extra depth as the Engineer may direct and fill up with concrete Class 15. Payment for this Work will be made at the rates tendered.

213 EXCAVATION IN EXCESS

If any part of a trench or foundation is by Contractor's error excavated deeper and/or wider than is required, the extra depth and/or width shall be made good at the Contractor's expense with Class 15 concrete or otherwise as the Engineer may require.

214 SITE CONCRETE

Areas of excavation which are to receive a layer of Site concrete as a screeding under the structural concrete or which are to form foundations to thrust and anchor blocks shall be covered with the screeding immediately the excavation has been completed.

215 FORMING OF EMBANKMENTS

The Contractor shall carry out the forming of embankments in accordance with the Drawings and shall adhere to the slopes, level, depths and heights shown thereon.

Unless otherwise directed or permitted by the Engineer, all suitable excavated materials shall be used to form embankments. All such excavated material which is surplus to this requirement, shall be disposed off in tips to be provided in accordance with appropriate Clause. Any material which according to the Specification requirements is unsuitable for forming embankments shall be similarly disposed off.

All filling material other than rock in embankments or below formation level in cuttings shall be deposited in layers not exceeding 25 cm loose depth unless as a result of compaction trials the Engineer approves spreading to a greater depth up to a maximum of 35 cm loose depth. Each layer shall extend over the full width of the embankment and shall be completed in accordance with the requirements of this Specification.

Rock used in rock-fill embankment shall be of such size that it can be deposited in horizontal layers each not exceeding 45 cm loose depth and extending over the full width of the embankment except for any specified external cover to slopes or new formation level. The materials shall be spread and levelled by a crawler tractor weighing not less than 15 tons. Each layer shall consist of reasonably well graded rock and all large voids shall be filled with broken fragments before the next layer is placed. The top surface and side slopes of embankments formed shall be thoroughly blinded with approved fine graded material to seal the surface. Such material may be surface soil on side slopes. Isolated boulders each within the range 0.05 cu. metres to 0.3 cu. metres in size may be incorporated more than 60 cm below formation level in embankments not of rock-fill at the discretion of the Engineer, provided that the specified compaction requirements are met. No stone exceeding 0.05 m³ should be placed less than 60 cm below formation level.

During the construction of embankments the Contractor shall control and direct constructional traffic uniformly over their full width. Fill material shall not be stockpiled on embankments, unless this is permitted by the Engineer. Should the quantity of excavation from the Works, including that from any widened cuttings, be insufficient to make up the embankments, the deficiency shall be made good by approved imported suitable material and the Contractor shall be responsible for locating and obtaining such material. Where materials of different characteristics are readily available those of relatively high-bearing capacity shall be placed in the top-most (60 cm) below formation level.

The completion of embankments shall unless otherwise permitted by the Engineer, be undertaken in two stages. First the area shall be brought up to a level of 15 cm above formation level whereupon constructional traffic may continue to be allowed to use the surface so formed. Secondly, when it is necessary to complete to formation level, this excess of material shall be trimmed off as a single operation and disposed off either elsewhere in the Works if regarded by the Engineer as suitable material or if not, run to spoil. When the height above formation level has been reduced below 15 cm the movement and use of construction Plant other than that used to complete this operation, shall be in accordance with the requirements of the Engineer. This trimming operation shall be regarded for access roads as the commencement of construction of the pavement.

216 SIDE SLOPES

Should the slopes of any cutting be excavated beyond the widths shown on the Drawings or directed by the Engineer, the Contractor shall make good each affected area in a manner satisfactory to the Engineer.

217 COMPACTION OF EARTHWORKS

All filling material used in earthworks shall be compacted to specification by Plant approved by the Engineer for that purpose.

The Contractor shall submit to the Engineer for approval his proposals for the compaction of each main type of material to be used in the embankments, including those in relation to the types of Plant, the number of passes and the loose depth of layer. The Contractor shall carry out compaction trials, supplemented by any necessary laboratory investigations as required by the Engineer, using the procedure proposed by the Contractor for the earthworks, and shall satisfy the Engineer that all the specified requirements regarding compaction can be achieved. Compaction trial with the main types of material likely to be encountered shall be completed before the Works with the corresponding materials will be allowed to commence.

Work on the compaction of plastic materials in embankments shall proceed as soon as practicable after excavation and shall be carried out only when the moisture content is not greater than 2 per cent above the plastic limit for that material. Where the moisture content of plastic material as excavated is higher than this value the material shall, unless otherwise directed by the Engineer, be run to spoil. If the Contractor allows the moisture content of suitable plastic materials to increase to a value which is unacceptable for compaction he shall, unless he prefers at his own expense to wait until the material has dried sufficiently for acceptance again as suitable material, run such material to spoil and provide an equal volume of material suitable for filling, both without extra charge.

Work on the compaction of non-plastic materials in embankments shall be carried out only when the material has such a moisture content as is within the range from 1 per cent, wetter to 2 per cent drier than the moisture content of the material in cuttings or borrow pits when measured on samples obtained from at least 30 cm above the level of the water table as indicated by the presence of free water in the excavation. Nevertheless, if with any material the Engineer doubts whether satisfaction will be obtained within the above moisture limits, he may require compaction to proceed only when the limits of moisture content for the compaction of non-plastic materials are within the range of the optimum moisture content as determined by the laboratory compaction test method described in SSRN 601. Method of Test for Soil Classification and Compaction.

If any such non-plastic material on excavation is too wet for satisfactory compaction and the Engineer orders the moisture content to be lowered or raised, such Work shall be treated as included in the rates. All adjustments of moisture content shall be carried out in such a way that the specified moisture content remains uniform throughout compaction.

If the Contractor allows the moisture content of suitable non-plastic materials to change after excavation to a value unsuitable for compaction, he shall raise or lower the moisture content as required above, or the Contractor shall, if so directed by the Engineer, run the material to spoil and replace it with an equal quantity of material suitable for compaction.

Work shall be continued until a state of compaction is reached throughout the embankments, including especially the slopes of embankments (and the immediate approaches to bridge abutments) such that at least 9 out of every 10 consecutive samples taken of the compacted material have a relative compaction determined according to SSRN 601 of at least the following percentage of the maximum density of optimum moisture content:

- (a) For the topmost 15 cm below formation level a maximum density of 100 per cent.
- (b) For the remainder below formation a density of at least 95 as mentioned in the Bills of Quantities and as directed by the Engineer.

If with non-plastic material, the compacted material has become dry in the interval between the completion of compaction and the measurement of the state of compaction, then the moisture content to be used for the calculation of the air content shall be the mean moisture content for the compaction of such materials as specified above.

Each layer of rock used as rock-fill in embankments shall be systematically compacted by at least 8 passes of towed vibrating roller weighing not less than 3 tons or a grid roller weighing not less than 13 tons dead weight or other approved plant. Where however, it is established that rock can be compacted to the requirements for common excavation, the rock shall be compacted to such latter requirements.

218 EXCAVATION BELOW EMBANKMENT IN MATERIALS UNSUITABLE FOR CONSTRUCTION

Before forming the embankment any unsuitable material naturally occurring on the Site shall be removed to such depths and over such area as may be directed by the Engineer and shall be run to spoil. The resultant excavation shall be backfilled with suitable material deposited and compacted as specified for the forming of embankments. Nevertheless, where in these circumstances such backfill has to be deposited below standing water, compaction may be omitted provided that the material used is completely free draining.

If ordered by the Engineer as an alternative method of construction, approved rock-fill material shall be placed directly on the naturally occurring unsuitable material to such total depth that on completion of compaction negligible deflection of the surface occurs due to the passage of vehicles hauling in the rock. The rock-fill material shall be deposited, and compacted so as to comply with the requirements of this Specification for the compaction of rock. Such work will be dealt with as a Variation of the Works.

219 BENCHING

Where an embankment is to be placed on appreciably sloping ground, the surface of the ground shall be benched in steps or trenches, as shown on the Drawings or directed by the Engineer including, if necessary, any under-draining of the Site.

220 EXCAVATION BELOW FORMATION IN CUTTINGS IN MATERIALS UNSUITABLE FOR CONSTRUCTION

Where unsuitable material is encountered in the sub-grade it shall be excavated to such depths and over such area as the Engineer shall direct and be run to spoil. The resultant excavation shall be backfilled with suitable material deposited in layers each not exceeding 25 cm loose depth and compacted in the manner specified for the forming of embankments. Nevertheless, where in these circumstances such backfill has to be deposited below standing water, compaction may be carried out if the material used is completely free draining.

If ordered by the Engineer as an alternative method of construction, approved rock-fill material shall be placed directly on the naturally occurring unsuitable material to such total depth that on completion of compaction negligible deflection of the surface occurs due to the passage of vehicles hauling in the rock. The rock-fill material shall be deposited and compacted so as to comply with the requirements of this Specification for the compaction of rock. Such work will be dealt with as a Variation of the Works.

221 EXCAVATIONS FOR FOUNDATION PITS AND TRENCHES

Pits and trenches for foundations shall be taken out to the levels and dimensions shown on the Drawings or to such other levels and dimensions as the Engineer may direct. The bottoms of all excavations shall be carefully levelled and if necessary stepped or benched horizontally. Any pockets of soft material or loose rock and fissures in the bottoms of pits and trenches shall be removed and the cavities so formed, filled with concrete of the appropriate Class. When any excavation has been taken out and trimmed to the levels and dimensions shown on the Drawings or directed by the Engineer, the Engineer shall be informed accordingly so that he may inspect the completed pit or trench and no excavation

shall be filled in or covered with concrete until it has been authorised to proceed with the work. All surplus excavated materials from such excavations not required for refilling shall be deposited in embankments, or otherwise disposed off, as directed. All excavations shall be kept dry, and all bailing and pumping, timbering, shoring and supporting of sides that may be required, and any refilling, ramming and disposal of surplus materials necessary in carrying out the excavations for foundation pits and trenches shall be included in the prices for excavation.

222 EXCAVATION FOR FOUNDATION BELOW OPEN WATER

The rates for excavation for foundations below the agreed water level shall include for the cost of all temporary loose timbering and shoring, sheet piling, cofferdams, caissons, pumps and other special appliances required.

223 FOUNDATION PITS AND TRENCHES OF GREATER WIDTH AND DEPTH THAN NECESSARY

The Contractor shall not be entitled to payment in respect of excavation to any greater extent, whether horizontally or vertically, than is necessary to receive any structure for which the excavation is intended, except where a separate item is provided for additional excavation for Working Space, timbering or other temporary work. Excavation to a greater depth or width than is directed shall be made good with concrete of the appropriate Class as determined by the Engineer who may allow excavation to a greater width than is necessary to be filled and tightly packed with suitable material.

224 COMPLETION OF EARTHWORKS

The formation shall be properly shaped and regulated and compacted. When completed the formation shall be at the required level and generally parallel to the required finished surface.

225 OPEN DITCHES

Open ditches for drainage purposes shall be cut where and of such cross section as the Engineer shall direct and where so required by him they shall be constructed before the cuttings are opened or the embankments begun. The sides shall be dressed fair throughout and the bottoms accurately graded so as to carry off the water to the outlet to be provided. The material excavated from the ditches shall be disposed off as directed by the Engineer.

226 DISPOSAL AND STORING OF EXCAVATED MATERIAL

All surplus material arising from excavation shall be disposed off to a tip or tips to be provided by the Contractor unless otherwise stated. The disposal tip and manner of disposal shall be to the approval of the Engineer.

Where spoil from excavation is required for re-use as refill or for the formation of embankments, the various types of material shall be kept separately and stored in convenient and approved places.

227 BORROW CUTTINGS AND PITS

Where for any reason, it becomes necessary to form borrow cuttings or borrow pits, these shall be located by the Contractor and approved by the Engineer and the Work executed in all respects to the instructions of the Engineer. They shall be properly graded and drained and finished with neatly trimmed slopes.

228 ROAD APPROACHES AND ACCESS ROADS

The excavations and embankments in road approaches, junctions, access roads and fringe lands, shall be of such form and dimensions as the Engineer may direct, and in all respects finished as specified for those of the main carriageway. The materials arising from such excavation shall be disposed off as directed by the Engineer.

229 REFILLING OF PIPE TRENCHES

Pipe bedding and surround material comprises backfill placed and compacted in trench bottoms up to a level above the pipe crown such that pipes are uniformly supported, centred on the pipe centreline, for their full length.

Placing and compaction of the pipe bedding shall be regarded as the most critical phase of the backfilling operation. Backfilling beyond this point shall only proceed after inspection and approval of the completed bedding and surround by the Engineer.

The soil filled around and for 300 mm over the top of the pipes shall be free from stones, tree roots or similar objects which through impact or by concentrating imposed loads might damage the pipes, and not of black cotton soil type. The filling shall be carried out with utmost care, special attention being paid to tamping or material around the pipes and to joint holes so as to obtain the greatest possible compactness and solidity. The soil shall if necessary, be screened to exclude material which would damage the pipes. The soil shall be in accordance with the relevant pipe bedding drawing and shall be approved by the Engineer before backfilling commences.

The bedding for the pipes shall have a minimum thickness of 100 mm in normal trenches, and 150 mm where rock/stones are present and at designated road crossings. In trenches where there is a continuous accumulation of groundwater, the trench shall after obtaining the approval of the Engineer, be over-excavated by 150 mm and shall be backfilled using compacted granular material. Bedding material shall be compacted in layers not exceeding 50 mm thickness. Compaction of fill around the pipe shall be in layer thickness not exceeding half the pipe diameter or 75 mm whichever is the lesser. Layer thickness is however subject to achieving 90% MPD (Modified Proctor Density), failing which layers shall be reduced in depth as necessary to achieve the % compaction. The Contractor shall control the field compaction densities with a fully registered nuclear surface moisture- density gauge that is in a proper working order. This density gauge with operator shall be made available to the Engineer for his use as and when required.

The backfill soil shall be placed in layers of not more than 150 mm thickness when compacted and where hand ramming is employed the number of men filling shall not be more than half the number of men ramming. Where mechanical-ramming of the fill is employed, the machines shall be to the approval of the Engineer and soil shall be replaced and well rammed down by hand for a depth of not less than 60 cm to give sufficient cover to the pipes and obviate risk of damage to them before the mechanical rammer is brought into operation. The rammer shall not cease to be used on any length of trench until thorough compaction has been obtained. The backfill soil shall be free from clay lumps, boulders and rock fragments greater than 150 mm and as far as practicable 90 % MPD shall be attained, but this may be relaxed (e.g. in fields and open areas) by the Engineer.

The Contractor in excavating shall ensure that materials from strata containing no stones and suitable for filling around the pipes as described above, shall be kept separately and used for this purpose. The Contractor shall not be entitled to claim for any extra costs (as provided for below) for screening if this requirement is not complied with. If no such strata occurs in the excavation, the excavated material shall either be screened or suitable material transported to the Site from other excavations as the Engineer shall direct. The cost of such work shall be paid for according to the rates in the Bills of Quantities.

Before backfilling trenches, the Contractor shall obtain approval from the Engineer of the methods he proposes to use and he shall demonstrate by means of tests that the specified compaction can be achieved (according to SSRN 601 using the "sand replacement" method). The method of compaction and the testing thereof shall be at all times to the approval of the Engineer.

Trenches shall be backfilled as soon as possible after pipe laying to curtail thermal movements of the pipeline, damage to coatings and flotation of the pipeline should the trench fill with water. At no time shall backfilling lag more than 500 m behind the last pipe

laid. All specified tests on pipe barrels and joints shall therefore be carried out as soon as possible

The Contractor may use his discretion as to whether to backfill around joints before the pipeline is hydrostatically tested. The Contractor shall be responsible for the location and repair of any leaks on the pipeline under hydrostatic test and no extra payment will be made for any re-excavation and subsequent reinstatement which may be necessary to locate and remedy leaks or for the installation of cathodic protection equipment. Should the Contractor elect to leave joint holes open until after the hydrostatic test, he shall provide at his own expense effective and approved barricades and fences around each hole for the protection of persons and animals. In built-up areas, barricades shall be clearly marked at night with red warning lights.

230 MAKING GOOD SUBSIDENCES AFTER REFILLING

All refilling whether over foundations or in pipe trenches shall be thoroughly compacted by ramming and any subsidence due to consolidation shall be made up by the Contractor at his own expense with extra compacted material. Should subsidence occur after any topsoil has been replaced, the topsoil shall first be removed before any hollows are made up before being re-laid.

231 REINSTATEMENT OF SURFACES

- (i) All surfaces of roads, fields, paths, gardens, verges, etc. whether public or private which are affected by the operations of the Contractor shall be temporarily restored by him in the first instance and permanently reinstated in the second instance when the ground has consolidated fully. Separate payment for reinstatement shall be made only for surfaced roads (e.g. tarmac, concrete, paving bricks or similar material), for official designated dirt roads of at least 6m width, grassland, cultivated lands and sports fields. Any other reinstatements are deemed to be covered by the pipe installation rates.
- (ii) The Contractor shall be responsible for the temporary reinstatement and permanent reinstatement of all surfaces whether or not the area requiring restoration is within the limits of his excavations if the necessity for the restoration arises from causes due to the operations of the Contractor. The Contractor's prices shall include for restoring all surfaces so damaged to their original condition as no extra payment will be made for any such work. The Contractor shall take all necessary measures to ensure that no toxic materials which may cause damage to vegetation or livestock or pollute streams or watercourses are used in any temporary restoration or permanent reinstatement and shall indemnify the Employer against any claims arising out of the use of such materials.
- (iii) Temporary restoration shall be carried out immediately after the excavations have been refilled by returning the excavated material to the position from which it was removed and adding such suitable materials as may be required and consolidating the various materials as the Work proceeds in order to provide a surface that is adequate for the purpose that the original surface fulfilled. Temporary surfaces shall be maintained in a condition satisfactory to the Engineer and/or responsible Authority until the permanent reinstatement is made. In the case of roads and streets the surface shall be necessary to consolidate the filling and keep the surface fit for traffic, suitable material being added to all placed which have sunk or become rough.
- (iv) Permanent reinstatement shall not be made until the ground has consolidated permanently and until sanction to do so is received from the Engineer. It shall be carried out with materials similar to those which were used in the original Work to the entire satisfaction of the Engineer and/or responsible Authority.
- (v) In verges and other grass surfaces the topsoil shall be removed, stored and replaced after consolidation of the filling and planted or seeded with approved

grass. Should subsidence occur, it shall be made good with additional topsoil and be replanted with grass or re-seeded. New grass shall be planted if for any reason the grass fails to grow or is destroyed.

- (vi) The trenches, channels, gutters and kerbs shall be reinstated to the condition in which they were before excavation was commenced. The final surface of the trench shall be flush with the surrounding ground.
- (vii) If the work of restoration or reinstatement as carried out by the Contractor is not to the satisfaction of the Engineer and/or the responsible Authority and should the Contractor not remedy the defect forthwith, any remedial work considered necessary may be undertaken by the Engineer and/or the responsible Authority and the cost thereof shall be borne by the Contractor.
- (viii) If at any time any trench becomes dangerous, the Engineer shall be at liberty to call upon the Contractor to restore it to a proper condition at three hours' notice and should the Contractor fail to carry out the work, have it done at the Contractor's expense.
- (ix) The Contractor shall include in his price for all materials and labour which he may have to employ in reinstating the trenches and surfaces to their original condition to the satisfaction of the responsible Authority.

232 FORMING BANKS AND FILLED AREAS

- (i) Banks and filled areas shall be made and built up to the levels, dimensions and shapes shown on the Drawings or as may be subsequently directed by the Engineer.
- (ii) Before any filling is started, the ground on which embankments are to be sited, shall be stripped of all grass and topsoil and all roots, vegetable matters and other unsuitable substances removed.
- (iii) The soil to be used in the banks and fill areas as shown on drawings shall be approved material either borrowed or arising surplus from the excavations, the material being placed according to its nature as shall be directed. Usually, coarse hard material shall be placed at the bottom of the pile with the fine material and/or soil at the top or at the surface. Should there be insufficiency of such material arising from the Works, the Contractor shall supply other approved material for this purpose and shall be deemed to have included for such supply in his prices for filling. Any subsidence shall be the Contractor's liability and he shall forthwith make them good to the satisfaction of the Engineer.
- (iv) The filling shall be placed in layers not more than 15 cm thick, each layer being thoroughly compacted to the satisfaction of the Engineer.

233 EARTHWORKS TO BE KEPT FREE OF WATER

The Contractor shall arrange for the rapid dispersal of water shed onto or entering the earthworks from any source at any time during Construction, or of water which is shed onto the completed subgrade. He shall provide within the Site where necessary, temporary watercourses, ditches, drains, pumping or other means of maintaining the earthworks free from standing water. Water discharged from the Site, shall not be run into a road but be carried direct to an approved sewer, ditch or river through troughs, chutes or pipes.

Such provision shall include carrying out the work of forming the cuttings and embankments in such a manner that their surfaces have at all times a sufficient minimum crossfall and where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding. In pumping out of water from excavations and in any lowering of the water tables, the Contractor shall pay due regard to the stability of all structures.

The cost of compliance with the requirements of this Clause shall be covered in the rates for earthworks. If the Engineer is dissatisfied with the measures taken by the Contractor to

keep the Works free of water, the Engineer shall be free to instruct the Contractor to adopt what measures the Engineer may require. The cost of this Work shall be deemed to have been included in the rates in the Bills of Quantities.

234 SUPPORTS FOR FOUNDATION PITS AND TRENCHES

The sides of pits and trenches shall where necessary, be adequately supported to the satisfaction of the Engineer by timber or other approved means. The costs of this work shall be included in the rates inserted in the Bills of Quantities.

235 REFILLING OF FOUNDATION PITS AND TRENCHES AND REMOVAL OF EXCAVATION SUPPORTS

Refilling of foundation pits and trenches shall be carried out only after the foundation and structural works within the excavation have been inspected and approved by the Engineer. Unless otherwise directed by the Engineer, all filling shall consist of approved excavated materials which shall be deposited and compacted, using approved Plant, in layers not exceeding 25 cm loose depth, to a dry density not less than that of the adjoining soil. Timber sheeting and other excavation supports, shall be carefully removed as the filling proceeds except as otherwise specified, but the removal of such supports will not relieve the Contractor of his responsibility for the stability of the Works. The number of separate layers deposited and compacted at any one time shall be subject to the approval of the Engineer.

236 USE OF VIBRATORY COMPACTION PLANT

Where vibratory rollers or other vibratory compaction Plant are used, the mechanism and vibration shall be kept working continuously during compaction operations, except during period when the Engineer permits or directs discontinuance of vibration.

Unless otherwise permitted by the Engineer, the frequency of vibration shall be maintained within the range of amplitude and frequency recommended by the manufacturers of the Plant for the material to be compacted. The frequency shall be recorded by a tachometer indicating speed of rotation of any shaft producing vibration.

237 PROVISION OF SPOIL HEAPS

The Contractor shall provide spoil heaps at his own expense for the disposal of surplus materials and all rubbish collected when clearing the site and during the Construction of the Works. The Sites for these shall be approved by the Engineer.

238 TOPSOILING

Topsoil for planting grass shall be selected topsoil from approved stockpiles or materials from excavation for embankment foundations or from stripping from borrow areas or other approved sources. The material shall contain the most fertile loam available and shall be free from excessive quantities of grass, roots, weeds, sticks, stones or other objectionable materials.

Areas to receive the topsoil shall be brought to within 100 mm of the prescribed final cross-section at all points and finished smooth and uniform before topsoil is applied. Topsoil shall be evenly placed and spread over the graded area in one layer and shall be placed at locations shown on the Drawings or designated by the Engineer.

239 GRASSING

It is expected that it will be necessary to water the areas with newly planted grass to ensure germination and establishment of plants. The Contractor shall provide for a temporary sprinkler irrigation system to the approval of the Engineer and shall irrigate the newly planted grass at such times as the Engineer instructs. The Contractor shall repair at his own expense any damage to the slopes or any part of the work caused by excessive or irregular application of irrigation water.

Planting shall consist of ground preparation, furnishing approved grass, planting and covering the planted grass and shall be completed on areas shown on the Drawings or as designated by the Engineer.

When the topsoil has been placed on the areas to be planted with grass, levelled and compacted to finished grade, it shall be brought to a friable condition by harrowing or otherwise loosening to a depth of maximum 100 mm. All lumps and clods shall be thoroughly broken by approved means.

240 MEASUREMENT OF TOPSOILING AND GRASSING

Measurement for topsoiling and grassing shall be made according to the amount of square metres of topsoiled areas measured in place to the lines and grades on the Drawings or as established by the Engineer, and paid for at the rates per m² tendered in the Bills of Quantities, which rate shall include for all as specified, including supplying the grass seeds or sprigs.

241 FORMATION OF FOOTPATHS

The ground under footpaths shall be trimmed to formation level and 5 cm thick precast concrete paving slabs shall be bedded on 5 cm thick layer of fine sand unless the Engineer directs otherwise.

242 HARDCORE

Hardcore, shall be sound hard stone, rock or broken concrete not less than 10 cm in size unless otherwise directed. Sufficient but not excessive blinding material of smaller sizes may be permitted at the discretion of the Engineer.

243 RUBBLE

Rubble for use in drains and backing to walls shall be of durable natural stone or large sized gravel. It shall be of a size that will pass a 5 cm mesh-sieve and retained on a 2.5 cm mesh-sieve and it shall be free from earth clay vegetation or other organic matter and shall contain no rubbish.

244 GEOTEXTILE

Geotextile shall be placed where indicated on the drawings or as instructed by the Engineer in order to prevent sand from migrating outside their confined area, whilst allowing water to drain. The geotextile shall be a non-woven needle punched and thermally bonded polymer and be manufactured in accordance with SSRN 874.

The minimum tensile strength and maximum elongation at maximum tensile strength in accordance with SSRN 874 (a) shall be 9 kN/m and 40% respectively. Puncture resistance in accordance with SSRN 874 (b) shall be 1500 N, whilst the effective opening size and permeability shall be 125 micrometer and 190 l/m².sec respectively. Installation shall be in accordance with the manufacturer's guidelines and the contractor's proposal in this regard shall be submitted for the Engineer's approval before installation commences.

245 GEOGRID

The reinforcing element in the reinforced earthworks shall be a geogrid manufactured in accordance with a quality management system which complies to SSRN 875 and shall be from high-density polyethylene sheet, oriented in one direction so that the resulting ribs shall have a high degree of molecular orientation which is continued through the transverse bar.

The quality control strength in accordance with SSRN 875 shall not be below 52 kN/m at the 95% confidence limit, whilst the creep limited tensile strength for a design life of 120 years shall not be below 20 kN/m at 20 deg Celsius. The tensile strength at 2% and 5% strains in accordance with SSRN 875 shall be at least 12.5 kN/m and 24.5 kN/m respectively. The strength of the junctions between the longitudinal ribs and transverse bars

shall be not less than the quality control strength, whilst site joints shall be capable of carrying 90% of the quality control strength in accordance with SSRN 875 (c).

The geogrid shall be inert to all chemicals found in soils and shall have no solvents at ambient temperature. It shall not be susceptible to hydrolysis, shall be resistant to aqueous solutions of salts, acids and alkalis (pH = 2 to 12.5), shall be non-biodegradable and shall have a minimum of 2% finely divided carbon black well dispersed in the polymer matrix to inhibit attack by ultraviolet light.

The geogrid shall have an appropriate partial factor for site installation and construction damage, determined by the particle size distribution of the reinforced fill and in accordance with the values used in the design. This factor shall be based on full-scale tests carried out in accordance with SSRN 875 (d). Installation shall be in accordance with the manufacturer's guidelines and the contractor's proposal in this regard shall be submitted for the Engineer's approval before installation commences.

246 POLYETHYLENE PAVING

The paving on top of the earthwork protection structure shall be able to withstand water flows of at least 5 m/s and shall be manufactured from polyethylene and be able to carry a load of 200 tonnes per m². The paving elements shall be flexible for laying on undulating surfaces and gradients and be interconnected by lugs and slots to form one continuous paving area. The cellular structure shall be filled with topsoil and grass and provide unrestricted root growth.

247 BAG WORK

Bag work protective construction shall be carried out in accordance with the drawings or as otherwise directed by the Engineer. The foundation shall be prepared to the satisfaction of the Engineer. Approved hessian sand bags shall be filled with a 1:6 cement : sand dry mix, properly sealed with placed dimensions of 660 mm long, 330 mm wide and 150 mm high.

The next course of bags shall be laid and secured to the previous layer with high-density polyethylene pegs (Tensar or similar approved) of a length of 280 mm and at intervals of 330 mm (i.e. 2 No. per bag). The pegs shall be stabilised with carbon black for UV resistance, shall have two sprung shafts at the head of the peg to hold down the top bag and have a cruciform barbed shaft for maximum adhesion. The pegs shall be manufactured in accordance with a quality management system which complies with the requirements of ISO 9001. The next layer of bags shall be placed so as to cover the pegs of the previous layer.

Approved fill material shall be placed behind the bags and compacted to 95% Modified Proctor Density. A geotextile shall be placed between the bags and the fill as indicated on the drawings.

The bag work face shall be wetted down at the end of each working day or as directed by the Engineer.

CHAPTER 3

**CONCRETE, REINFORCEMENT AND
SHUTTERING**

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CHAPTER 3 - CONCRETE, REINFORCEMENT & SHUTTERING

301 GENERAL

- (i) The standard of materials and of workmanship shall be not inferior to the recommendations of the current:-
- (a) A code of Practice dealing with the Structural Use of Reinforced Concrete in Buildings, SSRN 101 whichever is applicable to the particular structure,
- OR -
- A code of Practice dealing with the Design and Construction of Reinforced Concrete Structures for the storage of liquids, SSRN 102,
- AND
- (b) Appropriate Standard Specifications herein referred to.
- The requirements outlined in the above documents must be read with those of this section of the Specification and where any conflict exists between the recommendations of the above and of this Specification, the requirements of this Specification shall prevail.
- (ii) As and when required by the Engineer, the Contractor shall prepare and submit, before commencing the work, a Time Chart (additional to the General Programme) detailing the various operations for concrete work.
- (iii) No material shall be used in the work until prior approval for its use has been given by the Engineer; neither shall any change in the nature, quality, kind, type, source of supply or manufacture be made without the Engineer's permission.
- (iv) Names of manufacturers and test certificates, shall be supplied as soon as possible to the Engineer.
- (v) The prices inserted in the Bill of Quantities shall include for the provision of all samples and for all costs incurred in the execution of the tests specified or referred to herein in accordance with the General Conditions of Contract; the prices shall include also for transport of samples of cement, sand, concrete, aggregates, and similar materials to an approved materials testing laboratory. Results of laboratory and Site tests shall be kept on Site and copies of all test Reports shall be forwarded in duplicate to the Engineer.
- (vi) Frequency of tests and number of samples required will be governed by the results of previous tests, the quality of the materials revealed during the tests and the uniformity of that quality. Should it become evident that the quality of the concrete is deteriorating the Engineer may require additional samples to be taken and test cubes to be made and tested to determine the cause.
- (vii) During the progress of the works, consignment notes shall be supplied to the Engineer giving details of each consignment of each concreting material.
- (viii) The use of the word "approved" in this Specification refers to the approval by the Engineer.

302 STEEL REINFORCEMENT

The reinforcement shall be of the type specified and shall comply with the appropriate SSRN number as follows:

- Mild Steel Bars - SSRN 126
- Cold-Twisted Steel Bars - SSRN 127
- Reinforcing Fabric - SSRN 128

303 WATER FOR USE IN CONCRETE

All water used in mixing concrete shall be obtained by the Contractor and comply with SSRN 114.

The water for each batch shall be just sufficient to ensure the production of concrete of the required consistency and shall be measured in a small tank, and the quantity shall be varied from time to time as required by the Engineer.

304 CEMENT

- (i) All cement used (unless otherwise ordered) shall be ordinary Portland Cement or if required or allowed by the Engineer, rapid-hardening Portland Cement of the best quality and of a brand or brands to be approved by the Engineer and shall comply in every respect with the conditions, analyses and tests laid down in SSRN 103 for Portland Cement.
- (ii) Cement shall be obtained from one manufacturer unless otherwise authorised by the Engineer. Should the use of cement from different manufacturers be authorised, the different supplies of cement shall be stored separately and shall not be mixed.
- (iii) The Contractor shall supply to the Engineer copies of the manufacturer's test certificates certifying that each consignment of cement has been tested and analysed, and that the results comply in all respects with the above standards. Each certificate shall state clearly the date of despatch and the number of bags despatched in each consignment.
- (iv) Bagged cement shall be delivered in sealed 50 kg paper sacks. Cement shall not be delivered in bags of less than 5 ply. Each bag shall be marked with the parcel number of the cement contained. Bagged cement shall be transported so that at no time is it exposed to damp and so that moisture cannot be absorbed from the atmosphere. Cement in bulk shall be transported in totally enclosed water tight and sealed containers.
- (v) Sulphate Resisting or High Alumina Cement
Where a sulphate-resisting cement or a high alumina cement is specified or ordered, it shall be of the best quality and of brand or brands approved by the Engineer. The cement shall comply in every respect with SSRN 104.
- (vi) Cement Storage
The cement shall be delivered on the site of the works in such consignments as shall ensure satisfactory progress of the work, each bag or container being sealed to the satisfaction of the Engineer. The cement shall be stored on the Site in a dry store or in approved bulk containers, large enough to contain the required quantities. The store shall be provided by the Contractor and shall have sufficient sub-division of such sizes as the Engineer may approve, it shall be properly roofed and perfectly watertight, and it shall have a dry wooden floor above ground level with an air space at least 15 cm in depth below it. The cost of all work specified in this Clause shall be borne by the Contractor.
- (vii) Cement of different consignments shall be stored separately and consignments shall be used in the same order as they are delivered to the site. No cement shall be stored on the site for longer than three months from the date of despatch by the manufacturer. If not used within that period, the cement shall be removed from the site.
- (viii) Any bag of cement which is damaged or found to contain cement which has set or partly set, shall be discarded and not used in the Permanent Works.
- (ix) The Engineer may cause samples to be taken from any consignment of cement for testing by the Engineer's Representative at the Ministry of Works, Testing Station. If the results of these tests show that the samples do not conform to this Specification,

the whole consignment will be rejected as unfit for use, and must forthwith be removed from the Site by the Contractor at his own expense. The various consignments must be brought to the Site in ample time to allow the above tests to be carried out before the cement is required for use.

(x) **Later Tests**

Although the Engineer may have passed any consignment of cement, he shall nevertheless, have the power at any subsequent time to reject such consignment if he finds that any deterioration in the quality thereof has taken place. Any package of cement in which there are hardened lumps or cakes of cement, shall be rejected.

(xi) **Cement Containing Hardening or Waterproofing Compounds**

No cement containing hardening or waterproofing compounds shall be used nor shall calcium chloride or other chemicals be added to cements or to concrete except on the instructions of the Engineer. Any cement so treated shall be stored separately and clearly marked and shall only be used in accordance with the requirements of the Engineer.

305 SAND

Sand used for mortar shall comply with SSRN 135 and sand for rendering with SSRN 136.

306 COARSE AND FINE AGGREGATES

- (i) Mixed ballast for mass concrete shall comply with the requirements for "all-in" aggregates of 40 mm maximum size in SSRN 108 unless otherwise specified by the Engineer.

- (ii) All aggregates for graded concrete, except granolithic and fine concrete, shall comply with SSRN 108. Coarse aggregate shall be "graded aggregates" of 20 mm to 5 mm nominal size as specified in Table 3 - 1 unless otherwise ordered.

Fine aggregates shall be natural sand, in grading zone 2, as specified in Table 3-2.

Approved coarse and fine aggregates, mixed before the addition of cement, in volumes to be approved by the Engineer, may be used in lieu of "all-in" aggregates for mass concrete.

They shall conform to the moisture absorption requirements of SSRN 112. Otherwise the Contractor shall prove the durability of the finished concrete by approved tests when used for making concrete required for liquid retaining structures.

Aggregates of rounded shape or otherwise capable of procuring a concrete of good workability with the minimum addition of water, shall be preferred.

The Contractor shall ensure that the nature and grading of aggregates remain reasonably consistent, and shall, if necessary, stockpile and include different grading to ensure that the overall grading remains constant for each section of the work.

Dust or flour resulting from crushing the aggregate shall not be allowed to contaminate the stockpiles. When, in the opinion of the Engineer such contamination has taken place to the detriment of the finished concrete, it shall be removed by an approved means, otherwise the aggregate shall be rejected.

For mass concrete, dust or flour resulting from crushing the aggregate may be included in controlled quantities to supplement the fine aggregate in order to improve the consistency of the mix.

- (iii) **Aggregates for Fine Concrete**

Coarse aggregate for fine concrete shall comply with SSRN 110, but shall have a grading which shall be 10 mm to No. 7 sieve size. Fine aggregates shall be as specified in (ii).

(iv) Source of Supply of aggregates

Aggregates shall be obtained from a source to be approved by the Engineer. Coarse and fine aggregates shall be delivered and stored separately on to a clean, hard base, in separate compartments or into approved hoppers.

(v) Samples of Aggregates

Samples of aggregates and sand for use on the works shall be submitted to the Ministry of Works, Materials Branch, for approval and no materials will be accepted for use unless they comply with the requirements stated.

(vi) Defective Aggregates

If any aggregate is defective in grading or other respect, the Contractor shall remedy the defect at his own expense and to the satisfaction of the Engineer.

307 GRADING OF AGGREGATES

The combined grading of aggregates shall be a smooth curve approximately parallel to the grading envelope limits, given in the following Table, and to the approval of the Engineer.

TABLE 3.1: COMBINED GRADING CURVES FOR CONCRETE

SIEVE SIZES	PERCENTAGE BY WEIGHT PASSING SIEVE NOMINAL MAXIMUM SIZE OF AGGREGATE (mm)		
	40	20	10
1½"	100		
¾"	50 – 75	100	
⅜"	36 – 60	45 – 75	100
⅜"	24 – 47	30 – 48	30 – 75
No. 7	18 – 38	23 – 42	20 – 60
No. 14	12 – 30	16 – 34	16 – 46
No. 25	7 – 23	9 – 27	4 – 20
No. 52	3 – 15	2 – 12	4 – 20
No. 100	0 – 5	0 – 2	0 – 6

308 COMPOSITION OF CONCRETE

All concrete shall be dense, impermeable, durable, consistent and cast accurately to the lines and dimensions shown on the drawings and shall present a uniform surface free from blemishes, cracks and honeycombing, resistant to wear and mild chemical attack. Concrete mixes are to be such as to enable the concrete to fill the formwork completely with intimate contact between concrete and reinforcement and the concrete is to be thoroughly and uniformly vibrated throughout.

The cement, aggregates and water for concrete shall be as specified. Samples of cement and aggregate shall be submitted to the Engineer for testing as early as possible prior to the commencement of concreting works.

Water for mixing concrete, mortar and cement grout and for use during curing, shall be taken from a source approved by the Engineer, shall be clean, fresh and free from matter in solution or suspension in such amounts that may impair the strength or appearance of the concrete, mortar, rendering or grout.

Seawater or brackish water containing more than 1000 milligrammes per litre of chloride ion or 2000 milligrammes per litre of sulphate ion shall not be used for mixing or curing concrete.

309 CLASS AND STRENGTH OF CONCRETE

The concrete shall be of the Classes shown on the Drawings, described in the Bills of Quantities or ordered by the Engineer, which will be one or more of the Classes described and tabulated below, with the appropriate specified maximum size of aggregate.

Description

The concrete mixes, as described, are "guaranteed strength" mixes in the sense that no proportions are given but the required concrete strength is shown and the Contractor will be required to design a suitable mix with the given grading to fulfil the requirements as laid down hereunder for relevant Classes shown.

The mixes will be composed of the following Classes: 10, 15, 20, 25 and 30. These figures represent the minimum 28-day strength in N/mm² of the Works Cubes.

The maximum size of aggregate shall be as shown on the Drawings or as ordered by the Engineer, and may be indicated in brackets after the mix Class, for example 'Class 30(20)'.

All reinforced and graded concrete shall be composed of cement and fine and coarse aggregates gauged separately and in the following proportions:

TABLE 3.2: CLASSES OF CONCRETE

CHARACTERISTIC COMPRESSIVE STRENGTH AT 28 DAYS N/mm ²	NOMINAL MIX CEMENT, SAND & AGGREGATE	LIMIT OF COMBINED WEIGHT OF DRY AGGREGATE TO 50 KG CEMENT		MAX VALUE OF WATER CEMENT RATIO FOR VIBRATED CONCRETE (BY WEIGHT)
		MAX. KG	MIN. KG	
10	1:3:6	-	-	-
15	1:2½:5	450	-	-
20	1:2:4	400	230	0.55
25	1:1½:3	360	180	-
30	1:1:2	320	160	-

Before any concreting commences, trial mixes shall be made and cube tests performed as described in the Specification and these cubes shall obtain strengths at least 30% greater than the works cubes shown in Table 3.2 before the mix is approved by the Engineer.

If required or allowed by the Engineer, the relative proportions of fine and coarse aggregates shall be varied to obtain a denser mixer and to reduce shrinkage and such change shall not affect the price so long as the sum of the volumes of fine and coarse aggregates remain unchanged. Where sulphate-resisting cement is used, the water cement ratio shall not exceed 0.55.

Aggregate shall be batched by weight and the weighing hopper shall be of an approved adjustable type. Volume batching will not be allowed for concrete work except under special circumstances such as for small pipe culvert headwalls, pipe surrounds, and other isolated minor works.

When aggregates are batched by volume, the approval of the Engineer shall first be obtained before the use of this method of batching. With volume batching, stout gauge boxes approved by the Engineer, shall be used.

When cement in bags is used, the total volume or weight of aggregate per batch shall be such that a whole number of bags of cement is used and the use of cement from broken bags will not be permitted.

Once the proportions of the mixes have been agreed by the Engineer, they shall not be amended without his consent.

310 TESTS FOR CRUSHING STRENGTH

The Contractor shall be held responsible for ensuring that the crushing strength for the respective classes of graded concrete is not less than the following for concrete made with ordinary Portland Cement or sulphate-resisting cement.

TABLE 3.3: CRUSHING STRENGTHS

CLASS MIX	NOMINAL	MINIMUM CRUSHING STRENGTH ON 150 mm WORKS CUBES				MIX AVERAGE MINIMUM TRIAL STRENGTH			
		AT 7 DAYS		AT 28 DAYS		AT 7 DAYS		AT 28 DAYS	
		N/mm ²	Kg/cm ²	N/mm ²	Kg/cm ²	N/mm ²	Kg/cm ²	N/mm ²	Kg/cm ²
10	1:3:6	7.7	78	11.4	116	-	-	-	-
15	1:2½:5	10	102	15	153	13	133	19.5	200
20	1:2:4	15	153	20	204	20	204	26	265
25	1:1½:3	19	194	25	255	25	255	32.5	332
30	1:1:2	24	245	30	306	32	326	39	400

Cubes made with rapid-hardening Portland Cement must attain at 3 and 7 days after casting a crushing strength equal to that specified for ordinary Portland Cement or sulphate-resisting cement at 7 and 28 days respectively after casting.

Test cubes shall be numbered and dated in a conspicuous manner and shall be delivered to the Ministry of Works, Materials Branch at least 24 hours before the date when they are due to be tested. Four cubes shall be made at least 14- days before concreting is to be commenced, from a batch of concrete made on Site with the aggregates, cement and water proposed to be used on the works and at least two additional cubes shall be made for each 25 cubic metre of concrete mixed or when otherwise required by the Engineer. Should the crushing strength fall below the figure specified, the Contractor shall, without extra charge, adopt a richer mix or make other changes in proportion or otherwise as the Engineer may direct or approve, so as to bring the concrete up to the required strength.

311 CEMENT CONTENT AND WATER-CEMENT RATIOS

Notwithstanding the strength requirements of this Specification, in order to ensure adequate durability of the finished concrete while at the same time limiting the shrinkage characteristics, the following limits shall not be exceeded:

TABLE 3.4: LIMITS TO WATER

CLASS OF CONCRETE	MAXIMUM TOTAL WATER / CEMENT RATIO BY WEIGHT	LITRES WATER PER 50 kg CEMENT	CEMENT IN kg/m ³ FINISHED CONCRETE	
			MAXIMUM	MINIMUM
15	0.60	29.60	356	252
20	0.55	27.30	415	296
25	0.50	25.00	475	341
30	0.45	22.75	534	385

In all cases of mix proportioning, the added water shall be included with due allowance for the moisture contained in the aggregates, and shall be the minimum consistent with the workability requirements.

Where aggregates do not conform to the moisture requirements of SSRN 102 but are permitted for use, the above maximum water cement ratios shall be reduced by 0.05 (or 2.25 litres of water per 50 kg of cement).

Where the concrete is to be used in structures, protected from the elements, or not exposed to constant wetting and drying, the above maximum water-cement ratios may be increased by 0.05 (or 2.25 litres of water per 50 kg of cement).

312 DESIGN MIX

The mix should be designed for a mean strength that exceeds the specified works Cube Strength plus 30%.

The mix design shall follow the method explained in SSRN 115.

For the purpose of determining the "design strength" of the concrete, an allowance shall be added to the works Cube Strength indicated in Table 3 - 3 for the particular Class of concrete. This allowance shall be assessed on the degree of control reasonably to be expected in manufacturing the concrete and shall not be less than twice the Standard Deviation as defined in SSRN 117. Until such time as it has been determined, the Standard Deviation shall be assumed to be not less than 7 N/mm².

Details of the design mix shall be forwarded to the Engineer for his approval. However, such approval by the Engineer, shall not relieve the Contractor of his obligations.

313 TRIAL MIXES

314 COMPACTION AND SLUMP TESTS

The Contractor shall as and whenever required by the Engineer carry out slump or any other tests to determine the consistency of the mixed concrete and gauge, by measure, the amount of water prescribed by the Engineer for each mixing of concrete.

The tests of concrete shall not show a greater slump or compaction factor than the Engineer shall decide for each part of the work, but generally the slump for mass concrete must not exceed 25 mm and for reinforced concrete work 50 mm.

The compaction factor of vibrated concrete shall not exceed 0.91.

315 MIXING OF CONCRETE

The concrete shall only be mixed in approved power-driven concrete mixers for all Classes of Concrete, except that small batches of Class 15 and Class 10 may be mixed by hand with the approval of the Engineer.

The concrete shall be mixed continuously in the mixer for not less than 2 minutes after the whole of the ingredients are present in the drum. When a concrete mixer has been out of use for more than 20 minutes, or when the type of cement is changed, the mixer shall be thoroughly cleaned before a fresh batch of concrete is made in it.

The Engineer may prohibit concreting if in his opinion the number and/or sizes of the mixers available, or the quantity of materials in stock, is insufficient; or where he feels that the haulage of concrete from the mixer to the point of application of concrete is not near enough to guarantee quality.

316 WEIGHING, BATCHING AND MIXING

Aggregates and cement shall be proportioned by weigh-batching and water shall be proportioned by volume. Subject to the prior approval of the Engineer, volume-batching of aggregates may be used when weigh-batching is not possible, but volume-batching of cement will in no case be accepted. The contractor may, however, so mix his concrete that

such batch shall use a whole bag or bags of cement, the weight of which is known precisely.

Gauge boxes for volume-batching shall be strongly constructed and where necessary due allowance shall be made for bulking of the aggregates.

The aggregates and the cement shall be thoroughly mixed in a clean mechanical mixer for a period of time agreed with the Engineer and the water added on the basis of the approved design.

The amount of water added shall conform to the requirements as given in Table 3 - 4.

Batch-mixing machines shall comply with the requirements of SSRN 118. They shall be provided in such numbers and of such capacity as to ensure a continuous supply of freshly mixed concrete at all times during construction.

Continuous mixing machines shall be used only with the written permission of the Engineer.

When small quantities of concrete are to be mixed the Engineer may approve hand-mixing. In such cases, the cement content for all mixes shall be increased by 10% and the Contractor shall allow for this in his rates and prices.

Where concrete is mixed by hand, the fine aggregate and the cement shall be thoroughly mixed first and the coarse aggregate added. Mixing in the dry shall be carried out at least twice then water be added and the concrete again thoroughly mixed.

317 CENTRAL BATCHING PLANT

If a central batching plant is used, the method of weighing or measuring the cement and aggregate shall be to the approval of the Engineer. Accommodation for a Concrete Inspector shall be provided at the batching plant, and shall include a dust-proof room and shall be so situated that the inspector has a visual check on the quantities of cement and aggregate used per batch. The Contractor shall include in his prices for the provision and maintenance of this accommodation.

318 HAND MIXING

If hand-mixing is permitted, the quantity of cement to be used shall be increased by 10 per cent. Hand-mixing shall be carried out on an approved water-tight platform, the aggregate and cement being turned over three times in a dry state and thoroughly mixed by means of shovels. The water shall then be added through approved hoses fitted to watering cans, and the mixture shall be worked together until a uniform consistency is obtained.

During windy weather, protection shall be provided by screens or otherwise as directed to prevent cement from being blown away.

319 READY MIXED CONCRETE

Approval has to be obtained from the Engineer if the Contractor intends to use ready-mixed concrete, particularly at the tie-in sections shown on the drawings.

Ready-mixed concrete shall be mixed and delivered to the Site of the works by means of one of the following combinations of operations:

- (i) Mixed completely in a stationary mixer and the mixed concrete transported to the point of delivery in truck agitators or in non-agitating hauling equipment (known as central-mixed concrete).
- (ii) Mixed partially in a stationary mixer, and the mixing completed in a truck mixer, (Known as shrink-mixed concrete).
- (iii) Mixed completely in a truck mixer, (Known as transit- mixed concrete).

Mixers may be stationary mixers or truck mixers. Agitators may be truck mixers operating at agitating speed or truck agitators. Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates indicating the basis on which the equipment is

designed, the manufacturer's guaranteed capacity of the drum or container in terms of the volume of mixed concrete and the speed of rotation of the mixing drum or blades.

Truck mixers shall be equipped with electrically or mechanically actuated revolution counters by which the number of revolutions of the drum or blades may readily be verified. The counters shall be of the continuous registering non-resettable type, which accurately registers the number of revolutions and shall be mounted on the truck mixer so that the Engineer may safely and conveniently inspect them from alongside the truck.

Truck mixers shall be loaded not to exceed the manufacturers guaranteed capacity. They shall combine the ingredients of the concrete into a thoroughly mixed and uniform mass and discharge the concrete with a satisfactory degree of uniformity conforming with the above requirements.

When shrink-mixed concrete is furnished, concrete that has been partially mixed at a central plant shall be transferred to a truck mixer and all requirements for transit-mixed concrete shall apply. No credit in the number of revolutions at mixing speed shall be allowed for partial mixing in a central plant.

Mixed concrete may be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturer of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable for adequate placement and consolidation in place, and provided the mixed concrete after hauling to the delivery point conforms to the above requirements.

Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity. They shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

Bodies of non-agitating hauling equipment shall be so constructed that leakage of the concrete mix, or any part thereof, will not occur at any time, and they shall be self-cleaning during discharge.

Concrete hauling in open-top vehicles shall be protected during hauling against access of rain, or exposure to the sun when the ambient temperature exceeds 24 degrees centigrade.

No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point unless the Engineer orders additional water to be incorporated into the concrete, the drum shall be revolved not less than 30 revolutions at mixing speed after the water is added and before discharge is commenced.

The rate of discharge of mixed concrete from truck mixer agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

When a truck mixer or agitator is used for transporting concrete to a delivery point, discharge shall be completed within 1½ hours, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 29 degrees centigrade or above, a time less than 1½ hours will be required.

When non-agitating hauling equipment is used for transporting concrete to the delivery point, discharge shall be completed within one hour after the addition of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 29 degrees centigrade or above, the time between the introduction of cement to the aggregates and discharge shall not exceed 45 minutes.

Each batch of ready mixed concrete delivered at the job Site shall be accompanied by a ticket showing the volume of concrete, the weight of cement in kg and the total weight of all ingredients in kg unless they are otherwise ordered by the Engineer. The ticket shall also

show the time of day at which the materials were batched and for transit-mixed concrete, the reading of the revolution counter at the time the truck mixer is charged.

The organisation supplying concrete shall have sufficient Plant capacity and transporting apparatus to ensure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations, shall be such as to provide for the proper handling, placing and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 minutes. The method of delivering and handling the concrete shall be such as will facilitate placing with the minimum of re-handling and without damage to the structure or the concrete.

320 TRANSPORTING AND PLACING OF CONCRETE

No concrete shall be placed until the Engineer has approved the formwork and reinforcement. The Contractor shall provide all facilities for inspection.

The Contractor shall give at least 48-hours notice to the Engineer of the times he proposes to concrete and the Engineer may order that no concreting shall take place until either he or his Representative is present.

Concrete shall be transported in watertight containers in such a manner that will avoid the segregation of the constituent materials. The time elapsing between the initial mixing of the concrete and finally placing in the works shall not exceed 30 minutes when Portland Cement is used. Where other cements are used, the Engineer will stipulate the maximum time allowed. Concrete remaining unplaced at the end of this period shall not be placed in the work, but shall be removed from the Site and disposed off at the Contractor's expense. Should there be need for the use of rapid hardening cement at tie-ins particularly for expediting the completion of the works thereby the Contractor shall inform the Engineer who will when he deems it necessary approve such use.

Concrete shall not be dropped through a height exceeding 1.5 m. For lowering concrete through heights in excess of 1.5 m, special methods shall be used, such as chutes, tremies, bottom dumping hoppers, or bagged placing, and then only with the approval of the Engineer. All containers, troughs and chutes and apparatus through and in which concrete is passed, shall be kept clean and entirely free from hardened concrete or cement and free from contamination by extraneous material.

The concrete shall be placed in position in lifts not exceeding the heights to be agreed by the Engineer, and the excessive heights which may cause segregation of the aggregate at the working edge, shall be avoided.

Concreting of any unit or section of the work shall be carried out in one continuous operation, and no interruption will be allowed without the approval of the Engineer.

A competent steel fixer shall be in attendance the whole time concrete is being cast around reinforcement. Proper bridging arrangements for traffic over reinforcement shall be provided so that the reinforcement is not distorted, damaged or displaced.

Where approval is obtained for concrete to be conveyed by chutes, these shall have a slope (not exceeding 1 vertical to 2 horizontal) in order to ensure a continuous flow of concrete. Additional water shall not be introduced to assist the flow of concrete down the chute, deposition is to be intermittent and chutes shall be arranged to discharge into a storage hopper. Under no circumstances should a clear fall of more than 1.0 m be permitted at the discharge end of the chute.

The pumping of concrete shall be used only for such parts of the work as the Engineer considers suitable, and will be subject to the size, design, layout, and siting of the whole concreting plant including pumps, pipelines, water and air supply and all ancillary gear and apparatus and the conditions and methods of its operation and maintenance being to the entire satisfaction and approval of the Engineer.

Whenever transport of concrete is interrupted for any length of time (periods of over 30 minutes shall be treated as such), the chutes, pumps, pipes and any other means of distribution shall be thoroughly flushed out and cleaned. These shall also be flushed out immediately prior to resumption of concreting and shall be kept free from hardening concrete.

All wash water used shall be discharged outside the shuttering and clearing of any freshly placed concrete.

321 COMPACTION OF CONCRETE

All concrete shall be compacted mechanically, except when agreed by the Engineer that small areas may be otherwise compacted.

All vibrators shall be of a type approved by the Engineer. Mould vibrators shall not be used for in-situ concrete work and may only be used for the manufacture of small precast units, with the approval of the Engineer. Vibrators shall not be attached to the reinforcement and care shall be taken to avoid contact with it.

Concrete shall be placed to uniform levels in layers not exceeding 450 mm deep in such manner as to avoid segregation, and each layer shall be compacted by means of approved vibrators to form a dense material free from honeycombing and other blemishes. Compaction by hand may be used only with the prior approval of the Engineer.

Vibration time, the effectiveness, radius and other vibration characteristics shall be in accordance with the vibrator manufacturer's recommendations.

If internal vibrators are used, they shall be withdrawn immediately when a thin film of mortar begins to appear on the surface of the concrete. Withdrawal shall be carried out slowly to avoid cavitation.

If shuttering vibrators are used, the shuttering shall be strong enough to withstand the forces of vibration.

Unless otherwise specified, before placing new concrete against concrete which has already hardened, the face of the older concrete shall be prepared by the removal of any laitance and loose aggregate, and shall be cleaned by a jet of compressed air.

When displacers are used they shall be so placed that no displacer is within 300 mm of any finished face or within 450 mm of any other displacer. On completion of any lift displacers shall be so arranged that they project for half their height above the surface.

In order to avoid as much as possible the effect on the structure of shrinkage, no concreting of adjacent wall or slab panels will be allowed (except by special permission of the Engineer) unless a short intermediate section of not less than 0.45 m is left unconcreted. After the wall sections or slab panels have hardened for a period of not less than 5 days, the intermediates shall be concreted.

For reinforced concrete work in structures, the immersion type of vibrator shall be used. For carriageway and footpath construction, 150 mm thick or less, a vibrating screen may be used but for thickness in excess of 150 mm an immersion or plate-type of vibrator shall be used to compact the lower layers. Where a plate-vibrator is used, the thickness of each concrete lift shall be limited to 0.1 m.

In conjunction with each vibrator, one rammer consisting of either a pointed metal rod not less than 20 mm diameter and weight not less than 3 kg or a metal-shod tamper of size not exceeding 0.1 x 0.1 m and weight not less than 6 kg shall be used, together with a shovel or spade.

As the concrete flows under the action of the vibrator, it shall be shaped into position and thoroughly rammed, care being taken to fill the void left by the immersion vibrator. The concrete shall be compacted to produce a dense uniform mass and special care taken to

ensure that the concrete around the reinforcement and adjacent to the forms is free from voids.

Where agreed by the Engineer that a vibrator shall not be used, the concrete shall be compacted by rammers only, but otherwise as described above.

Concrete shall not be compacted by hand or machine to such an extent as in such a way that segregation takes place, and any concrete which, in the opinion of the Engineer, has been over-compacted, shall be removed, carted from the Site and replaced, all at the Contractor's expense.

322 HOT WEATHER CONCRETING

- (a) Concreting shall not be permitted if its temperature at placing is in excess of 38°C. In order to maintain the temperature of the concrete below this value the following precautions shall be taken wholly or in part as instructed by the Engineer.
 - (i) All aggregates stockpiles, water lines and tanks as well as the mixer shall be protected from the direct rays of the sun.
 - (ii) Coarse aggregate shall be cooled by constant watering where possible.
 - (iii) Mixing water shall be cooled by the addition of ice to the storage tanks where necessary.
 - (iv) Rapid hardening cement shall not be used.
 - (v) Where the above precautions are inadequate concreting shall be carried out during the cooler parts of the day or during the night as may be directed by the Engineer.
- (b) When the air temperature is above 20 degrees centigrade loss of mixing water by evaporation shall be considered in arriving at the amount of water to be added to the mix. In order to maintain the water/cement ratio within permissible limits an approved water-reducing agent shall be included in the mix.
- (c) The maximum water/cement ratios may be increased with the Engineer's permission by 0.05 (or 2.25 litres to 50 kilograms of cement) during mixing, but on no account shall water be added to concrete directly or indirectly once it has left the mixer.
- (d) In order to reduce premature drying of the concrete during transporting and placing, all chutes, shuttering and reinforcement shall be cooled by watering when possible, or shall otherwise be protected from the direct rays of the sun. Any water so used shall be removed by jetting with compressed air before placing the concrete in close contact.
- (e) As soon as possible after concreting, the shuttering shall be stripped and the surface of the concrete shall be kept moist for a period of 7 days by covering with wetted Hessian or sand, or shall otherwise be treated with an approved curing membrane.

Where drying winds are encountered, wind shields shall be positioned as directed by the Engineer to protect exposed surface of the curing concrete.

323 WET WEATHER CONCRETING

Concreting during periods of constant rain shall not be permitted unless aggregate stockpiles, mixers and transporting equipment and the areas to be concreted are adequately covered.

During showery weather, the Contractor shall ensure that work can be concluded at short notice by the provision of stop ends. On no account shall work be terminated before completion of each section, between one stop and another. Adequate covering shall be provided to protect newly placed concrete from the rain.

324 PROTECTION AND CURING OF CONCRETE

Immediately after placing, the surface of the finished concrete shall be protected from the harmful effects of sun, drying winds, rains, running or surface water and against any shocks. It shall be cured by keeping it covered with damp material for a minimum period of seven days after placing. The formwork shall also be kept damp and if struck earlier than 7 days, shall be replaced for the remaining period with some other approved damp material.

In the case of concrete made with high alumina cement, the whole of the concrete shall be kept thoroughly saturated with water for at least 24-hours after casting.

The Contractor shall protect and cure the concrete works as soon as practicable after completion by one or more of the following methods:

- (a) The concrete shall be covered with a layer of sacking, canvas, Hessian, straw mats, or similar absorbent material or a layer of sand and kept constantly wet for 7 days.
- (b) Except in the case of surfaces to which concrete has subsequently to be bonded, the concrete shall be cured by application of an approved liquid-curing membrane. On horizontal surfaces, the curing membrane shall be applied immediately after placing the concrete, and on vertical surface immediately after removing the formwork.

No traffic or constructional loads shall be permitted on newly placed concrete until it has hardened sufficiently to take such traffic or load without surface damage or deformation.

If directed by the Engineer, the finished concrete works shall be fenced in such a manner as to prevent the access of traffic, unauthorized persons or animals on the surface of the newly paved concrete, until such time when the concrete will have hardened not to show any imprints or defects caused by any interference.

325 LOADING

No loads shall be placed on beams, slabs or walls without the permission of the Engineer.

326 PLACING OF CONCRETE IN FOUNDATIONS

Before placing concrete in foundations, the bottom shall be thoroughly rammed and cleaned up to a neat horizontal plane, or such profile as is shown on the Drawings. No steps or batters will be permitted unless shown on the Drawings or approved by the Engineer.

Where shown on the Drawings or ordered by the Engineer that the sides of the concrete shall be cast against the existing ground without using shuttering, the faces of the earth shall be trimmed neat and true to line. Where such a hole is over-excavated due to the Contractor's method of working, the void shall be filled with concrete, at the Contractor's expense of the same Class as specified for the foundation.

Where pumping from the foundation is necessary, sumps and drains shall be provided outside of the area to be concreted. Where it is likely that there will be standing water in the foundation after excavation, the final 0.1 to 0.15 m of the soil shall not be excavated until immediately before the concreting. Where, in the opinion of the Engineer, the bottom of the excavation has become unsuitable for bearing due to the Contractor's method of working, the soft material shall be excavated to such a level as the Engineer may direct, and replaced with concrete Class 15 at the Contractor's expense.

No concrete shall be placed in the foundation until the excavation has been approved by the Engineer.

327 PLACING OF CONCRETE IN WATER

As far as possible, all concrete shall be deposited on a dry bottom and the placing of concrete under water will not be permitted except with the written approval of the Engineer. Concrete placed under water shall not be dropped, but shall be carefully placed in position by enclosing it in bags or by means of a bottom dumping-bucket or tremie, or by continuous

discharge through pipes leading from the mixer. Full details shall first be permitted to the Engineer, whose written approval shall be obtained before work is commenced.

The surface of the concrete deposited under water shall be kept as nearly as possible horizontal, and no concrete shall be placed in running water or water liable to disturbance or pumping. Placing shall be such as to require the minimum amount of spreading.

Tamping to such an extent or in such a way that segregation takes place shall be avoided. Sufficient time shall be allowed for the concrete to set before it is subjected to any form of loading, and also to ensure that it shall suffer no damage from subsequent pumping or dewatering operations.

328 JOINTS

(a) Construction Joints

Except where indicated on the Drawings, the position of Construction Joints shall be determined on Site. The Contractor shall submit to the Engineer for approval his proposals for the positioning of all Construction Joints. They shall be positioned with regard to the capacity of plant, weather conditions, conditions of operation, curing facilities and the structural requirements. For suspended floors, Construction Joints shall be formed generally at mid-span in both beams and slabs. Horizontal joints in walls shall be positioned with regard to the depth of penetration of the vibrator and the satisfactory compaction of the concrete. Unless otherwise indicated on the Drawings or otherwise permitted by the Engineer for the construction of circular tanks, concreting shall be carried out continuously for the full circumference without vertical joints. Where permission is thus granted, the Engineer may order at no extra cost the inclusion of an approved water bar.

Horizontal Construction Joints in walls shall be formed to present a clean straight line to the exposed face by using a fillet set horizontally and fixed to the shuttering.

For inclined members, joints shall be formed normal to the surface

Construction Joint surfaces shall be formed by the "wash-off" method. The concrete surfaces shall be left straight, free from all irregularities of level and clean of all loose aggregate. As soon as possible after placing the concrete the joint shall be sprayed with a fine spray of water to prevent the formation of laitance. Subsequently all excess water shall be removed by means of a jet of compressed air and the surface left clean. New concrete shall be placed in contact with the clean surface without the application of grout and shall be well vibrated to ensure complete union of the new with the old concrete.

The face of horizontal joints shall preferably be brushed while wet to expose the aggregate.

The face of the joint already set shall be thoroughly roughened by bush-hammering or chiselling, or wire-brushing if the surface has only partially set. All loose pieces of aggregate shall be removed, and the face scrubbed clean with a stiff wire-brush, and thoroughly wetted. In the case of horizontal joints, the face shall be rendered with 10 mm thick layer of cement/sand mortar proportioned to give at least the specified strength for that Class of concrete, and the new concrete laid immediately upon it and thoroughly punned in. Where joints will be permanently visible, the mortar shall be kept back at least 25 mm from the exposed face. In the case of vertical joints, the face shall be rendered with a coat of neat cement placed immediately before each fresh lift of new concrete.

Where due to accident or breakdown, it is impossible to continue concreting, the Engineer or his Representative shall be immediately notified, and his verbal instructions regarding either the making of a Construction Joint or the taking-out of the new concrete back to the last Construction Joint, shall be complied with

immediately. The cost of complying with these instructions and making good shall be entirely at the Contractor's expense.

Rubber, Polyvinyl-Chloride, or other approved waterstop not less than 125 mm wide, shall be used in Construction Joints as indicated in the Drawings or at additional or alternative positions to be agreed by the Engineer. Type and size of waterstop shall also be as indicated on the Drawings, and wall-to-wall foundation joints shall have an open centre bulb type waterbar. They shall be supported during Concreting or shall have eyelets to enable them to be tied and held in place during concrete placing so as to prevent dislodgement and to ensure that the ends remain at right angles to the Construction Joints.

Joints and intersections of waterstops shall be sealed by vulcanizing or other approved means. Open centre-bulb type waterstops shall be accurately positioned as detailed in the Drawings. The cost of forming Construction Joints where shown on the Drawings shall be paid for at the rates inserted in the Bills of Quantities, but Construction Joints required elsewhere shall be deemed to have been included for by the Contractor in his general concrete rate.

(b) Rubber Bitumen Joint Sealer

Joint sealers shall:

- (i) Retain elasticity at low temperatures;
- (ii) Maintain the ability to form a watertight seal;
- (iii) Not bleed or flow at sun temperatures;
- (iv) Not impart taste or odour to water

Other joint sealers having the above properties may be used with the approval of the Engineer.

Application of bituminous sealer shall be delayed where possible until all Construction of the structure has been completed. Recommended time for caulking of floor joints is during wire-winding operations on the tank wall (if any) but under no circumstances shall the joints subject to movement by stressing of adjacent sections be filled until such stressing operations have been completed.

The joints shall be filled exactly as detailed on Drawings and the handling and laying of bituminastic material, including priming, must be carried out exactly to the makers specifications. The practice of flooding the joint with primer is forbidden. Great care must be exercised when cleaning not to injure any sealing aid such as waterbars which have been cast into the joint. The hot rubber bitumen filler should be heated to the specified temperature in a purpose made heating unit and the temperature rigidly controlled with the aid of a suitable thermometer.

The practice of heating by use of a petrol drum over a wood-fire shall be avoided.

329 BENDING, PLACING AND FIXING OF STEEL REINFORCEMENT

The Contractor shall provide on Site, facilities for cutting and bending reinforcement whether he is ordering his reinforcement bent or not and shall ensure that a token amount of straight bar is available on Site for bending as and when directed by the Engineer.

Reinforcement shall be wire-brushed and cleaned at the Contractor's expense, before and/or after it is placed in position, if required by the Engineer.

The bars shall be cold bent in strict accordance with the bending schedules and the Contractor shall be responsible for the accuracy of bending. Bending dimensions shall be worked to the tolerance indicated in SSRN 129 except for binders and links which shall be bent to a tolerance of 1.5 mm. Bars in which any errors in bending are beyond the limits of the foregoing tolerances, shall be replaced at the Contractor's cost by correctly bent new bars, or, may be straightened and re-bent cold, subject to the Engineer's prior approval.

Steel reinforcement shall be bent accurately to the shape and dimensions shown on the Drawings. The Contractor shall satisfy himself as to the accuracy of any bar bending schedule supplied, and shall provide all steelwork in accordance with the detailed reinforcement Drawings.

Any discrepancy or inaccuracy found in the bending schedule shall be notified to the Engineer immediately.

After bending, reinforcement shall be securely bundled and labelled with weatherproof tags or shall be marked with other approved signs by which it can readily be identified.

Before assembling or placing the reinforcement the dimensions to which it has been bent shall be checked with the bending schedules by the Contractor.

The reinforcement shall be fixed in strict accordance with the Drawings as regards cover, spacing and position and suitable precautions shall be taken by the Contractor to prevent the displacement of reinforcement during the placing and compaction of concrete.

Where required to support and retain the reinforcement in its correct position, the Contractor shall provide templates, stools and other supports at his own cost.

Precast concrete support blocks for reinforcement shall be manufactured from Class 25 fine concrete to ensure the correct thickness. They shall be well cured before use and carefully stored on Site to avoid contamination. Plastic and metal supports, chairs, etc, may be used subject to the Engineer's prior approval.

A lap of not less than forty-four diameters of the large bar shall be provided at the junction of two bars for which the lap is not specifically detailed on the Drawings.

Fabric reinforcement shall be lapped at least 40 diameters or two squares whichever is the greater.

Additional splicers, other than those shown on the Drawings, may be permitted by the Engineer, but will not be paid for. All splices shall be staggered and the length shall be as directed by the Engineer.

All intersection of bars in walls and slabs and all connections between binders and links and main bars in columns or beams shall be tied with soft iron wire ties or with fixing clips which shall not be allowed to make contact with the shuttering or to project into the specified cover

Unless permitted by the Engineer, welding of bar reinforcement at intersections or for the joining of bars is prohibited. Where permission is granted, welding shall be carried out in accordance with the recommendations "Welding of Mild and Cold-worked Steel Bars for Reinforced Concrete Construction" as issued by the Institute of Welding, UK.

330 FORMS AND FORMWORK FOR CONCRETE: DEFINITIONS

"Forms, formwork or shuttering" shall include all temporary moulds for forming the concrete to the required shape, together with all temporary construction such as falsework, props and struts required for the support of such moulds, together with any special lining that may be required to produce a special concrete finish.

"Wrot" or "Wrought" formwork or shuttering shall mean formwork where the internal timber face in contact with the concrete is planed smooth, and the Contractor is to take particular care with the surface of the shuttering, and with the floating of unshuttered surfaces, it being the intention that a very smooth face will result when the shuttering is struck.

"Unwrot" formwork or shuttering shall mean formwork when the internal timber face in contact with the concrete is left "as sawn".

331 FORMS AND FORMWORK FOR CONCRETE: CONSTRUCTION

All forms shall be constructed so as to facilitate the accurate placing and proper compaction of the concrete. Timber forms shall be constructed of sound, well-seasoned timber

of such quality and strength as will ensure rigidity throughout the placing, ramming, vibration and setting of the concrete without visible deflection or warping. They shall be so constructed that they can be removed without shock, vibration or damage to the concrete. All joints shall be tongued and grooved, unless otherwise required, and shall be made sufficiently tight to prevent any leakage of grout. Internal ties shall be avoided as far as possible, and if used, shall be metal. They shall be capable of removal without injury to the concrete, but if permitted by the Engineer to be permanently embedded in the concrete, shall be cut back after the concrete is cast to at least 25 mm below the concrete.

Formwork for columns and small concrete sections, or where directed by the Engineer, shall be fitted with trap doors through which saw-dust, shaving and other debris can be removed.

Steel forms of other materials may be used with the approval of the Engineer. Travelling forms will only be permitted in special circumstances, and with the written approval of the Engineer.

Struts and props shall, where required by the Engineer, be fitted with double hardwood wedges or other approved devices, so that the moulds may be adjusted as required and eased gradually after casting the concrete. Wedges shall be spiked into position, and any adjusting device locked before the concrete is cast.

All formwork shall be approved by the Engineer before concrete is placed within it. The Contractor shall, if required by the Engineer, provide the latter with copies of his calculations of the strength and stability of the formwork of falsework, but notwithstanding the Engineer's approval of these calculations, nothing shall relieve the Contractor of his responsibility for the safety or adequacy of the formwork.

Top shuttering shall be counter-weighted or otherwise anchored against floatation.

332 FORMWORK FOR MOULD VIBRATED PRECAST CONCRETE

Where precast concrete is to be cast in vibrating moulds, special care shall be taken to maintain the rigidity of the mould and supports against the action of the vibrators. Form vibrators shall be rigidly attached to the forms to ensure the transmission of the vibrations to the concrete, all wedges and clamps shall be fitted with locking devices to ensure they are kept tight during the vibrating operation.

333 PREPARATION OF FORMS BEFORE CONCRETING

Before the concrete is deposited, the forms shall be thoroughly cleaned of sawdust, shaving and other debris and hosed down with water. The face of the forms shall be coated with lime-wash or painted with an approved mould oil. Where reinforcement has been accidentally coated, it shall be cleaned with a wire brush, and a suitable solvent.

334 FORMS FOR CONSTRUCTION JOINTS

Where permanent or temporary joints are to be made in horizontal or inclined members, stout stopping off boards shall be securely fixed across the mould to form a watertight joint. Temporary contraction joints shall have blocks of timber at least 75 mm thick, slightly tapered to facilitate withdrawal and securely fixed to the face of the stopping off board. The area of the key or keys so formed shall be at least 30% the area of the member. The block shall be kept back at least 50 mm from the exposed surface of the concrete.

Where reinforcement passes through the face of a Construction joint, the stopping off board shall be drilled so that the bars can pass through, or the board shall be made in sections with a half-round indentation in the joint faces for each bar, so that when placed, the board is a neat and accurate fit, and no grout leaks from the concrete through the bar holes or joints.

335 SPECIAL METHODS OF WORKING

Should working. the Contractor propose to use special methods of working not included in these Specifications, such as pumping concrete or using vacuum moulds, he shall obtain the Engineer's approval before commencing work, and comply with any subsequent specification made by the Engineer for this special method of

336 FORMWORK LEFT IN

Where the striking of formwork would in the opinion of the Engineer, cause damage to or prejudice the safety of the structure, the formwork shall be left in. If, in the opinion of the Engineer, the necessity for leaving in the formwork arises from the Contractor's method of working, then that loss shall be borne by the Contractor but if it is due to circumstances beyond his control, the timber left in will be paid for at rates set out in the Dayworks Schedule of the Bills of Quantities.

337 MEASUREMENT AND PAYMENT FOR FORMWORK

Formwork shall be measured as the area of the concrete actually in contact with the mould, except that in the case of small fillets and chamfers of size 30 x 30 mm and less, the overall area of the concrete shall be taken as though the fillets and chamfers had been omitted. Formwork for Construction Joints will not be paid for and will be deemed to be included in the Contractor's rates for concreting.

The rates for formwork shall include for all timber or metal moulds inclusive of all necessary supports and stagings, bolts, nuts, straps, clamps, wedges and other fittings, also all cutting and waste and the cost of all labour transport and materials in making, erecting and removing the formwork and for any other work required to construct the forms to the shapes and dimensions shown on the Drawings, or as directed by the Engineer.

The rates shall also include for all cut outs, rebates, slots, etc., trimming and sealing, cutting and shaping.

The formwork for in situ concrete will be paid for separately according to whether it is vertical, horizontal or inclined, and whether it is unwrot, wrot or special facing, as set out in the Bill of Quantities. Formwork for precast units will not be paid for separately and the cost of the moulds will be deemed to be included in the cost of the concrete or completed product.

Where external shuttering is employed in excavations and is measured the cost of any additional excavation necessary for the shuttering shall be included in the rates for the shuttering.

Where an item for shuttering is given, the areas indicated are only approximate and the Contractor should check the areas before pricing the Tender. No formwork will be paid for where foundations are shown on the Drawings or are required by the Engineer to be cast against the existing ground.

The Contractor shall be responsible for the co-ordination of all requirements of his Sub-Contractor(s) (if any) as regards provision of holes, chases, cavities and fixings and shall, if required by the Engineer, prepare Drawings giving details of his and his Sub-Contractors' requirements and shall send copies of such Drawings to the Engineer prior to Construction.

Holes, etc. shall be accurately marked and boxed-out for before concreting operations commence and without the Engineer's prior approval, no such holes, etc, shall be formed after the concrete has set.

Where bars, if placed to specified spacing would foul holes of size less than 230 x 230 mm, the full length of the bar shall be moved to one side, and in the case of holes exceeding 230 x 230 mm, the bars shall be cut on site and lapped with additional bars.

Wherever possible, the Contractor shall build in all pipework, ironwork, etc. which passes through walls and floors and the pipework, ironwork, etc. shall first be thoroughly cleaned

and freed from any deleterious matter, and every care shall be taken to ensure that it is thoroughly encased in concrete.

Bolts, hooks and other fixings shall be embedded in concrete, or holes shall be drilled and fitted with threaded expanding anchors to receive the bolts. The Contractor shall ensure that bolts, hooks, etc. are accurately positioned. Holding-down bolts for machinery shall be set to template.

Where brick or stonework is to form a facing to the concrete or where the end of a brick or stone wall butts against a concrete face, 16 gauge 25 mm x 230 mm galvanized metal ties of approved manufacture to SSRN 857 shall be incorporated. The distance between ties shall be gauged with due regard for the bonding of the Walls, at intervals required by the Engineer.

The rates for fixing pipes, manholes, covers, steelwork, ladders, etc and the associated bolts and lugs shall include for cutting the shuttering, building-in, grouting-up and making good adjacent concrete, blockwork or stone surfaces.

338 REMOVAL OF FORMS

Forms shall be removed in such a manner as will not injure the concrete, and no formwork shall be removed before the concrete has sufficiently set and hardened. The minimum periods which shall elapse between the placing and compacting of Ordinary Portland cement concrete for the various parts of the structure are given in the following schedule, but compliance with these requirements shall not relieve the Contractor of obligation to delay the removal of the forms if the concrete has not set sufficiently hard:

Beam sides, walls, unloaded columns	4 days
Soffit of secondary slabs (props left in)	7 days
Soffit of main slabs (props left in)	14 days
Removal of props - slabs	17 days
Bottom boards of piles (Intermediate support left in)	21 days
Soffit of beams under 6 m span	21 days
Soffit of beams over 6 m span	21 days, plus 1 day per 0.6 m in excess of 6 m with maximum of 28 days.

339 MAKING GOOD

Honeycombing or damaged surfaces of concrete which in the opinion of the Engineer are not such as to warrant cutting out and replacement of the Concrete shall be made good as soon as possible after removal of the shuttering as follows:-

- A Portland Cement and sand mixture shall be worked into the pores over the whole surface with a fine Carborundum float in such a manner that no more material is left on the concrete face than is necessary completely to fill the pores so that a uniformly smooth and dense surface of uniform colour is finally presented.

340 PROTECTION OF CONCRETE AFTER REMOVAL OF SHUTTERING

Any concrete surfaces, rises and treads of stairways which might be damaged during the construction of the works, shall be adequately protected.

341 REMOVAL AND REPLACEMENT OF UNSATISFACTORY CONCRETE

The Contractor shall on the Engineer's instruction so to do, cut and replace any concrete in any part of the structure if in the Engineer's opinion:-

- (a) the concrete does not conform to the Specifications; or
- (b) deleterious materials or materials are likely to produce harmful effects have been included in the concrete; or
- (c) the honeycombed or damaged surfaces are too extensive; or

- (d) the finished concrete sizes are not in accordance with the Drawings within permissible tolerances; or
- (e) the setting-out is incorrect; or
- (f) the steel cover has not been maintained; or
- (g) the protection, including curing of the concrete during the Construction was inadequate, resulting in damage; or
- (h) the work of making or other remedial measures the Engineer may indicate are not carried out to his satisfaction; or
- (i) undue deformation of or damage to the works has taken place due to inadequate shuttering, or to premature traffic and loading; or
- (j) any combination of the above points has taken place resulting in unsatisfactory work.

342 CONSTRUCTION JOINTS

The details of the Construction Joints and their positions shall be submitted by the Contractor for approval together with the order of concreting.

Joints shall be made at right angles to the member. Stop end shutters shall be removed as soon as practicable after the concrete has set, but without moving the main shuttering. Exposed horizontal or vertical concrete shall be thoroughly cleaned to expose the coarse aggregate, being hacked, well brushed and washed with high pressure air and water jetting or by other approved method. Before fresh concrete is placed against the joint, the surfaces shall be cleaned to remove any laitance, loose material or dirt. Horizontal surfaces shall be coated with 1 to 12/3 cement mortar 12 mm thick, moistened and of approved consistency, and the concrete shall be deposited and rammed hard against the existing concrete before the coating has set.

In Construction Joints of water-retaining structures, and elsewhere as may be ordered by the Engineer, 200 mm "Dumbbell" PVC water bars shall be provided. Unless otherwise ordered by the Engineer, Construction Joints shall be rebated to an approved form.

The cost of water stops required at Construction Joints is to be included in the rates for concrete and formwork if not specifically itemised in the Bills of Quantities.

343 WATER TIGHTNESS

The water tightness of all members subject to water pressure shall be ensured by the use of proper materials and good workmanship as specified above and all precautions shall be taken to ensure thorough and proper consolidation of the concrete forming such members. The Contractor shall carry out such tests for water tightness as the Engineer may order. The cost of such tests shall be borne by the Contractor, unless otherwise included for in the Bills of Quantities.

344 FAULTY WORK

The Contractor shall on being requested in writing by the Engineer, remove and reconstruct any structural members or portions of the work which gives evidence of any fault, or injury which may effect the strength, durability of water tightness of the Construction. No concrete or steel shall be cut in any way except on such request and with permission in writing.

345 RATES OF CONCRETE

The prices inserted in the Bills of Quantities shall include for all materials including water for weighting, gauging, mixing, conveying, placing, spreading, compacting, vibrating, finishing, and except where otherwise provided for in the Bills of Quantities, for joints with existing work or recently deposited concrete; for shuttering to Construction joints, skew-back, stunt ends, stepping, bonding chases and the like; for Constructing the work under the alternative bay system; for curing and surface finish as specified in Clause 324 for the cost

of strengthening and stiffening the shuttering to resist vibration and for handling the concrete at the specified water-cement ratio.

Unless items for shuttering are included in the Bills of Quantities the prices for all mass concrete shall include for any necessary shuttering, side forms and timber work.

Unless otherwise specified, separate items are included in the Bills of Quantities, for moulds and shuttering for reinforced and other graded cast-in-place concrete and for finishing concrete to a very smooth surface.

346 PRECAST CONCRETE

The foregoing requirements relating to ordinary and reinforced concrete generally shall be observed in the case of precast concrete so far as they are applicable as well as the following requirements relating to precast work in particular.

The precast concrete work shall comply with the requirements of SSRN 142

The Contractor shall submit for the approval of the Engineer samples of all aggregates for use in the precast concrete.

Where holes or recesses are required for bolts, covers, etc. they shall be cast in the units.

Where reinforcement is required, the requirements of the Specification regarding holding of the bars or fabric firmly in position shall be strictly adhered to.

347 RATES FOR PRECAST CONCRETE

The price for each description of precast concrete shall include for all shuttering, moulds, fillets, for forming the tops to proper shapes, for finishing all exposed surfaces to a very smooth face and for fixing and building in place complete.

348 CONCRETE WORK - TOLERANCES

(a) Cover to Reinforcement

The cover to the reinforcement bars in concrete shall be as shown upon the drawings, or as ordered by the Engineer, with the following variations permitted:

Least Dimension on Concrete Structure -	Permitted variation
Less than 0.25 m	+ 4% to - 2%
Greater than 0.25 m	+10% to - 5 mm.

(b) Shuttering

Shuttering shall be of such accuracy, strength and rigidity as to carry the weight and pressure from the concrete to be placed on or against it, together with all constructional, wind or other loads likely to be imparted to it, without producing deformation of the finished concrete in excess of the tolerances outlined below:-

Overall dimensions and levels	+/- 5 mm
Column sizes	+/- 5 mm
Beam sizes	+ 5 mm
Slab thickness	+ 5 mm
Wall thickness	+ 10 mm
Vertical lines out of plumb	+ 5 mm or + 12 mm in every 30 metres

Except that in the case of "sawn" shuttering the dimensions of the finished concrete shall be no less than those shown on the Drawings.

Beam soffit shall be erected with an upward chamfer of 6 mm per 3 metre span.

349 WATER BARS

Waterbars shall be of PVC and of approved manufacture and securely fixed in place before concreting is commenced. All joints and junctions shall be welded in an approved manner, the cost of welding and jointing being included in the rate per linear meter entered in the Bills of Quantities.

350 ADMIXTURES TO MORTAR OR CONCRETE

The use of any admixtures to mortar or concrete shall be subject to the written approval of the Engineer.

351 SAMPLING AND TESTING

The Contractor shall provide on the site equipment, staff and labour for carrying out the sampling and testing, and he shall carry out any or all of these tests at such times and with such frequency as may be requested by the Engineer.

All equipment shall be calibrated and checked from time to time as the Engineer may require.

The Contractor shall provide all samples required by the Engineer. Those samples to be tested in a laboratory shall be carefully forwarded by the Contractor to an approved laboratory. Results of laboratory and Site tests shall be kept on Site and copies of all test Reports shall be forwarded in duplicate to the Engineer's Representative.

The provision on site of all instruments and apparatus and the expenses and costs (including laboratory fees and carriages) of all checking, calibrating, provision or making and of handling and testing materials and concrete either by a laboratory or on Site as

described herein shall be allowed for by the Contractor in his rates and prices together with the cost of preparing all test records and supplying copies to the Engineer.

352 TESTING OF CONCRETE DURING PRODUCTION

(a) Consistency

The consistency of concrete shall be frequently checked by means of a slump test performed by the Engineer or his Representative. The maximum and minimum slump for each Class of concrete used shall be as directed by the Engineer, and any concrete represented by the slump test which fails to comply with these specifications, shall be removed from the Site and disposed off at the Contractor's expense.

(b) Slump Test

Slump tests shall be performed in accordance with SSRN 116, during the progress of the work to ensure consistency of the concrete and carried out at such frequency and on such concrete as the Engineer shall direct.

The Contractor shall keep a record of slump tests showing:-

- (i) Date and time of test;
- (ii) Class of concrete and position of batch in the Works;
- (iii) Amount of slump;
- (iv) Remedial measures taken to correct mix.

A copy of this record shall be given to the Engineer at the end of each day's work.

(c) Method of Making Test Cubes

Test cubes shall be made by or under the supervision of the Engineer or his Representative from concrete placed in or about to be placed in the works.

Test cubes shall be made, stored and cured and tested in accordance with SSRN 117 'Method of Testing Concrete', except that no 100 mm cubes will be permitted. The method of compaction (by hand or vibrator) will be at the Engineer's discretion.

Test cubes shall be marked with the date of casting and a reference number, and the Contractor shall keep a record and provide the Engineer with a duplicate copy showing the date cast, reference number of cube, Class of concrete and position in the works of the concrete tested.

After approval of the trial mix by the Engineer, production of concrete for the works may commence.

The proportions of materials used in the works shall follow the proportions found to be acceptable in the trial mixes. The concrete shall be prepared under the control of a competent person, and close control kept over quantities and water content, care being taken to make due allowances for variations in the moisture content of the materials. Regular testing of the moisture content of the aggregates shall be carried out. All measurements of materials (except water) must be done by weight.

Immediately on starting production on Site, samples of concrete shall be taken as follows:-

On each of the first 4 days of concreting, for each Class of Concrete shall be made 6 No. test cubes from 2 No. separate samples. Three test cubes from each sample to be tested at 7 days, the other 3 at 28 days.

One test result shall be the average crushing strength from the three cubes in the sample tested either at 7 days or at 28 days.

For the concrete to be acceptable the following conditions must be satisfied:

- (i) No more than one individual result in the same test shall fall below the specified works Cube Strength.
- (ii) No individual result to fall below $0.9 \times$ the specified works Cube Strength.
- (iii) No test result (average of three cubes in one sample) to fall below the specified works Cube Strength.

When at least 4 consecutive working days concrete production has been proved satisfactory, the frequency of testing may be reduced at the Engineer's discretion.

(d) Transport of Test Cubes

Test cubes shall if required by the Engineer, be transported by the Contractor to a testing laboratory nominated by the Engineer so as to arrive not later than 6 days after casting but shall not be despatched earlier than 72-hours after casting.

353 FREQUENCY OF TESTS

Frequency of tests and the number of samples required will be governed by the results of previous test, the quality of the materials revealed during the tests and the uniformity of that quality.

In case of crushing tests to be made on concrete when Construction commences, the Engineer may require up to 12 test cubes to be cast each day for each Class of concrete (6 cubes to be tested at 7 days and 6 cubes at 28 days) until he is satisfied that the materials and the method of mixing used are such as to produce a concrete which complies with the requirements of SSRN 117 in the case of "Mix Design" and in the case of "Nominal" and "Standard" Mixes. The number of test cubes to be made for routine testing shall be 3 for each and every 38 m³ or part thereof per working day or as otherwise required by the Engineer. These cubes shall normally be tested 7 and 28 days after casting.

Should it become evident that quality of the concrete is deteriorating, the Engineer may require additional samples to be made and tested to determine the cause.

354 LOADING TESTS

The Engineer may direct that a loading test be made on the works or any part thereof if he deems such test to be necessary for one or more of the following reasons:-

- (a) Failure of "Site Cubes" to attain the specified minimum strength requirements.
- (b) Premature removal of shuttering
- (c) Overloading of structure during construction
- (d) Any other circumstances attributable to alleged negligence on the part of the Contractor, which in the opinion of the Engineer, may result in a structure being of less than the required strength.

If the loading test be ordered to be made solely or in part for reasons (a) to (c), the test shall be made at the Contractor's own cost.

If the loading test be ordered to be made for reason (d) the Contractor shall be reimbursed for the cost of the test if the result is satisfactory.

Loading tests shall be carried out in accordance with SSRN 117 as required.

If the results of the test are not satisfactory, the Engineer will direct that the part of the work concerned be taken down or removed and reconstructed to comply with the Specification, or that such other remedial measures as he may think fit be taken to make the work acceptable and the Contractor shall carry out such work at his own cost.

The Engineer may also instruct the Contractor before a loading test takes place to take out cylindrical core specimens from the structures concerned and have them tested. The cutting equipment and the method of doing the work shall be to the Engineer's approval. The specimen shall be dealt with in accordance with SSRN 117. Prior to testing, the specimens shall be made available for examination by the Engineer. If the cores are ordered to be taken solely or in part for reasons (a) and (b) above, the work involved and the testing shall be made at the Contractor's own cost. If the costs are to be taken for reasons (c) and (d) above, the Contractor will be reimbursed the cost if the loading test described in the previous paragraphs proves satisfactory.

355 REFERENCE AND RECORD BOOKS TO BE KEPT ON SITE

A triplicate book shall be provided by the Contractor wherein all instructions on concrete work given by the Engineer shall be entered. This book shall be kept on the Site and one copy of all entries shall be forwarded to the Engineer.

A continuous entry diary shall be kept permanently on Site by the Contractor wherein he shall record details of shuttering, construction, placing or reinforcement, concreting and curing operations, striking or shuttering, making good, daily temperature and weather conditions. The diary shall always be available for the Engineer's inspection.

The Contractor shall provide and keep permanently on Site all the Standard Specifications referred to herein.

356 TESTING EQUIPMENT

The Contractor shall provide the following equipment for carrying out control tests on the Site:-

- (a) Straight edges (3.00 metres and 1.25 metres long) for testing the accuracy of the finished concrete.
- (b) A glass graduated cylinder for use in the silt test for organic impurities in the sand.
- (c) Slump test apparatus
- (d) A sufficient number of 152.4 mm steel cube moulds with base plates and tamping rods to SSRN 117.

357 REPAIR OF CONCRETE STRUCTURES**(a) General**

All materials for use in concrete repairs shall be obtained from an approved manufacturer. The application tools and equipment, methods, climatic conditions (such as temperature and humidity) and surface preparation shall be strictly in accordance with the manufacturer's specifications and instructions and these shall be subject to approval by the Engineer. The supply source shall not be altered without the Engineer's approval.

Generally before any repair is done, the surfaces shall be thoroughly cleaned and freed from any oil, grease, cement laitance or loosely adhering particles. Upon application of final layer, the surface shall be suitably finished to give the appearance of a smooth surface.

For surfaces in contact with potable water, the chemicals shall have been certified as suitable for use in potable water retaining structures by competent and internationally recognised authorities. Products acceptable include waterproofing chemicals consisting of rapid hardening Portland cement, oven-dried quartz sand and active inorganic chemicals of a type that upon application to a concrete surface a crystal chain reaction starts as the active chemical ingredients react with the free lime and water in the concrete capillaries resulting in the formation of insoluble crystals which drive out the surplus capillary water ensuring a permanently water tight concrete but which however at the same time allow the concrete to breath.

For application on all water retaining surfaces, the objective shall be to achieve complete water tightness, by forming an effective barrier against water infiltration and bond concrete sections together, thereby restoring original structural strength. Notwithstanding the manufacturer's instructions, the contractor shall be fully responsible for the water-tightness of water retaining structures and any remedial measures necessary.

(b) Sealing of cracks and surfaces with epoxy mortar

For repair of cracks, each shall first be widened by cutting a 'V' groove 20mm x 20mm, along its entire length. The crack surface shall be cleaned thoroughly and wire-brushed to remove any loose chippings, grease or dirt. The groove shall then be filled with an approved epoxy resin mortar (a solvent free 3-component repair and filling mortar based on a combination of epoxy resins and selected high strength aggregates e.g. Sikadur 43) in accordance with the manufacturer's instructions.

For application on other surfaces as indicated in the Bill of Quantities, the surfaces shall be prepared in accordance with the manufacturer's instructions, before application of the epoxy mortar. In floors this will also involve hacking away all spalled concrete and cleaning off loosely adhering particles and cement laitance. In the internal surfaces of tanks the surface preparation shall involve water-jetting or as specified by the manufacturer.

(c) Sealing of Cracks in Horizontal Construction Joints with Polyurethane Sealant

The joint shall be cleaned thoroughly along its length to remove any loose substrate, grease and dirt. It shall be repaired by sealing with 1-component polyurethane sealant (e.g. Sikaflex PRO 2HP or 1A) that cures on exposure to moisture to form a tough and permanent elastic seal followed by a high performance joint sealing system for irregular and high movement joint (e.g. Sikadur Combiflex).

(d) Sealing of Cracks on Walls with injection liquid

The joints shall be cleaned thoroughly to remove any loose substrate, grease and dirt. They shall then be repaired by injecting a 2-component solvent free, low viscosity injection liquid, based on high strength epoxy resins (e.g. Sikadur 52). After mixing,

the liquid shall be injected into cavities and cracks in concrete where it cures to a rigid high strength material.

(e) Water Proofing Slurry Walls

The wall surfaces shall be cleaned by water jetting to the satisfaction of the Engineer. A water proofing slurry, such as synthetic rubber based, water resistance bonding agent for mortar (e.g. Sikar Latex), shall then be applied in accordance to the manufacturer's instructions.

(f) Wall Roof Joints

Where indicated for repair, the joint at the interface between the wall and the roof should be cleared off by removing existing sealant and any loose mortar. The joint shall then be sealed with an approved bitumastic sealant (e.g. Igas Black) according to the manufacturer's instructions.

(g) Replacement of Ground Floor Screed

The floor surface shall be chiselled, to remove all the damaged floor screed, cement laitance or loosely adhering particles and the surface thoroughly wetted. A new 1:3 cement sand screed floor shall then be placed and finished off appropriately to match existing or adjacent surfaces.

(h) Repair of Floor Slabs Joints with bitumastic sealant

Where indicated in the Bill Of Quantities, the joint shall be cleaned off by removing existing joint sealant and any loosely adhering particles. The joint shall then be sealed with an approved bitumastic sealant (e.g. Igas Black) in accordance with the manufacturer's instructions.

(i) Repair of Cracks in Walls or floors Using Cement Mortar

The cracks should be enlarged into wedge shaped grooves at least 20 mm wide at the top. They should be cleaned thoroughly, wetted and filled with 1:3 cement sand mortar. Such repaired surface shall be adequately cured for at least 3 continuous days or as directed by the Engineer.

(j) Protection of Concrete Columns at Intake

Where indicated in the Bill of Quantities, columns above water level should be plastered with an approved epoxy mortar (a solvent free 3-component repair and filling mortar based on a combination of epoxy resins and selected high strength aggregates e.g. Sikadur 43). The surfaces shall be prepared in accordance with the manufacturer's instructions. For column surfaces below the water level, gabion boxes shall be installed around them to prevent further wearing off of the concrete as directed by the Engineer.

(k) Repair of Stone Pitching

Where it has worn off, stone pitching shall be replaced by jointing using 1:3 cement sand mortar after replacing and compacting any lost fill material beneath as directed by the Engineer. In locations where the jointing has become loose, repair shall be carried out using pressure grouting. The grout shall be 1:3 cement sand mortar made to a sufficient consistency to allow pressing into the cavities with a steel trowel.

(l) Pressure Grouting into Blockwork Bases and Retaining Walls

Pressure grouting where indicated in the Bill of Quantities shall be done using approved equipment and the mortar shall be 1:3 (cement sand mortar) mortar made to a sufficient consistency to allow injection into the cavities.

(m) Replacement of Concrete Paving Slabs

Damaged concrete paving slabs shall be removed and any lost fill replaced and compacted to the Engineer's satisfaction. They shall then be re-laid and jointed using

1:3 cement sand mortar made to a sufficient consistency to allow pressing into the cavities with a steel trowel.

(n) Reflective Gravel on Tank Roof Slabs

The existing gravel that has become discoloured over the years should be replaced with a fresh supply of reflective gravel uniform size 20 mm to a uniform thickness of 100 mm to the approval of the Engineer.

(o) Repair of Scoured Holes in Access Road

The scoured holes shall be filled with suitable stone base and compacted to Engineer's approval and surface reinstated by appropriate double surface dressing. To avoid ponding, openings should be created in existing kerb and stone pitching as directed by the Engineer. Where necessary, the road shall be reshaped to enable water to flow away.

358 FINISHES ON UNFORMED SURFACES

Horizontal or nearly horizontal surfaces which are not cast against formwork shall be finished to the class shown on the drawings and defined hereunder.

UF 1 Finish

All surfaces on which no higher class of finish is called for on the drawings or instructed by the Engineer shall be given a UF 1 finish.

The concrete shall be levelled and screeded to produce a uniform plain or ridged surface, surplus concrete being struck off by a straight edge immediately after compaction.

UF 2 Finish

This is a floated finish for roof or floor slabs and other surfaces where a hard trowelled surface is not required.

The surface shall first be treated as a Class UF 1 finish and after the concrete has hardened sufficiently, it shall be floated by hand or machine sufficiently only to produce a uniform surface free from screed marks.

UF 3 Finish

This is a hard trowelled surface for use where weather resistance or appearance is important, or which is subject to high velocity water flow.

The surface shall be floated as for a UF 2 finish but to the tolerance stated below. When the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, it shall be steel trowelled under firm pressure to produce a dense, smooth uniform surface free from trowel marks.

TABLE 3.5: SURFACE TOLERANCES

Class of Finish	Tolerance in mm. See notes		
	A	B	C
UF 1	N/A	10	+ 20 or - 10
UF 2	Nil	10	+ 20 or - 10
UF 3	Nil	5	+ 12.5 or -7.5

Notes:

1. Col. A is the maximum allowable value of any sudden change of level in the surface.
2. Col. B is the maximum allowable value of any gradual irregularity of the surface, as indicated by the gap between the surface and a three metre long straight edge or correctly shaped template placed on the surface.

3. Col. C is the maximum allowable value of the difference in level or position between a three metre long straight edge or correctly shaped template placed on the surface and the specified level or position of that surface.

Where dimensional tolerances are given on the drawings or in this Special Specification they shall take precedence over those given in Table 3.5.

CHAPTER 4

BUILDINGS AND ASSOCIATED WORKS

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CHAPTER 4 - BUILDINGS AND APPURTENANCES

4001 GENERAL

- (a) Throughout the Drawings, Standard Specification and their Special Specification, all references to Standard Specifications shall be deemed to be to the latest Edition of the Standard to which the Clause refers at the time of Tendering.

No allowance shall be made for the Contractor's lack of knowledge in this particular respect.

- (b) This Special Specification is to be read in conjunction with other parts covering the Works.
- (c) Details on Drawings and in the Bills of Quantities and instructions given on site by the Engineer will take precedence over the Specifications given herein.

4002 EXCAVATION AND EARTHWORKS

- (a) The Contractor is advised to visit the Site and ascertain the nature of the soil to be excavated, as no claim will be allowed on account of the soil being of a different nature from that for which he allowed in his Tender.
- (b) All grass, vegetable matter, etc. must be removed or burned on Site at the commencement of the Contract over the area of the buildings plus an area (3.0 m) distance all round or as directed by the Engineer. The line of all paths, roads, etc. shall also be cleared in the same manner. On no account will earth containing vegetable matter be used for backfilling.
- (c) The foundation trenches for all walls, etc. shall be excavated to the width and diameter shown on the Drawings and to the depths below existing ground level as directed by the Engineer in order to obtain satisfactory foundations or sanitary conditions.

If, however, the Contractor excavates to any widths, diameter or depths greater than those shown on the Drawings or as instructed by the Engineer, he shall at his own expense fill in such depth, diameter or width with concrete (1:3:6) to the satisfaction of the Engineer.

All excavations are to be measured net as before digging. The Contractor shall be deemed to have allowed in his prices in the Schedule of Rates, for increase in the bulk after digging.

- (d) Where buildings are to be erected upon a sloping ground, the ground shall be excavated to a minimum of 250 mm below finished floor level on the topmost sides of the slope for a horizontal distance of 3.0 m from the external wall of the building or buildings and the ground left sloping slightly away from the building. All banks formed by this excavation shall be cut to slope at an angle of 45 degrees or to the angle of natural repose of the excavated material and a natural earth drain formed to carry off surplus water around the foot of the slope so formed.

On the lower sides of the slope the ground shall be made up where necessary to form a similar slight slope 3.0 m wide from the external walls.

In all cases the finished floor level shall be at a minimum height of 250 mm above ground level unless otherwise specified or indicated on the Drawings.

4003 PRECAST CONCRETE

The mixes for Precast Concrete units shall be as follows:-

Lintels	1:2:4 (19 mm nominal aggregate)
Units less than 40 mm thick	1:2:2 (6.4 mm nominal aggregate)
All other units	1:2:4 (12.5 mm nominal aggregate)

The concrete shall be cast in suitable moulds true to shape and size, thoroughly tamped into the moulds (and round / twisted reinforcement where applicable) and shall be vibrated where specified herein. Moulds shall not be removed until 7 days after pouring and shall be protected by covering them with wet hemp sacks or other suitable material kept wet throughout that time. The cast work shall be seasoned for a further 7 days under cover and a further 7 days in the open before fixing. Unless otherwise described, faces are to be left rough for sawn moulds.

Where precast concrete is described as "finished fine" the moulds are to be made of metal or are to have linings which will produce a smooth dense fine face to the finished concrete free from all shutter marks, protuberances and pittings, so as to make them suitable to receive a direct painted finish.

Unless otherwise described prices of all precast concrete shall include for all moulds, finishing fine where so described, including rubbing down if required, hoisting and fixing, at the required levels, bedding and jointing in cement and sand (1:5) mortar and pointing beds and joints in exposed faces flush in cement; also for casting or cutting to the exact lengths required and any waste resulting from much cutting. The sizes of weathered or moulded items stated are extreme sizes.

4004 CONCRETE APRON

Concrete aprons where directed, shall comprise a 50 mm thick concrete (1:3:6), 1.0 metre wide round the perimeter of the building, laid on a 100 mm bed of hard-core.

4005 VENTILATORS

Unless otherwise stated, precast concrete ventilators shall be 300 mm or 225mm wide x 40 mm thick and of approved pattern. The ventilators shall be fixed double, one fixed flush with outer face of wall complete with approved copper mosquito gauze cut to size and fixed by tucking over top and bottom edges of ventilator before building in, the other ventilator shall be fixed flush with inner face of wall and rendered around sides, using cement and sand (1:4) top and bottom of ventilator opening.

4006 ENTRANCE STEPS

Entrance steps as required to suit ground and floor levels shall be formed in concrete (1:3:6), with suitable underneath foundations as directed by the Engineer. Treads shall be not less than 300 mm wide and risers not more than 175 mm high. All exposed surfaces shall be finished in cement and sand (1:4) trowelled smooth with a wood float 18 mm thick on treads and 12 mm thick on risers or finished with Carborundum dust.

4007 CONCRETE SHELVES

All suspended precast or in situ concrete shelves, pot slabs, etc, shall be reinforced with weld mesh to SSRN 128 as directed by the Engineer and/or shown on the Drawings and in the Bills of Quantities.

4008 PAVING

Precast concrete paving slabs shall conform to relevant BS Standards where required, these shall be size 609.6 mm x 609.6 mm x 50.8 mm thick of vibrated 1:2:4 concrete finished on top with a wood float, clean cut edges and free from all cracks, chips or broken corners. The slabs shall be laid on a 75 mm consolidated bed of sand or stone dust, in

cement mortar 1:4. The jointing mortar shall be worked well down into the joints, the pointing to the key-drawn and all excess mortar cleaned off.

4009 ATTENDANCE UPON SUB-CONTRACTORS

Particular care shall be exercised by the Contractor to ensure that all pipes, ducts, drains, conduits, junction boxes, anti-static installation, etc. are laid before the concrete for the floor and roof slabs is poured. The Contractor will be held responsible for the cost of any additional cutting, etc. and making good which becomes necessary through his failure to make proper arrangements for all Sub-Contractors work to be undertaken in close co-operation with his own, or under his strict attendance.

4010 WALLING

All block walls throughout the work shall be carried up evenly with no part allowed to be carried up more than 1.0 m higher at one time than any other part, and in such cases, the jointing shall be made in long steps so as to prevent cracks arising, and all walls shall be levelled round at each stage. All faces of walls to be plastered shall have all projections dressed off and joints raked out as key for plaster.

The blocks shall be bedded and jointed in cement mortar 1:5 with beds and joints not more than 20 mm or less than 12 mm thick, all flushed up and grouted solid as the work proceeds. All walling shall be properly protected as the mortar is setting.

Ends of lintels, sills, joints, roof trusses etc., are to be pinned up to the underside of concrete beams and slabs with cement mortar.

Timber frames are to be built in with holdfasts and bedded solid and pointed both sides in cement mortar. Lugs of window, door and louver frames are to be built in or cut and pinned to blockwork. Frames are to be bedded solid in mortar and pointed in approved mastic applied externally.

4011 SILLS

Sills to windows shall comply with SSRN 801. They shall measure 105 mm deep, showing 70 mm at the front edge, by 175 mm wide and be of appropriate length as indicated on the Drawings. All sills shall be cast with a recessed throating under the front edge and shall bear 150 mm on supports.

4012 LINTELS

Lintels to windows, louver and door openings where these are separate from the reinforced concrete ring beam shall be of precast concrete complying in all respects with SSRN 861. They shall bear 300 mm on supports and shall be cast with a recessed throating under the front edge. Design calculations for lintels shall be submitted to the Engineer for approval before casting is commenced.

4013 SAND

All sand for making mortar shall be cleaned well, graded siliceous sand of good, sharp, hard quality equal to samples which shall be deposited with the Engineer for prior approval before use for the Works.

The sand shall be free from lumps of stone, earth, loam, dust, salt, organic matter and any other deleterious substance, and shall be sieved through a fine sieve and washed as necessary or when directed by the Engineer.

4014 LIME

Lime for mortar shall be non-hydraulic or semi-hydraulic quicklime or hydrated lime in accordance with SSRN 801.

Quick lime shall be run to putty in a pit dug on the Site or in an approved container immediately after delivery to Site. The water to be first run into the pit or container and the

lime shall be added until it is completely submerged and stirred until all lumps are disintegrated. The resulting milk-lime shall then be run through a 3 mm square-mesh sieve and run into a pit or other container and kept clean and moist for not less than 4 weeks before use.

Hydrated lime shall be added to water in a clean receptacle thoroughly mixed to the consistency of thick cream. The lime shall then be allowed to stand and kept clean and moist for not less than 16 hours before use.

4015 CEMENT MORTAR

Cement mortar shall be to ratio 1:5. This will be achieved by addition of 50.0 kg of Portland Cement to 0.15 cu. metre of sand. The mortar shall be measured in specially prepared gauge boxes and thoroughly mixed in an approved mechanical mixer or mixed dry on clean and approved mixing platforms, with water added afterwards until all parts are completely incorporated and brought to a proper consistency. The use of re-tempering of wholly or partially set mortar will not be allowed.

4016 GAUGED CEMENT LIME MORTAR

Gauged cement lime mortar shall be composed of 40.0 kg cement to 0.085 cu. metres of lime to 0.34 cu. metres of sand measured in specially prepared gauge boxes and thoroughly mixed dry on clean and approved mixing platforms, with water added afterwards until all parts are completely incorporated and brought to a proper consistency. No partially or wholly set mortar will be allowed to be used or re-mixed.

4017 GAUGED LIME MORTAR

Gauged lime mortar shall be composed of 2 parts by volume of lime putty to 9 parts by volume of sand measured in specially prepared gauge boxes and mixed dry on clean and approved mixing platforms with water added afterwards until all parts are completely incorporated and brought to a proper consistency.

The mortar shall be mixed 7 to 10 days before it is required for use and shall be stacked in a neat heap well smoothed off covered with wet sacks and allowed to mature.

Immediately before use 1 part by volume of Portland Cement, shall be added to 9 parts by volume of lime mortar, the whole being re-mixed with the addition of extra water until all parts are completely incorporated and brought to a proper consistency.

The gauged mortar must be used within 45 minutes of being mixed and the use of re-tempering of wholly or partially set mortar will not be allowed.

4018 PROTECTION

All walling shall be properly protected while mortar is setting, as the Engineer shall direct.

4019 SETTING OUT RODS

The Contractor shall provide setting out rods and set out all Works on same courses, openings, heights, etc. and shall build the walls, piers, etc. to widths, depths and heights indicated on the Drawings. Setting out rods shall be gauged to allow an average height of 225 mm for each course.

4020 BONDING

The blocks or stone for general walling shall be bedded and jointed as described. Stones or blocks shall be properly bonded together and in such manner that no vertical joint in any one course shall be within 125 mm approximately of a similar joint in the courses immediately above or below. All walling of 300 mm thickness or less shall be built in single thickness of blocks or stone.

Walling exceeding 300 mm in thickness shall be built in two thicknesses of blocks or stone with through blocks or stone not more than 1.0 m (approximately) apart in each course or as directed by the Engineer.

Alternate courses of walling at all angles and inter-sections shall be carried through the full thickness of the adjoining wall.

All walling shall be built entirely solid in blocks, without voids.

All perpend, reveals and angles of the walling shall be built strictly true and square.

Stone blocks shall be wetted before being laid and the walling shall be kept wet while the mortar is setting and the top of the walling where left off shall be well wetted before recommencing building as the Engineer shall direct.

All walling shall be flushed up and grounded solid as the work proceeds.

4021 PARGING AND CORING OF FLUES

All flues shall be parged and cored in lime and sand mortar (1:4).

4022 DAMP PROOF COURSE

The bituminous felt sheeting for damp proof courses shall be three-ply approved membrane in accordance with SSRN 803 weighing not less than 3.175 kg per 8361 sq.m. The sheeting is to be lapped 152.4 mm at running joints and the full width of walls and angles. It shall protrude beyond the outer face of the wall for a minimum of 25 mm, the last 10 mm of which shall be turned down at an approved profile to form an anti-ant lip, and laid on a cement screed trowelled smooth. At all angles, intersections etc., the sheeting must be lapped not less than 75 mm. The net area covered is measured and the Contractor shall allow in his prices for all cutting and waste and extra material in laps at joints, angles, etc.

4023 REINFORCED WALLING

Walls of less than 225 mm thickness shall be reinforced with one row of 20 gauge hoop iron built into every third course, well lapped at junctions and joints and carried at least 115.0 mm into abutting walls at intersections.

4024 FIXING OF TIMBER DOOR FRAMES

All door frames are to be bedded, and pointed in mortar (as described for walling)

All frames shall be securely fixed to reveals by means of 22.5 mm mild steel cramps 300 mm long, bent and screwed to backs of frames and with flanged and built 225 mm into joints of walling, three cramps to each side frame of each door. Where the door is provided with fanlights, etc. four cramps are to be used to each side frame.

4025 HOLES FOR TIMBERS IN WALLING

Holes for timber-built into or passing through a wall, shall be square out to suit the timber size and angle and lined with 3 ply roofing felt cut flush to finished wall surfaces.

4026 CONCRETE BLOCKS

Concrete blocks shall be solid, hard, true to size and shape with sharp arises in accordance with SSRN 804 and approved by the Engineer.

They shall be obtained from an approved manufacturer or manufactured on Site in an approved block-making machine. The mix used shall be not less than (1:9) by volume and the maximum size of aggregate shall not exceed 12 mm.

All solid and hollow concrete blocks used in the walling must be capable of withstanding a crushing pressure of not less than 0.280 kg/mm² after 28 days.

The blocks on removal from the machine shall be carefully deposited on edge on racks under sheds erected by the Contractor and left for 3 days during which period they shall be kept constantly wet after which they shall be placed on edge in the open on racks and protected by sacking or other approved covering and kept wet for a further 5 days. Thereafter, the blocks shall be left in the same position without wetting for a further 20 days.

No blocks will be allowed to be used in the work until they are 28 days old and until samples have been taken and approved by the Engineer.

They shall be laid dry except for the top surface which shall be wetted immediately before mortar is spread on. After laying, no further water shall be applied.

4027 INTERNAL FACINGS

Except where plaster finish is required internally, the internal faces of walls shall be finished fair with beds and joints neatly flush pointed as the work proceeds.

4028 WALLS LEFT FOR PLASTER

All walls to be plastered shall have the joints raked out 12 mm deep as key for plaster.

4029 JOINTS

The concrete blocks shall be bedded and jointed in gauged lime mortar as described with beds and joints not more than 12 mm or less than 6 mm thick, all flushed up and grouted solid as the work proceeds, or pointed as required.

4030 STONE WALLING

The stone for wall shall be sound and hard throughout, free from all defects, and shall be obtained from a quarry approved by the Engineer. It shall be chisel dressed into true rectangular blocks, with each surface even and at right- angles to all adjoining surfaces.

4031 STONE SIZES

Stone blocks for general walling shall nominally be 225mm high and 100 mm, 150 mm, 225mm or 300 mm thick as required for the works, the maximum permissible variation of any of the foregoing dimensions being 2.0 mm.

4032 JOINTS

The stone blocks shall be bedded and jointed in cement mortar as described with beds and joints not more than 12 mm or less than 6 mm thick, all flushed up and grouted solid as the work proceeds, or pointed as required.

4033 FIBRE CEMENT ROOF SHEETING

Fibre Cement roof sheeting and accessories shall be of approved manufacture in general accordance with SSRN 807, except that asbestos fibre shall not be used. The type of sheeting shall be as shown in the Drawings and of an approved colour and shall be laid and fixed strictly in accordance with the manufacturer's printed instructions. The fibre type shall be approved by the Engineer prior to the supply of such fibre cement roof sheeting.

4034 LAPS

Sheeting shall be laid with end laps of 150 mm and side laps of one corrugation of the side away from the prevailing wind.

4035 FIXING TO PURLINS

The sheets shall be fixed to timber purlins with 8 mm Galvanized gimlet pointed screws 115 mm long and to steel angle purlins with 8 mm diameter Galvanized hook bolts and nuts 50 mm longer in the shank than the depth of the steel purlin to which they are fixed and all screw and bolt fixings shall have "selawasher" plastic washers or other equal and approved.

4036 HOLES

Holes shall be drilled through the ridges of corrugations not in the hollows.

4037 INTERSECTIONS

Where four sheets meet, two sheets shall be cut and measured for the full length of the end lap and the full width of the side lap at the appropriate corners to ensure three thicknesses of sheeting at this point.

4038 RIDGES

Ridges and other accessories shall be supplied as shown in the Drawings and shall be fixed to timber and steel purlins as above described.

4039 FIXING BOLTS

All fixing bolts and screws shall comply with SSRN 808.

4040 QUALITY TIMBER

Softwood shall generally be Podocarpus or Cedar complying with BS 1186: Part 1 or other equal approved timber.

All softwood for carpentry shall be treated by the "Celcure" process or other equal approved process carried out by an approved firm. Joints in timber for carpentry shall only be in the positions shown on the Drawings or approved by the Engineer.

Softwood for joinery shall be kiln dried to moisture content between 10% and 12%. Hardwoods may, if approved by the Engineer, be used for joinery in place of softwoods but any additional costs arising shall be borne by the Contractor.

The qualities of timber are stated hereunder:

All timber described as "sawn podo" shall be Grade II (Select Grade) sawn podocarpus.

All timber described as "wrot podo" shall be Grade I (Prime Grade) wrot podocarpus.

All timber described as "wrot cedar" shall be first (Prime Grade) wrot cedar.

All Musharagi, Mvuli, Mahogany and any other hardwood shall be selected quality kiln seasoned or air dried and when delivered to Site, shall have a moisture content of not more than 14% of its dry weight.

All timber for permanent work in the building shall before use, be approved by the Engineer for quality in accordance with the foregoing Specification for its respective grade.

4041 CARPENTRY

All carpentry work shall be left with sawn surface except where particularly specified to be wrot. Scantlings and boarding shall be accurately sawn and shall be accurately set out and in strict accordance with the Drawings and shall be framed together and securely fixed in the best possible manner with properly made joints. Provide all beads, nails, screws, etc. as necessary and as directed and approved.

4042 NAILS AND SCREWS

Nails for joinery are to be oval lost head nails.

Screws are to be countersunk wood screws. Steel screws shall be used only in concealed positions, or where the work is to be painted. Steel screws in contact with aluminium shall be dipped in zinc chromate solution before fixing. Ironmongery is to be fixed with chromium plated brass screws.

4043 TOLERANCE OF SCANTLINGS

Variations from specified dimensions of scantlings shall not exceed the tolerance stated in the Grading Rules. Boards 25.4 mm thicker or less shall hold up to the specified sizes. All timber shall be as long as possible and practicable to eliminate joints.

4044 TREATMENT OF TIMBER

All structural timber used in the works shall be treated with an approved preservative. Such timbers shall be impregnated under pressure before fixing with Tanalith, Celcure or other approved medium, toxic to termites, cryptotermes and other timber pests. All cut ends of timber so impregnated are to be treated with two coats of "B" crystals or other approved method.

4045 SIZES AND THICKNESSES

Sizes and thicknesses of wrot carpentry and joinery are nominal that is to say 3 mm reduction off specified sizes will be allowed for each wrot face, except where described as finished sizes in which case no reduction from the stated thickness or size will be permitted.

4046 FASCIA AND BARGE BOARDS

Fascia and barge boards shall be in wrot cedar or as specified and to detailed Drawing.

4047 GANG BOARDING

Gang boarding 25.4 mm thick, butt jointed and securely nailed to ceiling joints shall be provided to form access floor 457 mm wide between ceiling opening and water storage cisterns unless otherwise specified.

4048 WALLPLATES

The wall plates shall be bedded on walls in cement mortar and secured with 12 mm diameter bolts 304.8 mm long at 914.4 mm centres built 228.6 mm deep into walling. Plates to be in long lengths, halved and spiked at joints and angles.

4049 JOINTS WITH SPLIT RING CONNECTORS

Where timbers of trussed rafters are connected at joints with split ring connectors, they shall be grooved as required to take split ring connectors and bored for and bolted together with 12 mm diameter mild steel bolts all in accordance with structural engineer's drawings.

4050 VALLEY RAFTERS

Valley rafters shall be fixed double and bolted or spiked together as directed or shown on Drawings.

4051 ENDS OF TIMBERS

Ends of timbers such as purlins, etc. required to be built into or through inner and outer walls shall have 12 mm air space between same and walling.

4052 JOINERY

All joinery shall be executed with workmanship of the best quality and in strict accordance with the detailed Drawings. All mouldings shall be accurately run and all work planned, sandpapered and finished to the approval of the Engineer. All finishes shall be slightly rounded. All framed work shall be cut out, properly tenoned, shouldered, etc. and framed together as soon after commencement of the works as is practicable but should not be wedged up until required for fixing in positioning. Any portions that warp, get in winding, develop shakes or other defects shall be replaced with new ones. Whenever required for fixing in position, the framing shall be glued together with best quality glue and properly wedged or pinned, etc. as described.

All timber is to be sound, straight, of matured growth, square edge and free from whitewood, shakes, large loose or dead knots, cracks, wavey edges or other defects and blemishes except to the extent to which the Engineer considers that the timber is not rendered unsuitable for its intended use.

Oval or round brads or nails shall be used for fixing all face work and in each case, all heads shall be properly punched in and puttied.

The quality of all workmanship shall conform to SSRN 816.

4053 PLUGS

All fixing for joinery, etc. shall be approved and plugging fixed into holes of a recommended size. The holes shall be drilled with special masonry drills and not cut with a cold chisel and hammer. Under no circumstances shall wooden plugs be permitted. The expression "plugged" shall be taken to mean fixed with and including plugs as last described to stone or concrete.

4054 PROTECTION

Any fixed joinery which in the opinion of the Engineer is liable to become bruised or damaged in any way, shall be properly cased and protected by the Contractor until the completion of the works.

4055 SETTING OUT

All joinery work shall be accurately set out on boards to full size for information and guidance of artisans before commencing the respective works with all joints, ironwork and other connections therewith fully delineated. All setting out details shall be submitted to the Engineer and approved before such respective works are commenced. All joinery work shall be wrot unless otherwise described.

4056 INSULATION BOARD

Insulation Board shall be 12.5 mm thick, of an approved type of fibreboard in accordance with SSRN 809. Insulation board ceilings shall be fixed to a symmetrical pattern in each room.

4057 SOFT BOARD

This board is similar to insulation board but having high moisture absorbing properties.

4058 BLOCK BOARD

Block board shall be of approved local or imported manufacture, to SSRN 810 and shall be made up of softwood or hardwood faced as hereinafter specified. A sample of the proposed blockboard shall be deposited with the Engineer for approval and which when so approved, shall form the standard for the works.

4059 PLYWOOD

Plywood shall be approved local or imported manufacture, in accordance with SSRN 811 and of approved first or second grade softwood faced, unless otherwise described. "Exterior Quality" plywood shall be exterior moisture resistant type.

4060 HARDBOARD

Hardboard shall be suitable for painting and in accordance with SSRN 809 and shall be used, prepared and fixed strictly in accordance with the manufacturer's printed instructions.

4061 CHIPBOARD

Chipboard shall be approved imported or local softwood faced in accordance with SSRN 813 and shall be used and fixed strictly in accordance with the manufacturer's printed instructions.

4062 PLASTIC SHEETS

Laminated plastic sheeting shall be of a type approved by the Engineer, in accordance with SSRN 814 and of the type and grade specified. The sheeting shall be prepared, fixed and used strictly in accordance with the manufacturer's printed instructions.

4063 WOOD WOOL SLABS

Wood wool slabs shall be of approved Normal Quality to SSRN 815. The slabs shall be and fixed in accordance with the manufacturer's printed instructions.

4064 DEFECTS

Should any of the Carpentry or Joinery shrink, warp, wind or develop any other defects within six months after the completion of the works or within the maintenance period, the same shall be removed and new fixed in its place together with all other work which may be affected thereby all at the Contractor's cost and expense.

4065 CEILING JOINTS

Where ceilings are shown on the Drawings, ceiling joints shall be fixed at 600 mm centres and round walls and the underside shall be perfectly level.

4066 BRANDERING

The brandering shall be 50 x 50 mm fixed to and level with the underside of ceiling joints, at 600 mm centres maximum in both directions. The Contractor shall include for cutting and fitting at trusses.

4067 PRIMING

Where intended to be in contact with stone, concrete blocks, concrete, cement or plaster, the backs and other surfaces of all door, window or other frames and linings, posts, architraves, skirting, fillets and fascias and cornices, etc. shall be treated with one coat of aluminium priming paint applied before fixing.

4068 CEILINGS

Where shown on the Drawings, ceilings to all rooms shall be formed of approved insulation board not less than 12.5 mm thick.

Ceilings shall be fixed to brandering in symmetrical pattern with edges chamfered to form 'V' joints, all to the approval of the Engineer.

4069 FLUSH DOORS

The materials used in the Construction of all flush doors shall be in accordance with SSRN 817 (a) Part 2A. Flush doors shall be obtained from an approved manufacturer. The size of members and method of Construction shall be to the approval of the Engineer.

Flush doors shall be 45 mm (finished) thick to the sizes specified on the Drawings. Internal doors shall be faced both sides with 4 mm plywood and lipped on all edges with 10 mm (minimum) hardwood. External doors shall be faced both sides with 4 mm exterior quality plywood assembled with a waterproof adhesive to SSRN 818. They shall be lipped on all edges with 10 mm (minimum) hardwood. All doors shall have suitable blocking pieces to take door furniture.

4070 FRAMED, LEDGED AND BRACED DOORS

Framed, ledged and braced doors shall be 50 mm (Nominal) thick 838.2 x 1032 mm overall or to sizes specified on the Drawings and shall consist of 101.6 x 50.8 mm stiles and top rail, 228.6 x 25.4 mm lock and bottom rails and 101.6 x 25.4 mm diagonal braces filled in with 25.4 mm tongued, grooved and "V" jointed both sides boarding in matched widths and shall include chamfer on edge of stiles and adjacent boarding to form "V" joint.

4071 LEDGED AND BRACED DOORS

Ledged and braced doors shall be 50 mm (Nominal) thick (838.2 x 1032 mm overall) or to sizes stated on the Drawings and shall consist of 101.6 x 25.4 mm top rail and diagonal braces.

228.6 x 25.4 mm lock and bottom rails and covered on one face with 25.4 mm thick tongued grooved and "V" jointed both sides boarding in matched widths.

4072 WARDROBE DOORS

Wardrobe doors shall be 25.4 mm thick flush doors constructed of approved blockboard and hardwood lipped on all edges.

4073 DOOR FRAMES

Door frames shall be cedar 101.6 x 76.2 mm rebated and moulded frames. Door frames shall be secured to the concrete stone or brickwork with hold fasts built into the stone or brickwork and grouted into the concrete, all in accordance with first class practice.

4074 WARDROBE DOOR FRAMES

Wardrobe door frames shall be cedar 76.2 x 50.8 mm rebated frames.

4075 CUPBOARD DOOR FRAMES

Cupboard door frames shall be cedar 50.8 x 38.1 mm rebated frames.

4076 DOOR FURNITURE

Doors shall be provided complete with all hinges, locks, keys, knobs, handles, bolts, floor stops, etc., and all necessary screws, bolts or other fixings including mortices in concrete for bolt sockets, sinking for boxes etc. Ironmongery and locks shall be to the approval of the Engineer.

4077 ARCHITRAVES

The finishings to door frames to all doors shall consist of 76.2 x 19 mm wrought cedar splayed architraves plugged to walling and measured at all angles. Where the door frame is set against the face of the wall or where there is insufficient room for architrave, the finishing shall consist of 19 mm wrought cedar quadrant moulding planted on the frame.

4078 WOODEN SHELVES

Slatted shelving shall consist of 50.8 x 25.4 mm wrought podo slats 19 mm apart screwed to bearers.

All board shelving exceeding 225 mm wide shall be cross- tongued.

Blockboard shelving shall be 25.4 mm thick with hardboard or softwood veneer as stated or shown on Drawings and with 12.7 x 25.4 mm softwood or hardwood edge strip on all edges. The shelving shall be screwed to bearers.

4079 TRAP DOORS

Where shown or directed in fibreboard ceilings trim ceiling joints and brandering shall be used to form access door in ceiling. Where directed the trap door overall size shall be 1000 x 850 mm. At hanging side of opening 75.0 x 50.0 mm splayed frame shall be provided 75.0 x 50.0 mm stop on top of trimmer planted. The door shall be formed with 50.0 x 25.0 mm frame covered with fibreboard to match ceilings, to hang on a pair of approved strong 96.2 mm steel butts and finish around opening with 38.1 x 25.4 mm rebated fillet which shall be screwed to trimmers to form stop.

4080 BAT PROOFING

The underside of projecting eaves to buildings with ceilings shall be bat proofed by means of 50.0 x 25.4 mm wrought podo framing filled in with stout Galvanized coffee tray-mesh.

The framing shall be nailed on one edge to ends of rafters to butt up against fascia board and on other edge 50.0 x 25.4 mm sawn podo bearers plugged to wall.

4081 IRONMONGERY - QUALITY

All ironmongery shall be of the description and manufacture described and shall be fitted and fixed in an approved manner. All locks shall be provided with two keys and shall have a sufficient number of differs to ensure that no two external locks of the same contract may be opened with the same key. The Contractor shall include for all cutting, sinking, boring, mortising and fitting and for supplying all necessary and suitable matching screws. The Contractor shall also include for removing door furniture etc. during painting operations and afterwards re-fixing and for labelling all keys with door references and handing to the Engineer on completion.

Master keys shall be provided and properly labelled where directed.

Face plates with all locks shall match the door furniture.

All finishes shall be in satin chrome or silver anodised aluminium unless otherwise stated.

4082 IRONMONGERY - MOVEABLE PARTS

All locks, springs and other items of ironmongery with moveable parts shall be properly tested, cleaned and adjusted where necessary to ensure proper working order by the time of completion of the works and shall be left in perfect working order by the Contractor.

4083 IRONMONGERY - SAMPLES

Samples of all ironmongery specified shall be submitted to the Engineer for approval, and the approved samples shall thereafter be regarded as the standard for the work. Ironmongery which in the opinion of the Engineer does not conform to this standard shall be removed from the Site.

Alternatively, ironmongery of an equal standard will be acceptable providing samples are submitted and approved by the Engineer before orders for such ironmongery are placed.

4084 W.C. FITTINGS AT OFFICES

The following shall be provided and fixed with matching screws in the positions shown:

- i) One chromium plated toilet roll holder of approved pattern screwed to door or plugged to wall.
- ii) One C.P. hat and coat hook plugged to wall.
- iii) One C.P. towel rail 600 mm long with brackets plugged to wall.

4085 DOOR STOPS

40.0 mm diameter rubber door stops shall be provided to all doors and securely plugged and screwed to floors with screws 40.0 mm long.

4086 STRUCTURAL STEEL AND METALWORK

Mild steel shall be sound, of approved manufacture and shall comply with the requirements of SSRN 819 and full threads to all screw work. Welds shall be neatly executed, filed smooth and left clean.

Prices for all mild steel shall include for removing all rust and scale and applying one coat of red oxide or other approved priming paint to all surfaces before fixing.

Cast Iron shall be best quality cast clean and sharp and free from all cracks, vents, holes and other defects.

4087 SPLIT RING CONNECTORS

Split ring timber connectors shall be of approved manufacture, in accordance with SSRN 820, or may be manufactured locally from Galvanized mild steel water tubing, to the approval of the Engineer.

4088 METAL WINDOWS

These shall be as shown on the Drawings.

4089 PLASTERWORK AND OTHER FLOOR, WALL AND CEILING FINISHINGS

The cement and sand pavings and finishings shall include for finishing of the surface to a perfectly smooth and hard standard with a steel trowel to deal level or true falls if so described. This shall apply for all temporary rules, formwork to stop pavings at openings or edges as required, for preparing concrete beds to receive paving by thoroughly brushing clean the surface with a steel wire-brush, and well wetting and painting the same with cement and sand (1:1) grout immediately before paving is laid, for any additional thickness of paving beyond the thickness specified required due to irregularities in the concrete bed to receive such paving, and for keeping paving damp for at least 7 days after laying.

4090 PAVING GENERALLY

All pavings shall be laid with joints set out in accordance with a detailed pattern approved by the Engineer.

4091 PROTECTION OF FLOOR FINISHES

The Contractor shall protect the floor finish with heavy quality building paper or sheeting or sawdust to the satisfaction of the Engineer as each area is completed.

4092 PLASTERING

All surfaces to be plastered or rendered shall be brushed clean and be well wetted before the plaster is applied. All plaster and rendering shall be kept continuously damp for seven days after application.

All concrete surfaces which are to be plastered are to be hacked or otherwise suitably roughened to provide a key. All surfaces to receive plaster are to have the suction correctly adjusted by the application of clean water.

All arises shall be finished true and slightly rounded except where otherwise stated, and shall be run at the same time as the adjoining plaster. No partially or wholly set plaster or rendering will be allowed to be used or re-mixed.

4093 SAMPLES OF PLASTERWORK

The Contractor shall prepare samples of the plastering and rendering as directed until the quality, texture and finish required is obtained and approved by the Engineer after which all plastering executed in the work shall conform to the respective approved samples.

4094 DEFECTS IN PLASTERWORK

The Contractor shall cut and make good all cracks, blisters and other defects and leave the whole of the work perfect on completion. When making good defects the plaster or rendering shall be cut to a rectangular shape with edges undercut to form dovetailed key, all finished flush with face of surrounding plaster or rendering. 'Gypsum' or other equal and approved plaster shall be used when carrying out defective work.

4095 GAUGED (CEMENT LIME) PLASTER INTERNALLY

Gauged plaster internally shall consist of a first (or rendering) coat composed of one part cement, two parts lime and nine parts sand and a finishing coat composed of one part cement, three parts lime and six parts sand. The first or rendering coat shall be laid to a

uniform surface, finished with a wood float, well cured and allowed to dry out for at least 7 days before applying the finishing coat. The second or finishing coat shall be thoroughly worked and finished hard and smooth with a steel trowel.

Great care shall be taken in applying the finishing coat to obtain uniformity of the surface, smoothness and hardness. The total finished thickness of plaster shall not be less than 12 mm.

4096 CEMENT PLASTER-INTERNALLY

Unless otherwise indicated internally applied cement plaster shall be composed of one part cement to five parts sand applied in two coats. The first coat shall be well scratched to form key and allowed to dry out at least 24 hours before applying the second coat. The second coat shall be finished with a steel trowel.

4097 CEMENT RENDER-EXTERNALLY

Unless otherwise indicated, this shall be as described for internal plaster but the second coat shall be finished hard and smooth with a wood float and the total finished thickness of render shall not be less than 12 mm thick.

4098 PLASTER OVER WALLPLATES

Where the wall plaster is carried over wallplates, a strip of expanded metal shall be spiked to the wallplate to form a key.

4099 PLASTER AROUND INSTALLATIONS

Make good plaster around Plumber's water, soil and waste pipes and around Electrician's conduit fittings and switches.

4100 DUBBING OUT, ETC.

The Contractor shall include in his Tender for dubbing out as necessary in cement and sand (1:7) hacking concrete to form key and for all internal angles, arises, other labours and for making good up to windows or door frames.

4101 GLAZING

All glass shall be of approved manufacture in accordance with SSRN 822 free from flaws, bubbles, specks and other imperfections cut to size to fit the opening for which it is required with not more than 1.6 mm play all round.

The glass for glazing generally shall be clear sheet and flat drawn sheet and shall be Ordinary Quality (O.Q) sheet glass of the required thickness to suit the size of sheet and position.

4.8 mm semi-obscured glass shall be fitted to windows of lavatories, bathrooms and W.C.'s.

4102 PUTTY

The putty for glazing shall be tropical putty of approved manufacture suitable for glazing to metal or wood frames as hereinafter specified.

All putty shall be delivered on Site in the original manufacturer's sealed cans or drums and used direct therefrom with the addition only of pure linseed oil if necessary. No mineral or other oils may be used.

The rebates of all windows shall be painted one undercoat before puttying. Before glazing the rebates of all windows shall be adequately back puttied.

The putty shall within 14 days dry and harden without wrinkling of the surface or caking and shall adhere satisfactorily to the surface of the glass and the frame.

4103 GLAZING WORKMANSHIP

All glazing to wood frames shall be sprung while that to metal frames shall be fixed with clips. All glass shall be properly back-putted, and the front putty finished neatly and cleanly in line with back putty.

Glass to the glazed doors shall be fixed with glazing beads, secured with brass cups and screws and bedded in approved proprietary strip cut to fit the exact line of the beads.

The inside and outside of glass shall be cleaned to remove all paint and putty marks. Any broken scratched or cracked panes shall be replaced so as to leave all glazing sound and perfect at completion.

4104 PAINTING AND DECORATING TO BUILDINGS AND NON-METALLIC STRUCTURES

The Contractor may arrange for the painting work to be executed complete by an approved Sub-Contractor and he shall state the name of the Sub-Contractor he proposes to employ on the Form provided and included in this Tender Document in the list of approved Sub-Contractors. The Contractor shall not employ any other Sub- Contractor without the express permission of the Engineer in writing.

Before commencing the painting work, the Contractor shall submit to the Engineer for approval, a list of all the brands of paints and finishings including the necessary primers and undercoats to be used and immediately upon being approved orders shall be placed and total requirements obtained for the works.

Once approved, no other brand of material shall be used without the express permission of the Engineer in writing.

4105 MIXING OF PAINTS

All materials shall be delivered on Site intact in the original containers and shall be mixed and applied strictly in accordance with the manufacturer's printed instructions. No addition will be allowed to be made locally without the express permission of the Engineer.

4106 COLOURS OF PAINTS

The priming, undercoats and finishing coats shall each be of different tints, the printing and undercoats shall be the correct brands and tints to suit the respective finishing coats, in accordance with the manufacturer's instructions. All finishing coats shall be of the colours and types specified by the Engineer.

4107 PREPARATION PRIOR TO PAINTING

The Contractor shall include for the preparation of surfaces, rubbing-down between each coat, stopping, knotting and all other work in connection as previously described and as necessary to obtain a first class finish.

Plaster finished with a steel trowel and fair face concrete surfaces shall be well rubbed-down, filled and made good as necessary and thoroughly cleaned down immediately before decoration is applied.

Plaster finished with a wood float or other rough textured surfaces of a similar nature shall be made good as necessary and thoroughly brushed clean immediately before decoration is applied.

Cast-in-situ concrete with a rough textured surface shall be made good as necessary and thoroughly wire-brushed clean immediately before decoration is applied.

Insulation board or similar surfaces shall be filled and made good as necessary and lightly brushed-down to remove all dirt, dust and loose particles.

4108 PRIMING PAINT

All exposed cast iron or asbestos cement soil, waste and vent pipes shall be primed with two coats approved aluminium metal primer before further treatment.

Woodwork to be painted shall be well rubbed down and primed with aluminium wood primer well-brushed into the wood. All knots shall be covered with good shellac knotting before priming and all defects be filled with hard stopping after priming.

Plywood shall be filled over the entire surface, with an approved brush filler.

Woodwork to receive finishes other than paint shall have all stains removed, be well rubbed-down and have all defects levelled up with hard stopping or a colour to match the adjoining surfaces.

4109 METHOD OF PAINT APPLICATION

After each coat the work shall be allowed to dry and shall then be well rubbed-down with fine glass paper on blocks or other means as required for the particular work before the next coat is applied. The paintwork shall be finished smooth and free from brush marks.

4110 IRONMONGERY AND OTHER PROTECTION DURING PAINTING

All door furniture and other ironmongery shall during painting operations be removed and afterwards refixed as herein before described in the Ironmongery Preamble.

All metallic window and door frames shall be protected by drafting tape or other approved means before adjacent or adjoining surfaces are primed and painted.

4111 DISTEMPER

Distemper shall be oil-bonded or casein bonded washable distemper.

Distemper shall be thinned only with petrifying liquid made by the manufacturer of the approved distemper to be used, and in accordance with their printed instructions.

4112 EXTERNAL PAINTING WORK

All materials for external use shall be of exterior quality recommended by their manufacturers for external use.

4113 LIMEWASH

Limewash shall consist of slaked lime and coarse salt mixed in the following manner. To 25.0 kg of slaked lime add water into which has been dissolved (1 kg approximately) of coarse salt. Add clean water until the required consistency is obtained.

4114 COVERING UP DURING PAINTING

The floors, etc shall be swept cleaned and covered up with dust sheets when executing all printing and decorating work.

Paint splashes, spots and stains, shall be removed from floors, woodwork, etc. Any damaged surfaces shall be touched up and the whole of the work left clean and perfect upon completion.

4115 PAINTWORK TREATMENT FOR BUILDINGS

- | | | |
|----|--------------------|--|
| 1. | Fibreboard ceiling | Three coats distemper |
| 2. | Plastered Walls | Three coats plastic emulsion internally and two coats exterior water paint externally |
| 3. | Metal Work | Prime and paint one undercoat and two finishing coats gloss-paint. Only approved systems to be used. |

- | | | |
|----|---|--|
| 4. | Copper,
Galvanized and
coated Metal | Treat with approved calcium plumbate solution, prime paint two undercoats and one coat gloss-paint. |
| 5. | Galvanized
corrugated | Apply two coats of approved roof - Iron Roofing paint. |
| 6. | Woodwork | Knot, prime, stop and paint one undercoat and two finishing coats gloss-paint. Only approved systems to be used. |

4116 PLUMBING

Pipes and tubes shall be cut by hacksaw or other method which does not reduce the diameter of the pipe or form a bead or feather which might restrict the flow of water.

Bends shall be formed on an approved machine and in no case to an internal radius of less than eight times the outside diameter of the pipe.

Elbows may only be used on pipes of 12 mm and 19 mm diameters and not on hot water systems of any description.

All tubing exposed on faces of walls shall be fixed at least 25.4 mm clear of adjacent surfaces with approved holder bolts built into walls not more than 1.288 metres apart. Polythene tubing must be supported throughout the entire length in horizontal positions as directed.

Pipes fixed in roof spaces or to joinery shall be fixed with approved clips screwed to timber members, not more than 1.30 metres apart. Easy bends in the line of piping shall be made with an approved bending machine, no firebrands will be permitted. Where elbows are allowed, they will be of round pattern.

4117 PIPE MATERIAL FOR PLUMBING

All Galvanized mild steel tubing shall be of MEDIUM thickness in accordance with SSRN 823.

Fittings for the same shall be Galvanized malleable iron in accordance with SSRN 824. Joints are to be screwed and socketted and put together in approved jointing compound. Long screws and any other untapered threads shall have yarn as well as jointing compound incorporated in the joints.

Polythene tubing for cold water services shall be normal or heavy gauge as required or specified in accordance with SSRN 825. Joints and fittings shall be in accordance with the manufacturer's printed instructions.

All brass work and fittings shall be in accordance with SSRN 826 for draw-off taps and stop-valves and SSRN 827 for ball- valves (and plastic-floats in accordance with SSRN 828), and shall be high or low pressure as directed by the Engineer.

The soil, waste and vent pipes and their fittings shall be coated MEDIUM grade cast iron spigot and socket pipes. Pipes, fittings and accessories shall be in accordance with SSRN 843.

4118 PLUMBING WORKMANSHIP

Where directed, pipes shall be fixed in chases in walling and secured with approved holder bolts built into wall, not more than 1.30 metres apart.

All surface fixings, unless otherwise specified herein shall be carried out with "Philplug" or "Rawlplugs". The fixing holes shall be drilled with special masonry drills and not cut with a chisel. Under no circumstances will wooden plugs be permitted.

Lavatory basin brackets shall be fixed to solid walls with 6 mm diameter bolts 100 mm long with head nut and washer.

The tubing for the hot and cold water services, waste and overflow pipes, etc. is hereinafter described as Galvanized mild steel tubing.

4119 STOP COCK PIT

The stop-valve pit shall be constructed to size 250 x 250 x 600 mm deep internally and shall consist of 100 mm stone sides, 75.0 mm concrete base size 600 x 600 x 50 mm thick precast concrete cover slab of size 450 x 450 mm reinforced with 75 mm mesh, No. 10 gauge "Weldmesh" or other equal and approved fabric reinforcement and two 10 mm diameter mild steel rod lifting handles cast in the cover slab. Allowance shall be made for holes through the sides for pipes.

4120 CONNECTION OF PLUMBING PIPES AND TANKS

Each connection of tubing to cold water storage tank shall be made by drilling a hole on tank side and using a long screw, union and two backnuts all well screwed-up in red lead. Joints of tubing to flanged and bossed connections of hot water cylinders or boilers shall be made with a boiler screw, union and backnut screwed-up in red lead.

Connections to sanitary fittings shall be made with good flexible metal tubing with the required length. Copper to iron couplings shall be provided at each end, together with red lead joints to union of fitting and tubing.

4121 SANITARY FITTINGS

Where indicated on the Drawings or in the particular Specification, the supply, assembling and fixing of Sanitary fittings in the positions shown on the drawings shall allow for the provision of jointing material, mortises, plugs, screws, etc.

Sanitary fittings shall be manufactured by a manufacturer approved by the Engineer.

(a) Pedestal Type W.C. Suite (Low Level)

Pedestal type W.C. suite shall comprise white glazed vitreous china pan to SSRN 833, hinged black plastic seat to SSRN 834, complete with rubber buffers white glazed vitreous china 14.0 litres cistern with valveless siphon for normal flushing supported on pair of white porcelain enamelled brackets, 40.0 mm diameter white porcelain enamelled iron flush pipe with "Adaptors" or other equal rubber cone joint to pan and C.P. union connection to cistern.

(b) Pedestal Type W.C. Suite (High Level)

This shall be as (a) above but with 'P' trap, white glazed vitreous china pan and approved 9.0 litres plastic or other type cistern and all necessary fittings as directed by the Engineer.

(c) W.C. Suites

The pedestal type pan will be fitted above the floor level in ALL cases.

W.C. pans will NOT be placed in sinking below floor level unless specifically directed in writing by the Engineer.

(d) Lavatory Basins

The lavatory basin shall be glazed vitreous china lavatory type to SSRN 835 with combined waste and overflow complete with one 12.7 mm C.P. pillar valve to SSRN 832 fixed in tap hole provided, with fibre washer, C.P. waste, rubber plug and C.P. chain and stay, supported on a pair of porcelain enamelled towel rail brackets.

(e) Stainless Steel Sinks

Stainless steel sink shall be to SSRN 836 complete with draining board, work slab and back ledge overall size as in the Bills of Quantities with combined waste and overflow, complete with 19 mm diameter C.P. pillar valve to SSRN 832 marked

"cold", fixed in tap hole and provided with fibre washer, rubber plug and C.P. chain stay, fixed on angle iron brackets.

4122 WASTE FITTINGS

All waste fittings shall be provided with brass 'S' or 'P' traps to SSRN 837 with 40.0 mm (minimum) seals. They shall be properly connected to tails of waste fittings with screwed red lead joints, and be complete with cleaning eyes. Traps to sinks shall be unpolished while those to lavatory basins shall have a chromium-plated finish.

4123 BRACKETS AND SUPPORTS FOR SANITARY FITTINGS

Brackets and supports for lavatory basins and sinks shall be to SSRN 838.

4124 WASTE PIPES

The sink shall be provided with a 40.0 mm diameter waste pipe the lavatory basin shall be provided with 30.0 mm diameter waste pipe. Waste pipe shall be run to falls through external walls to discharge over trapped gullies and shall be finished with splay cut-ends.

4125 OVERFLOW TO W.C. CISTERNS

The internal overflow arrangement shall be achieved by the siphon flushing mechanism, where a lever is included internally to regulate overflow. The cistern shall be 6/7/9 litres complete with a ball valve, siphon and 355 x 230 mm flush pipe.

4126 SOIL AND VENTILATING PIPES

Where shown on the Site Plan, the head of each main drain shall be provided with a 110 mm diameter PVC ventilating pipe as described with open-end finishing at least 450 mm above the level of the eaves, and not less than 3.0 metres from any permanent opening into the building, terminated with approved quality Galvanized wire-balloon grating. Where the ventilating pipe passes through the roof, a 24 gauge Galvanized sheet metal flashing of approved size to suit roof shall be provided and dressed tightly against pipe and over and under roof finish and sealed to Engineer's approval.

4127 TESTING OF PLUMBING WORK

On completion, the whole of the plumbing work shall be tested to the satisfaction of the Engineer and in accordance with his instructions. Any materials or workmanship not to his satisfaction shall be replaced or re-executed at the Contractor's own expense.

4128 PVC DRAIN PIPES

PVC drain pipes and fittings shall be spigot and socket pipes of approved manufacture in accordance with SSRN 309.

4129 CONCRETE DRAIN PIPES

Concrete drain pipes shall be spigot and socket pipes of approved manufacture in accordance with SSRN 840 and shall be totally immersed in water for at least 3 hours immediately preceding laying.

4130 JOINTING FOR PVC AND CONCRETE DRAIN PIPES

The joints for PVC and concrete drain pipes shall be made by first inserting three turns of cement slurried yarn, caulked well home to the end of the socket so that the consolidated width of the yarn does not exceed one quarter of the depth of the socket. The yarn shall be best quality white-spun long staple yarn, soaked in water for 24- hours before use and inserted in the joint while still wet.

The remaining portions of the socket shall be filled solidly and homogeneously with cement mortar (1:2) and finished with a neat cement fillet on the outside at an angle of 30 degrees. Immediately after jointing a tight fitting wad or scraper shall be drawn several

times through the bore of the pipe to ensure that it is left clean and free from obstruction. The joints shall be protected from injury until they have set hard.

4131 PITCH FIBRE DRAIN PIPES

Pitch fibre pipes, coupling and fittings shall be of approved manufacture in accordance with SSRN 841 for pitch impregnated fibre drain and sewage pipes. The laying, cutting and jointing of pitch fibre pipes and the jointing to pipes of other materials shall be carried out strictly in accordance with the manufacturer's printed instructions.

4132 CAST IRON DRAIN PIPES

The cast iron drain pipes shall be coated spigot and socket pipes of approved manufacture in accordance with SSRN 842. All joints shall be made with P.C. 3 or other similar and approved jointing compound in accordance with SSRN 843.

4133 CAST IRON FITTINGS

The cast iron fittings shall comply in all respects with SSRN 829 and those of spigot and socket type for drains with SSRN 844 and will be used as drain connector to first manhole.

4134 CONCRETE BEDS FOR DRAIN PIPES

All drain pipes shall be laid on a concrete bed, or blinding as directed by the Engineer. Beds shall first be laid to correct falls and levels with recesses formed in same for the pipe sockets so that the whole of the soffit of the pipe barrel bears evenly on the bed. When the concrete has set a thin layer of mortar (1:5) shall be spread on the bed to receive the pipe barrel, sufficient to ensure that a surplus is squeezed out when the pipe is laid, and finally adjusted to level. After jointing, the recesses around sockets shall be filled with concrete of the same mix as the bed and the haunching or surrounding completed.

Where pipes are laid under driveways and parking areas, the pipes shall be bedded and surrounded with beds if the cover on the pipe is less than 1.0 m deep.

4135 LAYING OF DRAIN PIPES

Drain pipes shall be laid in straight lines to even gradients and to the required depths commencing at the lowest end.

Before each pipe is laid, it shall be examined to ensure that the bore is clean, all foreign material removed and any cracked or damaged pipes shall be rejected.

4136 TESTING OF DRAINS AND MANHOLES

Each length of drain and manhole shall be tested as described hereinafter and approved by the Engineer before any backfilling of the trench takes place.

Testing shall not be carried out until after at least 24 hours following completion of jointing.

The test shall be as follows:-

- i) The lower end of the pipe and all junctions shall be securely stoppered and the whole length under test filled with water.
- ii) When full, a further stopper shall be inserted at the top leaving a pipe attached to the drain plug. This pipe shall be bent through 90 degrees and shall terminate in a header tank 250 mm square. The vertical distance between the centre-line of the drain plug and the top of the header tank, shall be not less than 900 mm.
- iii) Water shall then be poured into the header tank which shall be kept full for a minimum period of 3 hours to allow absorption to take place. At the expiration of this period the header tank shall be topped-up and the testing of the drain commenced. If, after a further period of 30 minutes the water level in the header tank has not fallen by more than 12 mm, the test shall be considered satisfactory.

- iv) In the event of a pipe failing to withstand the test, the point of failure shall be completely surrounded, at the Contractor's expense, with concrete (1:3:6-19 mm maximum aggregate) to achieve a minimum cover of 150 mm in all directions. The length affected shall then be re-tested.
- v) Immediately a length of drain has been approved, the trench shall be backfilled to a depth of at least 300 mm above the top of the pipes.

4137 GULLIES

These shall be approved 100 mm salt glazed stoneware or cast iron trapped Gullies with 150 x 150 mm cast iron gratings to receive the wastes from waste fittings. The Gullies shall be bedded on and surrounded with concrete (1:3:6) of 100 mm minimum thickness, carried up to form 750 x 750 mm curb with all exposed surface finished in cement and sand (1:2) trowelled hard and smooth and all angles rounded. The cement joint to drain pipe and run drains to adjacent manhole shall be appropriately made good.

4138 ELECTRICAL INSTALLATION

All work in connection with the electrical installations shall be carried out by an approved Sub-Contractor under supervision of a qualified, competent and experienced supervisor. The finished work shall be to the satisfaction of the Engineer and in accordance with requirements of the local electricity supply company.

4139 GALVANIZED SHEET IRON

Galvanized sheet iron shall be at least Gauge 28 of approved manufacture, free from all defects and shall hold up to the gauge as specified.

Sheets shall be fixed with one and a half corrugated side laps and minimum 225 mm end laps secured to purlins by galvanised iron bolts and iron and lead washers spaced not more than 300 mm apart horizontally on each purlin.

Ridges, hips and valleys shall be at least 28 gauge galvanised sheet, minimum 450 mm girth with roll tops and fixed with galvanised iron screws and iron and lead washers spaced not more than 300 mm apart, lapped 150 mm at junction of lengths and with edges close dressed into corrugations of sheeting.

Valleys are to be inverted, lapped 150 mm at ends of lengths close welded and securely fixed under edges of roof sheeting. Flashings, gutters etc. shall be lapped 75 mm minimum at joints and shall be rivetted and soldered at joints where required.

Where applied to walls the side overlaps shall be seam bolted at 300 mm centres maximum with 6 mm diameter seam bolts 19 mm long each with diamond shaped bitumen washer, Galvanized steel washer and Galvanized steel nut.

4140 POLISHED TERRAZZO

Polished terrazzo shall be laid by an approved Sub-Contractor and shall consist of a screed or backing coat and a finishing coat of "Snowcrete" and marble chippings (1:2) mixed with "Cemantone No. 1" colouring compound in accordance with the manufacturer's instructions in the proportions of 10 lbs. compound to 100 lbs. cement. Overall thicknesses are to be as specified.

The finishing coat shall be a minimum of 12 mm thick for pavings trowelled to a smooth and even finish and well rubbed and polished with carborundum.

4141 TILES

Glazed and eggshell ceramic wall tiles shall comply with SSRN 879 and shall be of the colours described. Samples of tiles shall be submitted to the Engineer's Representative for approval.

Adhesive for fixing wall tiles shall be approved adhesive.

Tiles shall be wiped clean and fixed dry with the approved adhesive all in accordance with manufacturer's recommendations with straight joints 1.6mm wide, pointed in white cement.

Ceramic floor tiles shall be fully vitrified clay tiles complying with SSRN 879 and having a water absorption not exceeding 0.3%.

For laying of floor tiles the surface of the compacted bedding shall be spread with a 3mm thick cement and sand (1:1) slurry. Floor tiles shall be wiped clean and laid dry, in a square pattern with 3mm wide joints and tapped into the grout. Pointing shall be in an approved proprietary tile grout, tinted to match floor tiles.

CHAPTER 5

PIPEWORK

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CHAPTER 5 – PIPEWORK**PART I – ALL PIPES, VALVES & FITTINGS DURING DESIGN, MANUFACTURE, WORKS TESTING AND SUPPLY****501 PREFACE**

This specification applies in particular to water supply pipework. Pipes, valves and fittings shall comply with the relevant Standard Specifications as stated hereinafter.

The pipe materials and installation methods specified are aimed at balancing capital investment cost, the operation and maintenance cost, the social implications and the environmental health implications in the supply and installation of water pipelines.

The specifications have been prepared with the intention of ensuring that adherence to the specifications meet the following criteria:

- *Unless specifically prohibited, or constrained by socio-environmental consequences as hereinafter indicated, manufacturers and contractors are free to bid for any of the four pipe material against all pipeline diameters and the market price at the time of bidding shall be allowed to determine what material is used;*
- *The specifications should be performance based with guidance given to design requirements, acceptable grade, trenching conditions, etc. for each material likely to be bid;*
- *There should be one general approach to specifying pipeline materials and this should only be varied for specific design situations such as a major transmission main, unusually high working pressures, etc.;*
- *Specifications should not unduly prejudice local manufacturers but neither should they ignore international best practice in regards to the standards of design and construction*
- *Unless specifically indicated or allowed otherwise, e.g. hot dipped zinc (galvanised) steel pipes of diameter less than DN 80, the minimum design working life shall be 40 years and pipe manufacturers shall provide a written guarantee to this effect which shall nevertheless be conditional upon the installation requirements of this specification being complied with.*

As far as it has been possible, these specifications balance the rigorous requirements across the board for all pipe materials in conformance to their international standard and best practice. This also takes account of the issue of equivalent pressure rating for thermoplastic pipes to meet both hydraulic and area specific conditions such as temperature, loading, impact fatigue and the like and the issue of durable and long lasting coating and lining for ferrous pipes. In case of any doubts, respective international standards shall apply, strengthened where indicated by National Standards.

The specifications on pipe materials presented in this section shall therefore have precedence over other clauses that discuss the same issues elsewhere in this Specification Volume. The preferred standard specification is clearly indicated in every case. However, possible alternatives known to be available in certified English translation are acceptable. For these Standard Specification Reference Numbers, (SSRN), please refer to chapter 11. Whilst every effort has been made to quote the latest available version of the Standard Specifications mentioned herein as at the date of this edition (January 2013), due to continuous research and development on enhancing asset useful life, these standards are frequently being updated, revised or replaced, and in all cases, the editions current at the time of bidding shall be applicable.

Design, whether it be prior to bidding or for variations or additions during construction shall meet the requirements of the design standards as indicated herein.

The recommendations contained in SSRN 651 with regards to pipework and its installation shall be followed, in so far as they are relevant to the prevailing soil and climatic conditions.

502 GENERAL

In general the recommendations contained in SSRN 679 with regards to pipe design), and SSRN 269, SSRN 219 and SSRN 253, or their equal (with regards to general pipe work and its installation) shall be followed in so far as they are relevant to the prevailing conditions. For design recommendations not covered by SSRN 679, reference should be made to SSRN 202 for ductile iron pipes; SSRN 24 and SSRN 201 for steel pipes; SSRN 300, SSRN 305 and SSRN 306, for PVCu (uPVC); and SSRN 307 for HDPE (PE100) pipes. Other related standards listed in Chapter 11 of these specifications are also relevant and pipe materials and their installation shall conform to them as well. At all times latest editions and updated standards and procedures for design and installation shall be used and adopted. This will ensure that the employer benefits from superior materials with enhanced useful life. In the same context the Contractor may provide, with the approval of the Engineer, superior materials using other standards not listed here provided they can demonstrate this to be the case through tests, examples and guarantee certifications.

Except where otherwise specifically indicated, all ferrous pipes of DN 80 and above shall be barrier coated.

The Contractor shall be wary of the worst case scenarios making their pipes unsuitable and these can be caused by such things as unsuitable soils, shallow depths, bedding types and extraordinary traffic loads among other things and the Contractor shall inform the Engineer when they occur. Such incidences shall be remedied by using a higher class of pipe (wall thickness and/or yield stress) and / or bedding as shall be directed.

As a general guidance, the pipes proposed for the Contract shall conform to the following international and national standards unless a superior quality is demonstrated.

Standards for Pipes and Pipelines

Pipeline general	<p>SSRN 267 – Structural Design of Buried Pipelines, saving that where the Specification is silent on any pertinent matter, then the alternative relevant part of the SSRN indicated shall be complied with</p> <p>SSRN 268 British Standard Code of Practice for Pipelines</p> <p>SSRN 268 Pipeline on land: Design, construction and installation</p> <p>SSRN 267 – Ductile Iron</p> <p>SSRN 653 (d) - Glass reinforced and thermosetting plastics</p> <p>SSRN 270 – Pipelines subsea – design, construction and installation</p> <p>SSRN 653 (f) – Design and Construction of Steel Pipeline Inland</p>
Steel pipes & fittings	<p>Pipes SSRN 213</p> <p>Standard steel grades, SSRN 228 (c) (higher grades may be specified or allowed only with the written authorisation of the Engineer.</p> <p>Wall thickness SSRN 228 (c) as a minimum, unless otherwise indicated or specifically authorised following a design certified by the manufacturer</p> <p>Flanges SSRN 207 (a)</p> <p>Coating and Lining SSRN 271 for Type III soils (unless detailed field tests have proven Type I and II soils to be exclusively present).</p>
Ductile Iron pipes and Fittings	<p>Pipes and joints SSRN 202</p> <p>Flanges SSRN 207</p>

	Coating and Lining SSRN 272 for Type III soil (unless detailed field tests have proven Type I and II soils to be exclusively present), and SSRN 258
PVC pipes	SSRN 300 Fittings shall in general be steel or ductile iron. Injection moulded PVCu bends and tees shall be allowed.
HDPE pipes & fittings	SSRN 307 Fittings shall in general be steel or ductile iron whilst electro-fusion jointed bends and tees shall be allowed providing these are not formed by bending straight pipe below the minimum radius specified.

These and other specific standard specifications are listed in Chapter 10 – SSRN

Design Criteria for All Pipelines

Ductile iron pipes are classified as semi-rigid pipes whilst steel and thermoplastic pipes are classified as flexible and any design must take the different requirements between the two into account.

Materials data for all pipes is required to enable structural design to proceed. Common to all is the internal diameter, excluding lining (if any) and where applicable including lining as well as the wall thickness being considered. All flexible pipes also require the stiffness, $[S=E \times I/D^3]$ to be taken into account.

In addition, steel requires knowledge of the maximum allowable working pressure, the maximum allowable surge pressure, the allowable stress and the allowable deflection, whilst PVCu and pipes comprising PE require knowledge of long term ring bending modulus of elasticity, the allowable deflection, cyclic fatigue and the allowable long term combined stress.

In all cases, hydraulic design shall be based on the actual internal diameter and NOT the Nominal Diameter (DN) as well as the appropriate roughness (k) in mm.

Except where otherwise indicated, pipes have been designed to allow for the conditions listed in the Table below (these shall be changed to suit the actual situation). Where in the opinion of the Engineer, actual site conditions result in loads and stresses greater than allowed for, the Engineer may require the pipe design to be modified to account for such changes in design assumptions. Unless authorised otherwise in writing by the Engineer, these criteria shall also be used for any design undertaken during the construction stage.

Criteria	Units	Value	Specific Design Necessary
Minimum Pipe Cover	mm	900	May be increased for road crossings
Thermoplastic pipes	mm	600	
Ferrous Pipes	mm	900	
Transmission Mains (all)			
Minimum Trench Width	mm	600	General minimum trench widths OD + 450 OD + 600 OD + 900 OD + 1200
DN < 125	mm		
DN 125 to < 300	mm		
DN 300 to < 600	mm		
Diameter > 600	mm		
Soil Type Expected Native Soil Modulus E'_3	MPa	2.5	Clayey silty sand, loose condition

Cont'd

Criteria	Units	Value	Specific Design Necessary
Trench Type for Pipe Material			With Project Engineer's approval or direction
Thermoplastic	Class	S1 / S2	S2
Steel cement mortar lined	Class	S3 / S4	S3
Steel other linings	Class	S3 / S4	S4
Ductile Iron	Class	S3 / S4	S3
Minimum Surround Compaction	% MPD	90	MPD
Operating Temperature	°C		
Secondary and Tertiary	°C		27
Primary	°C		29
Transmission	°C		29
Operating Pressures			
Secondary & Tertiary	Bars	7	So as to suit operating pressure
Distribution	Bars	7	
Primary Distribution Transmission Mains	Bars	10, 12, 16 or 25	
Traffic Loading			May be increased for field & major road conditions and designs adjusted at the Engineer's discretion.
Vehicle Axle Load	kPa	73	
Vehicle Overload Risk Factor	%	25	
Vehicle Impact Factor		1.5	
Partial Vacuum in Pipes			
Secondary & Tertiary		No	No
Primary Distribution		Yes	Yes
Transmission Mains		Yes	Yes

Specific design (supported by properly documented calculations) and Engineer's written approval will be required for the following situations: -

- Thermoplastic pipes with nominal diameter greater than 250 mm for which, apart from soil and surcharge loads, loads due to partial vacuum and cyclic fatigue shall be taken into account.
- Road crossings for which, apart from soil and surcharge loads, loads due to cyclic fatigue shall be taken into account.
- Transmission mains for which specific conditions may apply.

The use of PVCu pipes in Pumping Mains is strictly forbidden.

Thermoplastic pipes less than OD 110 may be affected if the native soil modulus is less than the MPa value indicated above and the Engineer may require the pipe grade to be increased. Trench widths for pipes greater than DN 300 may be varied with the approval of the Engineer to suit actual site conditions and approved working methods provided that the Contractor has proven that the minimum compaction specified is being continually bettered.

For ferrous pipes of diameter less than DN 80 and where a non-barrier, (that is a metallic type coating) such as zinc has been specified or approved as part of the protection system, additional on-site protection as indicated herein for buried screwed joints and joints incorporating bolts must be strictly complied with and no exceptions whatsoever will be allowed.

CERTIFICATE AND SAMPLES FROM PIPE MANUFACTURERS

Where specifically required by the Bidding Document, samples shall have been provided by the Contractor at the time of Bidding and these, if accepted, shall be used for the purpose of comparison with all components of a similar nature delivered subsequently.

Any subsequent goods supplied that do not meet the standards of the sample shall be liable to rejection with all consequences to the cost of the Contractor.

The Contractor shall within 42 days of award, supply to the Engineer a signed certificate from the pipe manufacturer(s) stating that the pipes and fittings comply in all respects with the provisions of these Specification and the indicated National or International Standards, and that the material(s) from which they are to be manufactured conform to the required standards for all raw materials, processes, quality control, manufacturing, while for fully manufactured products this includes where appropriate, the handling to shipment. The pipe and fittings manufacturer's key personnel shall have at least three (3) years relevant manufacturing experience especially in regards to plant management, quality control / quality assurance, application of the coating and lining systems offered in the bid, and selection / batching / mixing of raw materials, and in the case of thermoplastic pipes, the manufacturer (or licensor in the case of local manufacture under license) shall certify that the requirements of SSRN 319 have been complied with. The Contractor shall have submitted reasonable documentary evidence with its bid to support statements made in the bid documents in this regard. The manufacturer shall also state that they have the ability to carry out the necessary tests during the manufacturing process and tests on the finished products as required by the respective standards.

If the manufacturer of any pipe, valve or fitting supplied under this Contract has a Quality Assurance (QA) System complying with ISO 9000/9001/9002, he shall submit a notarised copy of a fully independent 3rd Party certification to that effect together with sufficient information from his Quality Assurance Plan (in English) to enable the Engineer and the Employer to understand the levels of performance he has undertaken to honour. Where a manufacturer is not ISO QA certified, then a full copy of his Quality Assurance Plan (in English), shall be submitted.

The Contractor shall furnish the Engineer with a manufacturer's certificate in respect of every consignment of the pipeline materials, confirming that all the items of the consignment comply in all respects with the requirement of the specified standards and of this specification. The original and one copy of such manufacturer's certificate shall be delivered to the Engineer prior to shipment in the case of imported pipes and prior to despatch from the factory in the case of local manufacture.

504 INSPECTION AND TESTING DURING MANUFACTURE, SUPERVISION BY ENGINEER'S AND EMPLOYER'S REPRESENTATIVES

In addition to Clause 503 during manufacture and before despatch of pipes and fittings from the place of manufacture the Contractor shall allow for inspection by the Engineer or his representative and the Employer of all the manufacturing processes and tests on raw materials and finished products. The inspection may include attendance at all pressure and material tests, execution of dimensional checks and inspection of the workmanship and standard of manufacture with scrutiny of evidence of the materials used in the fabrication of the Pipeline Materials.

The Engineer and the Employer's representative shall be allowed full access to all areas at the place of manufacture or elsewhere where testing, furnishing or preparation of materials for the performance and testing of work under this Specification is taking place.

The Contractor shall furnish the Engineer with reasonable facilities and space (without charge) for the inspection, testing and obtaining of such information as he desires respecting the character of material in use and the progress and manner of the work.

The Contractor shall arrange for such testing at his cost as may be required to be carried out at the place of manufacture according to this Specification. If there are no facilities at the place of manufacture for making the prescribed tests the Contractor shall bear the cost of carrying out the tests elsewhere or avail an acceptable third party institution to carry out such tests.

The Contractor shall supply test certificates and shall furnish and prepare the necessary test pieces and samples and shall supply and provide all test rigs, equipment appliances, labour and any other facility required for inspection and testing.

During the duration of the Contract, the Contractor shall propose a schedule and meet all costs for two inspection visits to the yard of each manufacturer by a total of three representatives of the Employer and the Engineer during the manufacturing and pre-shipment stages.

505 THIRD PARTY INSPECTION DURING MANUFACTURE OF FIRMS WITH OR WITHOUT ISO QUALITY ASSURANCE ACCREDITATION

As quality assurance is considered to be of the utmost importance to ensure the required asset lives, all manufacturers of pipes and fittings shall have facilities that conform to international standards and also carry out tests related to manufacturing process, finished products and handling to shipment.

Where Third Party inspection is specified or in the Engineer or Employer's view becomes necessary, this shall be provided by an independent, non-governmental body acceptable to the Employer. Failure of a manufacturer to avail this in its home country shall require that the manufacturer provide the necessary samples as required by the Engineer for such Third Party inspection in a country where this can be carried out and at its own cost.

In the event, during inspections and tests carried out in the presence of the Employer and Engineer's representatives as stated in Clause 504 if any inadequacies in the manufacturing process are shown resulting in non-conformance in finished products to a level considered unacceptable to the Employer, solely at his own discretion, the Employer will deploy his agent or third party inspector to carry out independent third party inspection. Where such inspections or tests show that there is conformance, the costs shall then be borne by the Employer, but otherwise by the Contractor. In the event of non-conformance, the supply and incorporation of materials from such a source shall be stopped immediately until further notice and the Contractor shall instead provide materials from another approved source. The Contractor shall be required to replace at his cost all the rejected non-conforming materials including the cost of this inspection in the event such third party inspection reveal non-conformance in manufacturing and quality standards. The inspectors from the independent inspectorate shall be provided with full access to carry out third party inspection including the use of the in-house testing processes, failing which all manufacturing at the specific manufacturers premises will be rejected forthwith and all costs of whatsoever a nature, both direct and indirect shall be borne by the contractor.

Contractors are advised to take out the necessary insurances to cover such a possible eventuality, or to have covered these risks in the contract with their manufacturer(s).

506 ACCEPTANCE OF PIPES, VALVES AND FITTINGS

Only pipes, valves and fittings that are manufactured using acceptable materials, tested and delivered by firms which had been proven at the time of tender to be listed under the ISO standards hereinabove provided for, or alternatively, pipes, valves and fittings, which have been certified as acceptable subsequent to Third Party Inspection as herein provided for, shall be accepted as conforming to the Contract. Any other pipes, valves and fittings, shall be liable for rejection at the Contractor's risk, cost and responsibility.

Compliance with the provision of this Clause shall be separate and additional to the Contractor's compliance with the requirements of local customs authorities for pre- or post- shipment inspection of imports into the country. The costs for such inspection shall also be fully borne by the Contractor.

507 MANUFACTURER'S WARRANTY AND MANUALS

The Manufacturer shall specify the warranty period for the various supply items.

Valves and meters shall be guaranteed against faulty design, materials and workmanship for a period of at least 2 years from the date of acceptance subject to their being used only under normal conditions of flow, pressure and temperature specified in this tender for the type and size of meters and also as recommended by the manufacturer. In the event of failure within the guaranteed period, replacement component parts shall be supplied free of charge, including specialised fitment, or the item shall be replaced free of charge.

The Supplier shall state the manufacturer's warranty for replacement of meters due to poor material or bad workmanship or failure to meet the accuracy levels as specified for the class of meter specified.

The Manufacturer shall at his own expenses replace or adjust all meters and valves rejected which can be shown to fail to comply with the specifications or with technical characteristics claimed by the manufacturer.

The Supplier being the Manufacturer's agent shall be held responsible to initiate the necessary claims with the Manufacturer for any meters and valves found defective by the Employer.

Three complete sets of maintenance manuals, spare parts lists, drawings wall charts etc. (in English) required in carrying out tests are to be provided with the valves and meters.

PART II – FERROUS PIPES DURING MANUFACTURE, SUPPLY, INSTALLATION COMMISSIONING & TESTING

For ferrous pipes, emphasis is laid on corrosion protection and therefore no compromise will be accepted in pipe wall thickness, lining and coating, such that as far as possible the asset life is at least 40 years. Unlike thermoplastic pipes, ferrous pipes can withstand higher external pressure and therefore the bedding class requirements are less stringent provided they do not negatively affect the coating. It is pertinently important therefore for the Contractor to ensure that their ferrous pipe manufacturers are able to supply pipes and fittings with the specified lining and coating materials in compliance with the required recognised national or international standards. The manufacturer shall also be able to demonstrate that the lining and coating materials and application provided withstand all the necessary tests as detailed in this specification.

In lieu of this emphasis, it is important that all international and latest updated standards are applicable for ferrous pipes so that the asset useful lives are enhanced by providing more robustness and superior lining and coating materials. Standards that provide superior materials shall therefore apply.

508 DUCTILE IRON PIPES AND FITTINGS - MATERIALS AND STANDARDS,

Ductile iron pipes and fittings shall generally comply with SSRN 202 and other international standards that specify superior pipe thickness and lining / coating materials.

(a) Socketted Pipes

Ductile Iron Socketed pipes shall be centrifugally cast in accordance with SSRN 202. The minimum tensile strength shall be 420 N/mm² and the minimum 0.2% proof stress shall be 300 N/mm². The minimum elongation after fracture shall be 10% for nominal diameters DN 60 to 1,000 and 7% for nominal diameters DN 1,200 to 2,000.

Centrifugally cast ductile iron pipes shall be individually subjected to a works hydrostatic test of not less than 10 seconds duration. For class K9 pipes whose thickness shall be in accordance with SSRN 202, these shall be:

DN	Minimum Works Hydrostatic Test Pressure for K9 (bar)
60 – 300	50
350 – 600	40
700 – 1,000	32
1,100 – 2,000	25

All pipes supplied shall conform to class K9 and fittings to class K12 unless specifically indicated otherwise on drawings or in the bills of quantities.

If specifically called for elsewhere in this Bid Document, for pipe sizes DN 300 and above, the Contractor shall excavate trial pits along the proposed pipe alignment at not more than 500 metre intervals to a depth of not less than 2.0 metres and describe in detail or determine the appropriate native soil modulus for each section of pipe, and manufacturers/ contractors will have been required to submit, detailed calculations for the design of the pipe based on these findings. For pipe sizes DN 300 and greater, the Contractor shall (if required) determine the native soil corrosion characteristics in accordance with SSRN 279 to confirm whether the specified pipe coatings provide adequate protection in keeping with an expected life of 40 years.

(b) Socketted Joints

Socketted joints shall be of the push-on type to SSRN 219 unless otherwise specified on drawings or in bills of quantities. The material used for the rubber gaskets shall be either natural rubber or synthetic elastomer to SSRN 237, and they shall be stored in accordance with SSRN 238.

(c) Flanged Pipes

Ductile Iron Flanged Pipes shall be centrifugally cast to SSRN 202.

They shall be joined using a rubber gasket of minimum thickness of 3 mm which shall be reinforced unless otherwise indicated on drawings or in bills of quantities. The material used shall be either natural rubber or synthetic elastomer in accordance with SSRN 237, which shall be stored in accordance with SSRN 238. Pipe thickness shall conform to SSRN 202 class K9 unless otherwise indicated on drawings or in the bills of quantities.

(d) Internal and External Protections to Pipes

PIPES

Coatings:

All coating for ductile iron pipes shall be barrier coatings and conform to SSRN 272 for Type III soil or equal unless specifically indicated otherwise in the Bills of Quantities.

The coating for urban environments and coastal areas for Ductile Iron Pipes shall be a factory applied heat fused Polyethylene Coating to SSRN 258 either by extrusion or sintering, or by any other similar material of superior coating.

For rural environments and non-coastal areas, Ductile Iron Pipes, as a minimum requirement, may be externally protected by a metallic zinc spray coating to SSRN 220 applied directly to the warm film after annealing and covered by a layer of bituminous varnish to SSRN 239 but this shall only be used with an anodic embedment backfill material. The mass of sprayed zinc metal shall be not less than 130 g/m² and the thickness of the bituminous varnish not less than 70 microns. Such a coating shall not be offered for urban environments and coastal areas, or for soils with a pH value under 6, nor for peaty, boggy, silty or marshy soils.

Where the coating offered comprises zinc and bituminous varnish, a final coat of whitewash shall be applied generally in accordance to SSRN 221(a) to reduce heat absorption. The pipe manufacturer shall also provide a polythene sleeve for site protection purposes. The sleeve shall conform to SSRN 227 and be of minimum thickness of 200 microns.

In the event that corrosive soils are encountered in rural areas, then the pipes shall be externally protected by a factory heat applied fused polythene coating by extrusion or sintering, to SSRN 258 or equal.

In the case of Ductile Iron pipes supplied with a zinc coating and bituminous layer together with polyethylene sleeving in accordance with SSRN 272 or equal, the Contractor shall also supply and install anodic embedment material in accordance with SSRN 272 for Type III soils to the approval of the Engineer and his price will be deemed to have included for the cost of this.

For pipe sizes less than DN 300, if in the opinion of the Engineer native soil corrosion characteristics are worse than allowed for, the Engineer may require additional protection in addition to anodic backfill materials, pipe sleeving, or pipe wrapping. For pipe sizes DN 300 or greater, the Contractor shall (if called for) determine the native soil corrosion characteristics in accordance to SSRN 279 to confirm whether the specified pipe coatings provide adequate protection in keeping with an expected life of 40 years. The Contractor shall test along the alignment of the pipeline at intervals not exceeding 500 m and to a depth not less than the depth of the required trench. Where in the opinion of the Engineer, native soil corrosion characteristics are worse than the expected, the Engineer may require additional protection to be provided involving measures such as anodic backfill material, increased standard of pipe coatings, pipe sleeving, pipe wrapping or cathodic protection complete with the provision for electrical continuity between pipes where necessary. The Contractor shall be compensated for additional protection against corrosion required by the Engineer.

Linings:

Ductile Iron Pipes shall be internally lined with a cement mortar, centrifugally applied and conforming to SSRN 211.

Where the water being carried is specified as being aggressive, the internal face of the cement mortar shall be further protected by a factory applied epoxy coating.

Coating and Lining Tests:

Tests indicating the durability and robustness of the lining and coating shall be carried as specified in SSRN 251 and 272 or equal, and in accordance with the coating and lining specifications.

The supplier shall certify that their lining and coating materials conform to these tests and shall provide the Contractor testing instruments and train technician to operate the instruments for carrying out these tests on site. Visual inspection for damage and holiday testing of barrier coatings at trench side shall be done before laying.

(e) Fittings

Ductile Iron Fittings shall be sand cast in accordance with SSRN 202. The minimum tensile strength shall be 400 N/mm² and the minimum 0.2% proof stress shall be 300 N/mm². The minimum elongation after fracture shall be 5%. All fittings shall be subjected to a works leak-tightness test using water to a pressure as given in SSRN 202.

Fittings shall be to thickness class K12 except for tees that shall be to thickness class K14 unless otherwise indicated in drawings or in bills of quantities. They shall

be protected with a fusion-bonded epoxy, thickness range 305 minimum to 406 micron maximum.

(f) Joints to Fittings

Socketed fittings, except collars, shall be supplied with push-on joints unless otherwise called for on drawings or in bills of quantities. Collars shall be supplied with mechanical joint. Flange fittings shall be fixed by rubber gaskets as indicated above for flanged pipes.

(g) Assistance by Pipe Manufacturer

The Contractor shall utilise the technical services of the pipe manufacturer, unless he already has in his proposed site team a person or persons of appropriate competence with proven experience in the laying of pipes of the type and magnitude to be provided.

The Contractor shall therefore either have clearly stated in his Tender that he has such a person or persons who shall be named and their CV's provided or he shall indicate the extent, nature and duration of the technical assistance he proposes to obtain from the pipe supplier. This shall include details of the personnel to be provided, and the time when such shall be available during the laying and jointing, external pipe protection work, trench backfilling and testing periods and the cost of the above shall be deemed to have been included by the Contractor in his Tender.

(h) Provision of Laying Tools

The Contractor will be deemed to have allowed in his Tender for tools and equipment for use in the laying and jointing of the pipes and specials. The Contractor will also be required to provide a number of cutting devices and spare cutting discs.

(i) Marking

Each pipe, fitting or accessory shall bear the mark of the manufacturer, and indication of its casting and be marked with its nominal diameter. As appropriate, each fitting shall bear an indication of its main characteristics. Pipes, fittings and accessories with a nominal diameter of 300 mm or more shall also bear the year of manufacture. In addition, a referencing system shall be employed by the manufacturer denoting where pipes and fittings are to be stored and located along the route of the pipeline.

(j) Flexible joints for Ductile Iron Pipes

Ductile Iron pipes and fittings between sizes 65 mm diameter and 600 mm diameter shall have sockets suitable for joints to SSRN 219 and DIN 28603 except that from DN 300 to DN 600 mm they may have, as an alternative, sockets suitable for bolted gland joints to EN 545. Rubber rings for flexible joints to Ductile Iron pipes shall comply with EN 681 and EN 682.

509 BARRIER COATED STEEL PIPES AND FITTINGS - MATERIALS AND STANDARDS

Steel pipes and fittings shall generally comply with SSRN 228 (a), SSRN 230, and other national and international standards that specify superior pipe thickness and lining/coating materials. All latest and updated international standards pertaining to steel pipes and fittings shall apply.

(a) Standard Pipes and Fittings

Specifically steel pipes shall dimensionally conform to SSRN 210 and SSRN 228 and in terms of materials, properties and tests to SSRN 213, and where appropriate SSRN 203. Fittings shall in general conform dimensionally to SSRN10, and SSRN 216 however where specifically required the lengths of straight barrel sections may exceed or be less than standard dimensions. They shall be manufactured from pipes that have been manufactured to SSRN 210, SSRN 228, and SSRN 213, and successfully passed all mechanical, dimensional visual, pressure and non-

destructive testing. All new welds made during the fabrication of the fitting shall be subject to non-destructive testing using either radiological, ultrasonic or dye penetrants dependent upon the geometry of the weld. Where necessary fittings shall be reinforced in accordance with SSRN 216.

Flanges will be to SSRN 207. Flexible joints shall be by the use of bolted sleeve couplings to SSRN 244 or flexible grooved joints, with a tapping boss to SSRN 243-where specified in the Bills of Quantities, and of approved pattern. Alternatively, socket and spigot joints may be offered subject to SSRN 230 in which case saddle clamps in accordance with size equivalent to that indicated in the Bills of Quantities for tapping bosses shall be provided at no extra charge.

Fitting ends for use with flexible couplings shall be true ended with the ends appropriately prepared for the type of coupling required.

Joints for site welding shall comprise a socket and special spigot (bell joint with air chamber) to SSRN 244 such that the lining of the spigot shall be undamaged during the welding.

All bolts shall be hot dipped zinc coated and those for bolted sleeve couplings further protected with a topcoat of aluminium pigmented organic epoxy to their respective standards, unless otherwise indicated on the drawings or in the Bills of Quantities.

The Contractor shall demonstrate that the thickness and steel grade provided in accordance with SSRN 228 gives a thickness adequate for the pressure calculated in accordance with SSRN 267. The thickness calculation shall take into consideration the following: the operating pressure, test pressures, pressure transients or surges if applicable, external pressures, steel pipe strength characteristics, temperature, soil condition, trench width and depth and appropriate traffic loads.

If specifically called for elsewhere in this Bid Document, for pipe sizes DN 300 and above, the Contractor shall excavate trial pits along the proposed pipe alignment at not more than 500 metre intervals to a depth of not less than 2.0 metres and describe in detail or determine the appropriate native soil modulus for each section of pipe, and manufacturers/ contractors will have been required to submit, detailed calculations for the design of the pipe based on these findings.

(b) Manufacture of Steel Pipes

The manufacturer shall operate a quality system relating to the manufacture of pipes, and integral joints to the required specification that shall be no less rigorous than that of SSRN 673 to ensure that products consistently meet the required level of quality.

(c) Internal and External Works Protection

PIPES

Coatings:

All coatings shall conform to SSRN 271 for Type III soil or equal and coating thickness shall conform to SSRN 251 (a) or equal unless a less rigorous type soil is indicated.

All coatings for DN 80 and above shall be of the factory applied barrier type.

The preferred coating for buried steel pipes shall be factory applied external protection with triple layer polythene coating (3LPE) to SSRN 241 and SSRN 271 for Type III soil comprising triple wrap system of fusion bonded or sprayed epoxy primer, an intermediate polymer adhesive layer and an extruded polyethylene coating providing an overall total film thickness shall not be less than that specified in SSRN 241(c)) or its equal unless single layer fusion bonded epoxy to SSRN 256

is indicated in the Bill of Quantities. The epoxy thickness should be sufficient to provide a holiday free surface.

For above ground steel pipes a triple layer polypropylene coating (3LPP) with polypropylene to SSRN 241 and SSRN 251 shall be used unless single layer fusion bonded epoxy is indicated in the Bills of Quantities.

Where a 3LPE or 3LPP coating is specified, the manufacturer shall demonstrate that the adhesion of the coating to the substrate does not lessen to the extent that the PE coating could be easily cut or removed with time underground. The manufacturer shall carry out abrasive blast cleaning immediately before applying epoxy primer during the same work shift. In the case where steel plate or bare steel pipe is transported by sea to the place where coatings are applied, the steel or bare steel pipe as the case may be shall be subject to abrasive blast cleaning as well as phosphoric acid washing or chromate treatment immediately before applying epoxy primer during the same work shift.

The polyethylene offered shall be HDPE.

For the pipe sizes less than DN 300, if in the opinion of the Engineer the soils encountered are excessively corrosive, the pipe shall be provided with additional protection such as sleeving, wrapping or cathodic protection as instructed by the Engineer. The Contractor shall be compensated for such additional protection against corrosion.

For pipe sizes DN 300 and greater, the Contractor shall (if required) determine the native soil corrosion characteristics in accordance with SSRN 279 to confirm whether the specified pipe coatings provide adequate protection in keeping with an expected life of 40 years. The Contractor shall test along the alignment of the pipeline at intervals not exceeding 500 m and to a depth not less than a depth of the required trench. Where in the opinion of the Engineer, native soil corrosion characteristics are worse than expected, the Engineer may require additional protection to be provided involving such measures as increased standard pipe coatings, pipe sleeving, pipe wrapping, or cathodic protection. The Contractor shall be compensated for additional protection against corrosion required by the Engineer.

Protection to site welded joints shall be by a solvent free epoxy coating to SSRN 215 or a tape wrap to SSRN 216 as indicated in the Bills of Quantities or offered by the manufacturer.

For sizes less than DN 80, pipes may be protected by hot dipped zinc (galvanised) coating to SSRN 225, and all buried pipes shall in addition be protected by an organic coatings such or a factory applied extruded polyethylene or by bituminous or epoxy paint in at least two coats, or alternatively in rural areas only if the risk of subsequent damage is regarded as very low, by a tight fitting and strapped polythene wrap. In addition all threaded joints and any exposed threads as well as joints incorporating bolts shall be further protected after jointing, and should first be thoroughly cleaned, prepared and then wrapped in a suitable adhesive tape.

Linings:

For sizes DN 80 up to and including DN 300, pipes shall either be protected internally in cement mortar or epoxy at the manufacturers stated option. Cement mortar lining shall conform to SSRN 244, SSRN 211 and SSRN 212. Where the water being carried is specified as being aggressive, the internal face of the cement mortar shall be further protected by a factory applied epoxy coating.

If specifically called for elsewhere in this Bid Document, for pipe sizes DN 300 and above, the Contractor shall excavate trial pits along the proposed pipe alignment at not more than 500 metre intervals to a depth of not less than 2.0 metres and describe in detail or determine the appropriate native soil modulus for each section

of pipe, and manufacturers/ contractors will have been required to submit, detailed calculations for the design of the pipe based on these findings. For sizes above DN 300 pipes and fittings shall be lined in fusion-bonded epoxy conforming to SSRN 241 (b) unless otherwise indicated in the Bills of Quantities or directed by the Engineer.

FITTINGS

Coating and Linings:

Fittings shall be protected externally and internally by fusion-bonded epoxy to SSRN 241 (a) as specified by the manufacturer or required in the Bills of Quantities.

Flexible couplings and self-sealing (grooved) couplings shall be protected externally and internally by fusion-bonded epoxy to SSRN 214 (a).

Self-sealing (grooved) coupling shall, where specified or otherwise allowed, conform to SSRN 210 (d). Bolts and nuts for such couplings shall be hot dipped zinc coated and capped nuts shall be provided. Bolts shall be an exact pre-determined length so that no bolt thread is exposed but so that the capped nut fully tightens without bearing down on the top of the bolt.

If specifically called for, a polythene sleeve to SSRN 227 (a) protruding not less than 500 mm on each side of the joint shall be provided around all flexible couplings outside chambers during underground laying so as to further enhance joint protection, and shall be of minimum thickness of 200 microns. Such sleeves shall be tightly double-strapped at either end using a non-metallic strap.

Coating and Lining Tests:

Tests indicating the durability and robustness of the lining and coating shall be carried out as specified in SSRN 251 and SSRN 271 or equal and where relevant to the coating or lining in accordance with the requirements of the coating and lining specifications.

The supplier shall certify that their lining and coating materials conform to these tests and shall provide the Contractor testing instruments and train technicians to operate the instruments for carrying out these tests on site, or if agreed at the manufacturer's premises elsewhere.

All coating and lining shall be on site visually inspected and tested for holiday free surfaces using the holiday testers. No pipe shall be laid having failed the holiday tests.

The Contractor shall be compensated for additional protection against corrosion required by the Engineer.

(d) Flexible joints for Steel Pipes

Steel pipes from DN 65 to DN 500, outside chambers, may be plain ended suitable for jointing with flexible couplings and flange adapters or grooved for thrust-transmitting self-sealing joints, or with socket and spigot with rubber gaskets as described herein and as indicated in the Bills of Quantities. Steel pipes from DN 550 upwards shall be plain ended suitable for jointing with flexible couplings and flange adapters or with socket and spigot with rubber gaskets where the joint is specifically approved in advance. Steel pipes within chambers shall be suitable for jointing as shown on Tender Drawings.

Where a manufacturer opts for steel pipes with socket and spigot joints, or such joints are specifically called for, such joints shall in general conform to SSRN 210 (d) and SSRN 210 (a), and the manufacturer shall submit calculations that the natural sag under 1.5 m of soil load with 90% compaction and a parked vehicle (wheel load and overload as defined above) will not exceed 2.0% on the spigot end of the pipe with the coating and lining as specified. The socket and spigot assembly shall be capable of withstanding a works test pressure of not less than 1.5 times the nominal

pressure of the pipeline unless indicated otherwise on the Tender Drawings or in the Bills of Quantities. Sockets shall be produced integral with the pipe and be hot formed. Rubber gaskets shall conform to SSRN 222 (a) and (b). Unless a high pressure seal, they shall have a front lip for dirt removal and a back lip for pressure sealing. Unless otherwise indicated on Tender Drawings or Bills of Quantities, the internal faces of the sockets shall be coated in fusion bonded or liquid epoxy. A tight clearance shall be maintained between socket and spigot and should be in the range 1.6 mm +/- 0.8 mm.

(e) Assistance by Pipe Manufacturer

The Contractor shall utilise the technical services of the pipe manufacturer, unless he already has in his proposed site team a person or persons of appropriate competence with proven experience in the laying of pipes of the type and magnitude to be provided.

The Contractor shall therefore either have clearly stated in his Tender that he has such a person or persons who shall be named and their CV's provided or he shall indicate the extent, nature and duration of the technical assistance he proposes to obtain from the pipe supplier. This shall include details of the personnel to be provided, and the time when such shall be available during the laying and jointing, external pipe protection work, trench backfilling and testing periods.

The cost of the above shall be deemed to have been included by the Contractor in his Tender.

510 HOT DIPPED ZINC (GALVANISED) COATED STEEL PIPES AND FITTINGS (GS / GI)- MATERIALS AND STANDARDS

Hot dipped zinc (galvanised) steel pipes shall only be provided where specifically allowed for in the Bills of Quantities and then only in diameters less than DN 80. An acceptable alternative to GS pipes in the diameter range DN15 to DN 65 is to replace the zinc coating by either a coating of FBE or PE (if necessary after grit blasting off the zinc), with jointing then made using either similarly protected flexible couplings or flexible grooved joints. Cold applied zinc is specifically excluded.

Only heavy or medium duty pipes that as a minimum meet the requirements of SSRN 203 (a) shall be supplied and all buried pipes shall be wrapped in a polyethylene sleeve. Where threaded joints are included, the maximum working pressures for GS pipes as given in SSRN 203 (a) shall be reduced by 40%. Because threaded joints are also the weakest point of such pipes both in terms of pressure and corrosion risk, especial care shall be taken after laying at all such joints.

SSRN 278 (a), on protection of metallic materials against corrosion, shall be consulted during design and if necessary, the minimum thickness of galvanising increased accordingly.

In addition joints, and any exposed threads, should be cleaned, prepared and wrapped in a suitable approved adhesive tape in accordance with the tape manufacturer's instructions. In preparing the joint for wrapping and after cleaning this shall include the application of proprietary mastic adjacent to each side of the socket, tapered up from the pipe to the socket so as to present a smooth transition between diameters of pipe and socket and facilitate the application of the wrapping.

511 JOINING TO STEEL PIPES WITH BARE STEEL ENDS, ABOVE GROUND PIPELINES AND FITTINGS AND PIPELINES IN BACKFILLED TRENCHES BOLTED BY FLEXIBLE COUPLINGS (MOULDING METHOD)

Where exposed ends of existing sheathed steel pipes have not been factory coated with epoxy as indicated in Clause 509 then the external protection to sheathed pipes and fittings jointed by mechanical couplings shall be completed by moulding the couplings with an enamel composition compatible with the enamel used for the pipe sheathing i.e. a bituminous composition shall be used on pipes and fittings sheathed with bitumen

(asphalt) enamel, and a coal tar composition shall be used on pipes and fittings sheathed with coal tar enamel.

The exposed end of the pipe shall be thoroughly cleaned (including removing whitewash from that portion of the sheathing adjacent to the joint) and dried together with that portion of the pipe that will come within the moulding box and the whole shall be painted with the quick drying primer supplied.

The inside of the moulding box and externally around the pouring gate shall be coated with a thick wash of lime or similar material to prevent any possibility of the moulding box sticking, and shall be dried thoroughly before use.

The moulding box shall be fitted around the coupling so that the pouring gate is at the top and the flanges and bolts of the coupling sit centrally in the recesses provided for them in the moulding box. The clip or bolts of the box shall be fitted and tightened and all joints sealed, including the joints between the box and pipes, with clay or similar material to prevent the hot composition from running out.

The enamel composition shall be heated in an approved boiler (to be provided by the Contractor complete with an accurate thermometer) to the temperature recommended by the supplier, and stirred during melting to prevent overheating and the filler settling to the bottom.

The fluid enamel composition shall be slowly poured (at the temperature recommended by the supplier), taking care to prevent air-locks, until the gate is filled. The gate shall be kept filled by toppling up as necessary to allow for cooling shrinkage.

The moulding box shall be removed as soon as it is cool enough to handle by which time the enamel will have set. The moulding may be cooled with water to make the enamel set more quickly.

Any defective part of the moulding shall be immediately repaired by applying hot enamel composition with a trowel.

It may be necessary to support the moulding box on larger diameter sheathing pipes to avoid the box from sinking into the pipe sheathing which may have become softened by the hot enamel in the box. The moulding box must be re-coated with lime wash before being re-used.

The Contractor shall provide all other materials required for completion of external protection by the moulding method, and if the pipes and fittings are supplied under this contract, then the full costs of meeting these requirements shall be at the cost of the contractor

512 PACKING FOR TRANSPORT – FERROUS PIPES

Pipes up to DN 300 may be bundled; with larger sizes packed loose. Containerised packing and transportation is also acceptable and if proposed shall be so indicated by the Tenderer. Notwithstanding any intention to utilise containers, all nuts, bolts, rubber gaskets etc. shall be packed in wooden boxes and protected against the elements. Nesting of pipes is not permitted. Fittings up to and including DN 200 and flanged pipe pieces up to DN 200 and length not exceeding 1 metre shall also be packed and supplied in wooden boxes. All other fittings and flanged pipes may be packed loose. All flanges shall be protected with discs of wood, wool, fibre or timber. Bolted gland joints and flexible couplings shall be bundled if not containerised. Pipe sockets, spigots, plain ends shall be protected by suitable wrapping prior to transportation

The Contractor shall further have described in his Tender in full detail the method(s) of offloading for imported items or on- loading for locally manufactured ex-works items, the methods of road/rail transportation and of site off-loading including the lifting methods intended. He shall further have described in his Tender in full detail the method(s) of stacking and storage. His Tender shall also be deemed to have included for the

transportation as described and for the provision of all the necessary facilities for off- loading at the storage sites, and for proper stacking and storage.

At the time of tendering the Contractor shall also have stated the approximate areas of land required for the off- loading, and stacking of the pipes and for the storage of the fittings and of any special protection/storage facilities needed for any particular item(s) of his goods The following table indicates the maximum stacking height allowable:

Nominal Pipe. Diameter in mm	Maximum number of layers in stack, ferrous pipes
Up to 100	16
150	14
200	12
250	10
300	8
350	7
400 - 450	6
500 - 600	4
700 - 800	3
900 - 1400	2

Distribution of Materials from Storage

The Contractor shall make his own arrangement for storage including for temporary occupation of the necessary land, provision of suitable fencing, preparation of site and security.

The selected storage areas shall be suitably close to the final pipeline alignment.

When pipes are being loaded into vehicles care shall be taken to avoid their coming into contact with any sharp corners such as cope irons, loose nail heads, etc. Whilst in transit, pipes shall be well secured over their entire length and not allowed to project unsecured over the tailboard of the lorry. Pipes may not be offloaded from lorries by rolling them. Pipes shall not be rolled or dragged along the ground.

513 IN-COUNTRY STORAGE, HANDLING AND TRANSPORTATION OF FERROUS PIPES

Storage Areas

The Contractor shall provide storage of pipes in a manner and in facilities approved by the Engineer. At the Engineers discretion, ferrous pipes in diameters greater than 200 mm for laying in rural and peri-urban areas may be offloaded directly in the vicinity of the pipe trench provided the conditions and stacking method meet the requirements indicated below

Pipe Stacking and Storage

Pipes shall be stacked at the pipe storage areas using one or all of the following methods.

- square stacking for small diameter pipes
- parallel stacking using wooden roller boards
- pyramidal stacking

All pipes shall be stacked on raised wooden battens at least 100 mm thick and 225 mm wide. A minimum of three battens per pipe for ferrous pipe lengths not exceeding 6 metres should be used with the outer battens laid 600 mm in from both pipe end and the middle batten placed equidistant between them. For ferrous pipe lengths greater than 6 metres, four battens shall be used. Pipe stacks shall be suitably wedged and the Tenderer shall be deemed to have included for an adequate number of timber, wedges, etc., in his Tender.

Where socket and spigot pipes are stacked, the sockets should be placed at alternate ends of the stack with the sockets protruding.

514 DISTRIBUTION OF FERROUS PIPES FROM STORAGE

Ferrous pipes of DN 200 and less may be distributed from storage to the trench side no more than 7 days prior to laying whilst ferrous pipes above DN 200 may be strung out up to 15 days prior to laying. Stacking of pipes at trench side shall not be allowed.

In all instances when along trench sides, ferrous pipes shall be supported within 1 metre of either end on sand filled bags such that no part of the wall of the pipe touches the ground, and in the case of pipes over 6 metres long with additional central sand bags.

When pipes are being loaded into vehicles care shall be taken to avoid their coming into contact with any sharp corners such as cope irons, loose nail heads, etc. Whilst in transit, pipes shall be well secured over their entire length and not allowed to project unsecured over the tailboard of the lorry.

Pipes may not be offloaded from lorries by rolling them. Pipes shall not be rolled or dragged along the ground.

515 FLANGED JOINTS FOR FERROUS PIPES AND FITTINGS

Where specifically called for or deemed appropriate, flanged joints shall be utilised. They shall conform to SSRN 207, drilled to NP 10 except where otherwise indicated on drawings or bills of quantities, with gaskets made of reinforced elastomer rubber to SSRN 208 and of minimum thickness of 3 mm. They shall be stored in accordance with SSRN 238.

Bolts for flanged joints shall be SSRN 938 threaded to SSRN 923, nuts to SSRN 939 and washers to SSRN 925. Bolts, nuts and washers shall be protected to SSRN 921 for above ground installation and to SSRN 922 for below ground installation and in chambers. Nuts for use with self-sealing joints for steel pipes shall be as described under the section for service connections. Exposed threads of all bolts shall be fitted with a tight plastic cap after flange assembly along the full exposed length.

516 FLEXIBLE JOINTS

Where specifically called for or deemed appropriate flexible couplings shall be used and shall be coated with fusion bonded epoxy layer 350 microns thick. Flexible couplings shall be of a mechanical type coupling consisting of a centre sleeve, two end ring flanges, two wedge shaped sealing rings of grade T Nitrile rubber, and with galvanised nuts and bolts. The main components shall be made from hot rolled steel for larger diameters and malleable cast iron to SSRN 911 or ductile iron for smaller diameters. If specifically called for, couplings shall be provided with a suitably sized screw plugged hole in the sleeve to allow for the introduction of molten bitumen for additional internal protection. The manufacturer shall then include the necessary removable internal backing-up rings of rubber composition and shall further include for all materials for in-situ jointing and protecting both for remedial works and for internal and external protection at such joints. After jointing, the exposed part of the bolt shall be provided with a tight fitting polythene protection cap unless capped nuts are used.

517 COMPLETION OF EXTERNAL PROTECTION AT FLEXIBLE JOINTS ON FERROUS PIPELINES

The completion of the external protection at flexible joints on ferrous pipes and fittings (other than hot dipped zinc steel pipes) shall be carried out as detailed below as appropriate and shall be to the satisfaction of the Engineer's Representative. The costs thereof shall be deemed to be allowed for within the Tender.

(i) Above ground pipelines and fittings and in backfilled trenches Bolted by Flexible Joints

In all cases where the pipe joint has involved the use of nuts and bolts, the exposed threads of every bolt shall first be thoroughly cleaned and then coated with an approved zinc-rich paint allowed to dry for not less than 24 hours before proceeding with further protection as indicated below.

(ii) Above ground pipelines and fitting and in backfilled trenches Bolted by Flexible Couplings for Coal Tar or Bitumen coated Pipes and fittings supplied without epoxy coating (Moulding Method)

Where for whatever reason, any such flexible couplings have not been factory epoxy coated then the external protection to such mechanical couplings shall be completed by moulding the couplings with an enamel composition compatible with the enamel used for the pipe sheathing; i.e. a bituminous composition shall be used on pipes and fittings sheathed with bitumen (asphalt) enamel, and a coal tar composition shall be used on pipes and fittings sheathed with coal tar enamel.

The assembled coupling shall be thoroughly cleaned (including removing whitewash from that portion of the sheathing adjacent to the joint) and dried together with that portion of the pipe that will come within the moulding box and the whole shall be painted with the quick drying primer supplied.

The inside of the moulding box and externally around the pouring gate shall be coated with a thick wash of lime or similar material to prevent any possibility of the moulding box sticking, and shall be dried thoroughly before use.

The moulding box shall be fitted around the coupling so that the pouring gate is at the top and the flanges and bolts of the coupling sit centrally in the recesses provided for them in the moulding box. The clip or bolts of the box shall be fitted and tightened and all joints sealed, including the joints between the box and pipes, with clay or similar material to prevent the hot composition from running out.

The enamel composition shall be heated in an approved boiler (to be provided by the Contractor complete with an accurate thermometer) to the temperature recommended by the supplier, and stirred during melting to prevent overheating and the filler settling to the bottom.

The fluid enamel composition shall be slowly poured (at the temperature recommended by the supplier), taking care to prevent air-locks, until the gate is filled. The gate shall be kept filled by toppling up as necessary to allow for cooling shrinkage.

The moulding box shall be removed as soon as it is cool enough to handle by which time the enamel will have set. The moulding may be cooled with water to make the enamel set more quickly.

Any defective part of the moulding shall be immediately repaired by applying hot enamel composition with a trowel.

It may be necessary to support the moulding box on larger diameter sheathing pipes to avoid the box from sinking into the pipe sheathing which may have become softened by the hot enamel in the box. The moulding box must be re-coated with lime wash before being re-used.

The Contractor shall provide all other materials required for completion of external protection by the moulding method.

(iii) Where pipes and fittings are to be concreted in (Wrapping Method)

The external protection to pipes and fittings jointed by mechanical couplings, flanged joints, "Tyton", type or Bolted Gland joint, or similar shall be completed by wrapping the joint with approved petrolatum tape prior to which the area shall have been cleaned by an approved proprietary paste and the area protected by an approved proprietary mastic. It shall then be wrapped in PVC 'outerwrap' or similar material.

The whole joint shall be thoroughly cleaned removing all loose rust and extraneous matter and the approved paste rubbed well over the whole of the joint and for a few centimetres either side of the joint over the pipe sheathing. A liberal amount of paste shall be left around all bolt heads, narrow cavities, etc.

The approved mastic shall be applied to cover all bolt heads and nuts, forced into the annular gap between the spigot and socket in the case of 'Tyton' type or bolted gland joints, formed as a triangular fillet against the face of socket or flanges and filled in all gaps and abrupt change in contour to provide an even contour for wrapping.

The approved tape shall be applied circumferentially, starting and finishing at the top of the joint care being taken to smooth and eliminate any air pockets and to form the tape well into all angles and changes in contour. The tape should extend on to the pipe sheathing on either side of the joint by at least 50 mm and the tape should be applied with a minimum overlap of 25 mm.

An outer wrapping of 'PVC Outerwrap' shall be finally applied over the approved tape'. This wrapping should extend at least 500 mm on to the pipe sheathing and should be applied with a minimum lap of 50 mm.

All the above mentioned materials shall be provided by the Contractor and deemed covered in his rates.

518 BUTT WELDING OF STEEL PIPES

Welding of joints, where required or directed, shall be carried in accordance with SSRN 210 and SSRN 670 (butt welding).

The Contractor shall demonstrate his experience in large diameter welded steel pipe construction by example of completed works of similar size and nature. All field welding shall only be done by welders who satisfy the requirements of SSRN 671 and who have been tested by an independent testing authority.

Before any welding of pipeline materials commences, the qualification of welders shall have been approved, all detailed welding procedure specifications with weld diagrams required for their completion shall have been submitted for approval by the Engineer, and the welding procedure qualification tests shall have been successfully concluded all in accordance with the relevant standard specifications. Sufficient records shall be kept by the Contractor to ensure that all field welds can be subsequently identified with the welder concerned.

No welding shall be carried out during rain or high wind or under dusty conditions unless the welder, the weld area and the weld are adequately protected and sheltered.

Only welding rods which have been kept dry and uncontaminated shall be used. Welding rods shall be of a grade and quality such that the chemical composition of weld metal and parent metal is similar. Preheating of the rods and base metal is not usually necessary where temperature exceed 70°F (21°C) to avoid condensation of moisture which could produce porosity in the weld.

The Contractor shall submit to the Engineer a detailed method statement for constructing the pipeline using welded joints which shall include, but not be limited, to:

- details of the Contractor's skilled labour and supervision staff who shall have direct experience in the construction of large diameter welded steel pipe
- details of the Contractor's plant to be deployed
- design details for the welded steel pipeline to include proposals to allow for pipe movement, thrusts, expansion and earthquake loading
- quality assurance proposals for testing the integrity of the welds

These details shall be submitted to the Engineer for his approval not later than 84 days before the Contractor wishes to commence pipe laying. The Engineer shall inform the Contractor of his approval or otherwise within 28 days of receiving all necessary information.

Where the Engineer approves the use of site welded joints the Contractor shall submit for approval all details, designs and drawings necessary to modify the design at least 28 days before the commencement of pipe laying.

Welded pipe joints shall not be considered as an alternative to flanged or other flexible flanged adaptors or tied flexible joints where specifically detailed on the drawings.

Pipes and specials to be joined by field welding shall be supplied with ends bevelled for welding. A holdback band that is free of lining and coating shall be left on the inside and outside surfaces at the ends of the sections. This band shall be of sufficient width to permit the making of field joints without damage to the lining and coating. The holdback band shall be protected by material that can easily be removed, but provide protection of the steel up to the time it is joined (factory/ transportation/ period delivered on site until welded). Before welding, the joints are to be cleaned free from any impurities and protections.

Field butt welding shall be carried out in accordance with SSRN 670.

Before welding of joints proceeds, pipe ends shall be completely circular (cut end should be perpendicular to the pipe axis with zero tolerance to ensure straight portions of the joint pipes unless where deflection horizontal/vertical is specified) and properly mated up by means of backing rings (with a 2 mm gap). At least 4 tack (depending on pipe size) welds equally spaced around the pipe perimeter shall be applied to maintain the root gap and position of the pipe for completion of welding.

A protective plastic or rubber sheet shall furthermore be placed over the coating adjacent to the joints to protect same from damage caused by (welding spatter/corrosion before jointing).

Root welds shall thereafter be carried out followed by successive filler passes, and capper passes, all in accordance with the approved welding procedure. The inside weld bead shall not extend more than 1 mm into the bore of a pipe or special, or must be ground off.

Horizontal weld seams or spiral weld seams at pipe ends shall be placed near the horizontal diameter of the pipe or special and shall be staggered so that the circumferential distance between longitudinal or spiral welds intersecting the same circumferential butt weld, is not less than 90 mm nor more than 130 mm apart.

Defects caused by stray welding arc flashes, weld spatter etc. shall be removed by grinding provided that pipe wall thickness are not reduced to less than the specified minimum thickness, otherwise the portion containing the defect shall be cut out and repaired.

During welding of pipes with organic linings, mats of thick rubber felt or other suitable material shall be placed along the pipe invert to protect the pipe lining for the full distance from the point of access up to the point of weld or weld inspection. The mats shall be of sufficient width and shall cover a sufficiently wide area of pipe invert to protect the lining against damage due to access by staff, equipment, inspectors or fall out from arc weld. Workmen shall wear soft, rubber-soled shoes before entering lined pipes.

Care shall be taken not to stroke arcs on epoxy-lined areas and protective tapes, if any, at ends of epoxy lined pipes shall only be removed immediately prior to welding.

Pipes may be welded together alongside the edge of the trench. For factory lined and coated pipes, the maximum length so welded together shall be such that:

- the pipe can be subsequently stored, lifted or handled without damage to linings or coatings
- the out of roundness at a plane perpendicular to the pipe axis at any point along the pipe length during storage, lifting or handling does not exceed 4% of the minimum inside diameter (out of roundness being measured as the difference between the minimum and maximum inside diameter of the plane at the point)

- safe and easy access to internal tie-in welds are assured for staff and inspectorate with equipment
- the maximum length does not exceed 24 m

All field welds shall be inspected visually with special attention given to the line-up and the root run or stringer bends. Non-destructive (ultrasonic) testing of each completed weld shall be carried out immediately after the welding has been completed. Randomly selected welds (about every 10th) shall be tested using radiographic methods with procedures in accordance with SSRN 670.

On completion and inspection of joint welding, remedial works shall be carried out on the internal lining and external coating as specified below. Not more than 2 pipe joints (24 m joint section) for pipe diameter DN 600-1200 shall be welded without completion of internal remedial works to joints.

519 COATING REPAIR

Repair of damage to coating and final coating to welded joints shall be done in accordance with SSRN 215 and the manufacturer's instructions, but shall as a minimum comply with the following:

- Area requiring repair shall be cleaned to be free from mud, oil, grease, welding flux, weld spatter or other foreign contaminants.
- The surface shall be abrasive blasted, vacuum blasted or abraded using surface grinders to provide an acceptable surface. The adjacent epoxy coating shall be feathered by abrading the surface for a distance of 25 mm.
- The liquid epoxy coating shall be applied to the prepared areas as recommended by the manufacturer. If more than one coat is applied, the second coat shall be applied within the recommended time limits, surface conditions and temperature.
- After curing, the coating shall be tested by a holiday detector. Any holidays detected shall be marked and repaired.

520 TRENCH EXCAVATION AND EARTHWORKS FOR FERROUS PIPES

This clause for excavation shall apply except for thrust boring as specified in Clause 549 below.

- (i) All trench excavation will as a minimum precaution be taped off to alert members of the public to its existence.
- (ii) The excavation shall be made in open cutting unless tunnelling or heading is specified by the Engineer's Representative or it is specified in the Bills of Quantities.
- (iii) Trenches for pipes shall be excavated to the lines and depths shown on the Drawings, or as directed by the Engineer's Representative, and shall be of sufficient width to give an equal clearance on both sides of the barrel of the pipe or pipes such that in general the total trench width is $3/2$ 'D' where 'D' is the outside diameter of the pipe or the average outside diameter of the group of pipes or will be equal to the outside diameter or the pipe plus 300 mm on each side whichever is greater. For pipes bedded in concrete sections, the breadth of concrete bedding for the pipes will be equal to the width of the trench. Excavation for fire hydrants, valve chambers or any other water works structures, shall be carried out to the levels and outlines of such structures, and the rates shall include for any additional excavation or other temporary Works required.
- (iv) If in the opinion of the Engineer's Representative delays in laying are due to the fault of the Contractor and the ground becomes weathered prior to the laying of the pipes, the Contractor shall remove the weathered soil and replace it with suitable compacted material to the original formation level at his own expense.

- (v) Where pipes are not laid on concrete, the bottoms of the trenches as excavated, shall be smooth and shall be free from stones or other projections. Holes cut out at the joints in the lower bedding shall be of as small a size as possible throughout their entire length. The trench shall be dug to within 150 mm of its formation and proper grade pegs shall then be set in the bottom of the trench by the Contractor for the accurate taking out of the rest of the excavation. Grooves about 50 mm deep shall be cut across the trench in the lower bedding at the required positions to enable the easy removal of pipe slings.
- (vi) Where an imported lower bedding layer is not included and if instructed to do so by the Engineer's Representative, the pipe trench shall be excavated to a depth of 100 mm below the invert of the pipe and be refilled with suitable 'as-dug' material free from stones greater than 20 mm dia. and foreign matter and compacted to a minimum 90% MPD in order to provide a smooth bed for the pipes.
- (vii) The materials excavated from trenches shall be laid completely and neatly on the sides of the trench except where in the opinion of the Engineer's Representative this would so obstruct a road or footpath as to prevent the passage of traffic or pedestrians. In such cases the Contractor must dig out the pipe trench in such lengths as directed and keep his excavated material at such a distance as may seem advisable, and the rates shall be deemed to cover for this.
- (viii) During excavation, the Contractor shall ensure that all material suitable for re-use and which he intends for re-use are kept separate and set aside and protected as necessary to prevent loss or deterioration. Materials forming the surface and foundations of roads shall when excavated and if required for further use, be carefully separated. Paving slabs, bricks and similar surfaces shall be carefully removed and stacked for re-use, or as otherwise instructed by the Engineer's Representative.
- (ix) No pipes shall be laid nor lower bedding introduced and no excavation filled in or covered with concrete until the formation has been inspected and permission to proceed with the Work obtained. The Contractor shall provide to the Engineer, a weekly schedule in advance indicating the dates and approximate times he expects to request such inspections.
- (x) Where pipes are to be laid under a road formation or in open country, or in cutting, trenches shall generally be excavated after the earthwork is completed. The Engineer's Representative may permit these pipe trenches to be excavated before the earthwork is complete, but payment for the excavation of the trench will only be made upon the volume excavated below the road formation.
- (xi) The unit of measurement for the excavation of trenches shall be per linear metre or per cubic metre of void calculated from the deemed width of the trench, and the average depth of excavation as mentioned in the Bills of Quantities. Unless otherwise indicated, for valve chambers and other water works structures, the unit of excavation will be per number or per cubic metre of excavated material calculated to the exact outer dimensions and depths of the Permanent Works. In neither case will allowance be made for bulking.
- (xii) The rates for excavation of trenches in "normal" material shall include removal of all material except "rock", selecting and segregating material to be backfilled in special layers, supporting or sheeting, shoring and strutting, any additional working space or room for timbering or sheeting required, dealing with water, maintenance of the trench, and all labour, tools, materials, plants, supervision, overheads and profit.
- (xiii) The provisions of the above Clause shall apply to the rates of excavation in "rock" and in addition the Contractor shall also allow in his rates for back-filling the invert with Class 15 concrete or other materials as directed by the Engineer's Representative and removing to a spoil dump all "rock" excavated.

- (xiv) Where rock is encountered and should the Contractor wish to excavate the rock in advance and temporarily to refill the excavated trench with the excavated material until he is ready to proceed with the laying of the pipe, he shall be permitted to do so, which permission must be given in writing by the Engineer. Such work shall normally be included in the Contractors rates unless he can show that the amount of rock is in excess of the amount billed to an extent that his work programme will be unduly delayed if he does not do so. In such a case he may seek to be paid both the E.O. item rate for the rock and twice the rate quoted for excavation in class III material.

521 PIPE LAYING FOR FERROUS PIPES

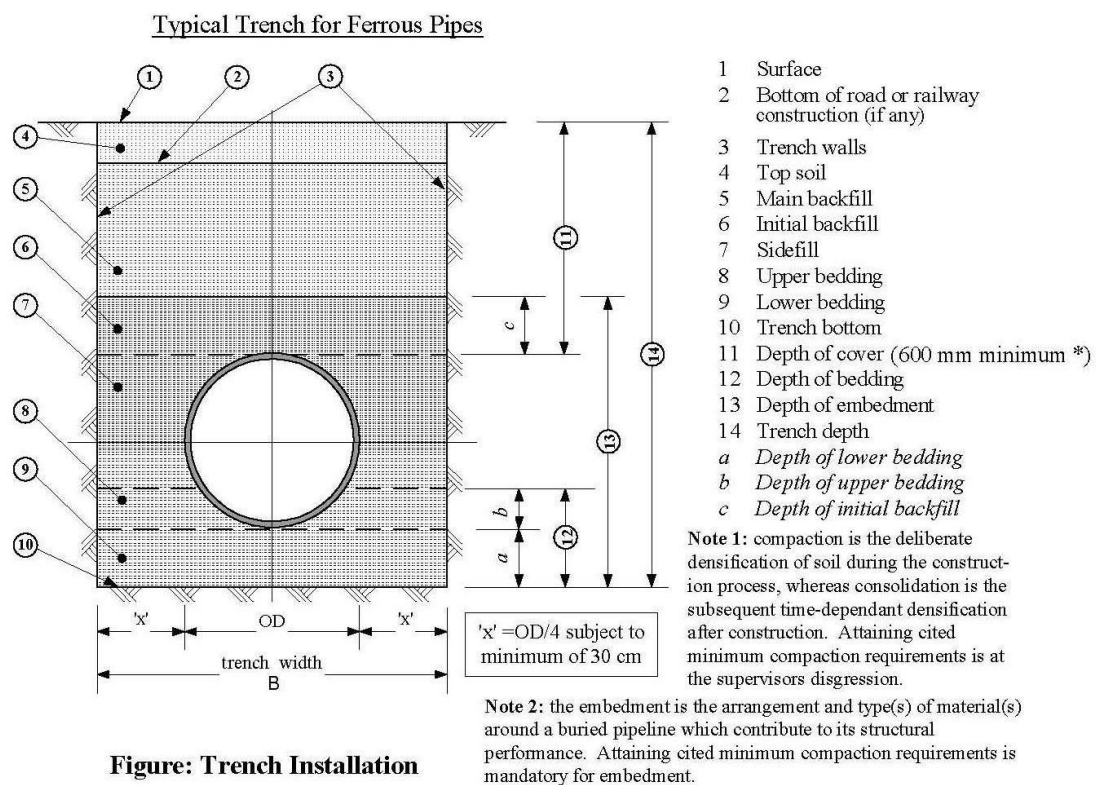
- a) Pipes shall only be laid in the presence of an Engineer's Representative unless written authority from the Engineer has been granted.
- b) Pipes generally shall be laid and jointed in accordance with the manufacturer's instructions. Extra excavation must not be carried out so as to avoid backfill, excessive deviation in joints and other irregularities. Otherwise, the pipe grade will follow the Drawings, with a continuous (but not necessarily uniform) fall towards washout-valves and rise towards air-valves.
- c) Prior to laying, damage to linings or coatings shall be repaired in accordance with the manufacturer's instructions and this will be the Contractor's liability. Where, in the opinion of the Engineer or his representative, the damage to a pipe coating is significant and notwithstanding the repairs made in accordance with the manufacturer's instructions, the complete pipe shall be further protected by a polythene sleeve. The sleeve shall conform to SSRN 227 (a) for steel pipes and SSRN 227 (b) for DI pipes and be of minimum thickness of 200 microns. It shall be strapped beyond the joints of adjoining pipes using a non-metallic strap around the pipe. All costs of supply and installation of such additional protection shall be to the Contractors account.
- d) Every pipe shall be laid separately and shall bear evenly upon the lower bedding or concrete for its full length, holes to receive sockets, couplings or flanges being cut in the bottom of the trench of such size and depth as to allow the joints to be properly made. The pipes shall be laid to true inverts, straight lines and falls, each pipe being separately boned between sight rails. Before lowering into the trench or placing in position each ductile iron pipe or casting shall be slung and sounded with a mallet to test for hair cracks. Pipes that do not ring true will be discarded. For ferrous pipes with barrier coatings, the coating, and where appropriate the lining of every pipe shall be inspected by use of holiday detectors in accordance with SSRN 280 and SSRN 281. Unless otherwise authorised in writing by the Engineer to carry out such inspections in a nearby storage yard, such inspections shall be carried out at the trench side immediately prior to lowering into the trench. Each pipe shall be thoroughly brushed inside and outside prior to laying and no foreign matter shall be allowed to enter the pipe during or after laying. At the end of each working day the exposed pipe end shall be stoppered up with a stopper plug of appropriate diameter and not merely covered in polythene sheet tied around the end.
- e) Trenches shall be bottomed up only immediately in advance of pipe laying, although at least 15 metres shall be prepared in advance of any given pipe. Trenches and joint holes shall be kept free from water, until the pipes are laid and the joints completed and no ground water shall be allowed to enter the new pipes.
- f) Prior to laying in trench, the lower bedding in the trench must provide support throughout the entire length of the pipe. The pipe shall never be laid directly on cohesive, rocky or stony material. Where the natural trench bottom meets the bedding class required, this shall initially be loosened to a depth of 100 mm and then re-compacted to at least 90% MPD and then the surface loosened on the day of and prior to laying

- g) In rock excavation, the pipes shall be bedded on concrete or selected granular fill, e.g. sand, to a minimum thickness of 150 mm and the exclusion of rocks and other hard material to at least 300 mm around the pipe, leaving proper joint holes and subsequently making good with selected materials to the Engineer's Representative's approval.
- h) All flanged joints shall be made with jointing rings, which shall be carefully inserted concentric to the bore of the pipe, so that undue stresses shall not be caused in any of the bolts or on the flanges when bolting up. The joint ring shall be compressed gradually and evenly by taking a few turns on each diagonal bolt in succession. Over-tightening shall be avoided. If the Engineer is dissatisfied with the degree of care being taken, the Contractor shall provide and use torque-wrenches for this purpose at no extra cost.
- i) Mechanical joints shall be made in accordance with the manufacturer's instructions. After successful testing of pipelines, the joints will receive external protection as specified or to the Engineer's Representative's approval.
- j) The threads of any screw connections shall be coated with red lead before the joint is made.
- k) Concrete anchor blocks shall be provided at bends, tees, stopped ends, etc. as shown on the drawings or as directed by the Engineer's Representative.
- l) Where a pipeline crosses under roads or railway lines, and if required by the relevant authority, the pipe shall be sleeved or surrounded with concrete or protected by reinforced concrete slabs as instructed by the Engineer's Representative, and Contractors shall have been deemed to have made allowance in their rates at the time of tender for compliance with the requirements of the relevant authority.
- m) For the insertion of valves and other fittings into existing pipelines, pipes may need to be cut. Approved tools and machines specially made for the purpose, shall be provided and used by the Contractor.
- n) The Contractor shall provide and fix wooden drumheads to the open ends of the mains, and similar drumheads shall be used to close the ends of any pipes to exclude dirt and stones, etc., when the pipe laying is not actually in progress. Wooden markers properly inscribed, shall be left projecting out of the ground to indicate the ends of all pipes, where these are buried in the ground in open country. In public highways, a danger sign or other suitable means as approved by the Engineer's Representative shall be adopted.
- o) At every point of loading or unloading, pipes must be handled by approved lifting tackle. (Unloading by rolling them down planks of any form or including ramp will not be allowed except with the special consent of the Engineer's Representative).
- p) The stacking of pipes shall be used such as to prevent damage during storage. Timber runners shall be laid to keep the upper row separated from the lower and the bottom row shall be staked to prevent any rolling. The whole arrangement shall be subject to the approval of the Engineer's Representative.
- q) Care should be taken to minimise the risk of bush fires damaging any pipes, their coatings and linings laid out along the line of the mains.
- r) Refilling of pipe trenches shall conform to the specifications provided in Clause 522. s) The requirements for making good any ground subsidence after refilling are provided for in Clause 523.
- t) Reinstatement of surfaces shall conform to the specifications provided for in Clause 524.

- u) For Ferrous Pipes Laid in Trenches the soil cover shall be a minimum of 600 mm. and the embedment material required is S3 (sand and coarse grained soil with less than 12% fines) for epoxy lined steel pipes and class S4 and for ferrous cement mortar lined pipes in all cases with a minimum of 90% compaction. For details of the trench specifications, and backfill material sizes refer to Clause 522 Contractors shall be deemed to have made full allowance in their Tender for the price of such trenching and importation of necessary backfill material and compaction as part of the pipe installation price.

522 BACKFILLING OF PIPE TRENCHES- FERROUS PIPES

All excavation of pipe trenches shall be of such form and to dimension as shown on the drawings or as the Engineer's Representative may direct, and in all respects provide with embedment configurations and minimum covers as detailed here below. As a general rule trench width shall be not less than 1½ times the OD of the pipe but subject to the following figure and tables.



* Minimum cover 600mm, except for Transmission mains, where minimum cover shall be 900mm.

Minimum Trench Width

Pipe Size DN	Trench Width
General	Minimum 600 mm
≤ 125 mm	D + 450
150 – 300	D + 600
> 300	To suit site condition and to the approval of the Engineer

Lesser trench widths may only be authorised if the Contractor can prove to the satisfaction of the Engineer that he can consistently achieve the required compaction for a lesser width in which case an absolute minimum of OD + 450 mm may be permitted.

In areas prone to waterlogging or where specifically called for on the Drawings or in the Bills of Quantities class S1 or S2 material shall be used for lower bedding in accordance with the following gradings:

Embedment for Flexible and Semi Rigid Pipes Ferrous

Embedment Class	Embedment Material Allowed	Notes
S1 and S2	Class S1: Gravel – single size Class S2: Gravel – graded	Normally processed granular materials where specified as bedding for ferrous pipes
S3 –S4	Class S3: Sand and coarse grained soil with less than 12% fines; Class S4: Coarse grained soil with more than 12% fines OR Fine grained soil, liquid limit less than 50%, medium to no plasticity and more than 25% coarse grained material	These represent “as dug” soils but require particularly close control when used with low stiffness pipes. Class S3 shall be used for epoxy lined steel pipes whilst class S4 is suitable for cement mortar lined ferrous pipes

S1 and S2 Material for Lower Bedding of Ferrous pipes where specified

Nominal Pipe Diameter (mm)	Grading [to ASTM Sieve Sizes]	
	S1 Embedment	S2 Embedment
80	10 single-size gravel	10 single-size gravel
100	10 single-size gravel	10 single-size gravel
150	10 or 14 single-size gravel	14 to 5 graded
200 to 500	10, 14 or 20 single-size gravel	14 to 5 graded or 20 to 5 graded
> 500	10, 14, 20 single-size crushed rock, or gravel	14 to 5 graded or 20 to 5 graded

- (i) The placing and compaction of pipe embedment shall only be undertaken in the presence of an Engineer's representative unless written authority from the Engineer has been granted.
- (ii) No pipes shall be laid nor lower bedding introduced and no excavation filled in or covered with concrete until the formation has been inspected and the permission to proceed with the Work obtained.
- (iii) In every instance, embedment material (consisting of bedding, side fill and initial backfill) filled around the pipe and for 300 mm over the top of the pipes shall be free from stones, tree roots or similar objects which through impact or by concentrating

imposed loads might damage the pipes, and shall not include black cotton type soil. The filling shall be carried out with utmost care, special attention being paid to tamping of material around the pipes and to joint holes so as to obtain the greatest possible compactness and solidity. The material shall if necessary, be screened to exclude material which would damage the pipes. The material shall be in accordance with the relevant pipe bedding drawing but no worse than a class S3 material for epoxy lined steel pipes (sand and coarse grained soil with not more than 12% fines) or an S4 material for cement-mortar lined ferrous pipes and the source and material shall be approved by the Engineer's Representative before excavation commences. Any delays as a result of not seeking this approval in good time shall be entirely to the Contractor's account.

- (iv) Where the 'as-dug' trench material contains material which meets the bedding class requirements as specified and providing that this is carefully screened to the sizes indicated above, and segregated from material that does not, the Contractor may, at his discretion, use it as such or incorporate such material into the imported embedment material being used.
- (v) The lower bedding for the pipes shall have a minimum thickness of 75 mm in normal trenches, and 125 mm where rock/stones are present and at designated road crossings. In trenches where there is a continuous accumulation of groundwater, the trench shall after obtaining the approval of the Engineer's Representative, be over-excavated by 150 mm and shall be backfilled using compacted granular material. Bedding material shall be compacted in layers not exceeding 50 mm thickness. Compaction of fill around the pipe shall be in layer thickness not exceeding half the pipe diameter or 75 mm whichever is the lesser. Layer thickness is however subject to consistently achieving 90% MPD (Modified Proctor Density) or better, failing which layers shall be reduced in depth as necessary to achieve the % compaction.
- (vi) The upper bedding shall be introduced as carefully and thoroughly as practicable to the underside or haunch of the pipe such that no large spaces remain before it is compacted.
- (vii) The sidefill and backfill material within the embedment shall be placed in layers of not more than 150 mm thickness when compacted and where hand ramming is employed the number of men filling shall not be more than half the number of men ramming. Sidefill shall be placed simultaneously on both sides of the pipe. Where mechanical-ramming of the remaining backfill is employed, the machines shall be to the approval of the Engineer's Representative and soil shall be replaced and well rammed down by hand for a depth of not less than 500 mm to give sufficient cover to the pipes and obviate risk of damage to them before the mechanical rammer is brought into operation. The rammer shall not cease to be used on any length of trench until thorough compaction has been obtained. All backfill soil shall be free from clay lumps, boulders stones and rock fragments greater than 20 mm and 90% MPD shall be attained in all instances. All backfill soil above the embedment shall be free from clay lumps, boulders and rock fragments greater than 50 mm and as far as practicable 90% MPD shall be attained, but this may be relaxed (e.g. in fields and open areas) by the Engineer's Representative.
- (viii) The Contractor in excavating shall ensure that materials from strata containing no stones and suitable for filling around the pipes as described above, shall be kept separately and used for this purpose. The Contractor shall not be entitled to claim for any extra costs (as provided for below) for screening if this requirement is not complied with. If no such strata occur in the excavation, the excavated material shall either be screened or suitable material transported to the Site from other excavations as the Engineer's Representative shall direct. The cost of such work shall be paid for according to the rates in the Bills of Quantities.
- (ix) Before commencing the placing of embedment in the trenches, the Contractor shall obtain approval from the Engineer's Representative as to the methods he proposes

to use and he shall demonstrate by means of tests that the specified compaction can be achieved (according to SSRN 601 using the "sand replacement" method). The method of compaction and the testing thereof shall be at all times to the approval of the Project Engineer's Representative and in general at a frequency of once every 30 metres unless this is specifically relaxed based on continuously good in-situ test results.

- (x) Where pipes are joined by rigid joint (flanges or welded), the pipe trench shall be backfilled entirely without leaving out areas around and at pipe joints uncovered, for subsequent filling. To facilitate the subsequent location of any suspected leaking joints during pipe testing, should this become necessary, the Contractor shall provide marker pegs at regular intervals and/or use a handheld GPS to be able to relocate joint positions.
- (xi) Where for pipes a minimum cover of 600 mm (or 900 mm for transmission lines) cannot be maintained, including highways and trafficked areas then the pipe must either be laid in a protective ferrous sleeve or be protected by a 150 mm thick reinforced concrete slab above the pipe. A minimum of a 150 mm layer of appropriate grade bedding material must first be placed and lightly compacted as a cushion above the crown of the pipe before the slab is laid, and the slab must extend at least 150 mm out beyond either side of the trench.

523 MAKING GOOD SUBSIDENCE AFTER REFILLING

Should any but very localised subsidence occur of the pipe trench after refilling and before the expiry of the maintenance period, the Contractor shall first demonstrate that such subsidence is only to the backfilling above the pipe and not to the pipe, embedment, bedding or sub-soil itself.

Should this not be so demonstrated then the Contractor at his own expense shall, excavate and remove the pipe or pipes affected and return the bottom of the trench to grade through a process of over-excavation, re-compaction or use of a lean concrete mix as determined by the Engineer's Representative, who shall also determine whether or not the affected pipes may be re-used or replaced.

The affected section or sections will in any event be liable for a further twelve months maintenance period.

All refilling necessary due to subsidence in pipe trench backfill shall be thoroughly compacted by ramming. Any subsidence due to consolidation shall be made up by the Contractor at his own expense with extra compacted material. Should subsidence occur after any topsoil has been replaced, the topsoil shall first be removed before any hollows are made up before being replaced.

524 REINSTATEMENT OF SURFACES

- (i) All surfaces of roads, fields, paths, gardens, verges, etc. whether public or private which are affected by the operations of the Contractor shall be temporarily restored by him in the first instance and permanently reinstated in the second instance when the ground has consolidated fully. Separate payment for reinstatement shall be made only for surfaced roads (e.g. tarmac, concrete, paving bricks or similar material), and for official designated dirt roads of at least 6m width, grassland, cultivated lands and sports fields. Any other reinstatements are deemed to be covered by the pipe installation rates.
- (ii) The Contractor shall be responsible for the temporary reinstatement and permanent reinstatement of all surfaces whether or not the area requiring restoration is within the limits of his excavations if the necessity for the restoration arises from causes due to the operations of the Contractor. The Contractor's prices shall include for restoring all surfaces so damaged to their original condition, as no extra payment will be made for any such work. The Contractor shall take all necessary measures to ensure that no toxic materials that may cause damage to vegetation or livestock or

pollute streams or water-courses are used in any temporary restoration or permanent reinstatement and shall indemnify the Employer against any claims arising out of the use of such materials.

- (iii) Temporary restoration shall be carried out immediately after the excavations have been refilled by returning the excavated material to the position from which it was removed and adding such suitable materials as may be required and consolidating the various materials as the Work proceeds in order to provide a surface that is adequate for the purpose that the original surface fulfilled. Temporary surfaces shall be maintained in a condition satisfactory to the Engineer's Representative and/or responsible Authority until the permanent reinstatement is made. In the case of roads and streets the surface shall be necessary to consolidate the filling and keep the surface fit for traffic, suitable material being added to all placed which have sunk or become rough.
- (iv) Permanent reinstatement shall not be made until the ground has consolidated permanently and until sanction to do so is received from the Engineer's Representative. It shall be carried out with materials similar to those that were used in the original Work to the entire satisfaction of the Engineer's Representative and/or responsible Authority.
- (v) In verges and other grass surfaces the topsoil shall be removed, stored and replaced after consolidation of the filling and planted or seeded with approved grass. Should subsidence occur, it shall be made good with additional topsoil and be replanted with grass or re-seeded. New grass shall be planted if for any reason the grass fails to grow or is destroyed.
- (vi) The trenches, channels, gutters and kerbs shall be reinstated to the condition in which they were before excavation was commenced. The final surface of the trench shall be flush with the surrounding ground.
- (vii) If the work of restoration or reinstatement as carried out by the Contractor is not to the satisfaction of the Engineer's Representative and/or the responsible Authority and should the Contractor not remedy the defect forthwith, any remedial work considered necessary may be undertaken by the Engineer's Representative and/or the responsible Authority and the cost thereof shall be borne by the Contractor.
- (viii) If at any time any trench becomes dangerous, the Engineer's Representative shall be at liberty to call upon the Contractor to restore it to a proper condition at three hours' notice and should the Contractor fail to carry out the work, have it done at the Contractor's expense.

PART III – THERMOPLASTIC PIPES DURING MANUFACTURE, SUPPLY, INSTALLATION, COMMISSIONING & TESTING

525 MATERIALS AND STANDARDS, UNPLASTICISED PVC PIPES AND JOINTS

PVC pipes and fittings shall be manufactured and installed in accordance to SSRN 300 and SSRN 301. Preference shall be given to PVCu pipes that are not stabilised by lead, tin or other heavy metals. However, where they are then tested in accordance with SSRN 305, and SSRN 301 (c) they must produce acceptable results.

Other related standards for pipes and joints of PVCu are given in SSRN 304 and SSRN 310,311 and SSRN 312. For laying, jointing and pressure testing they shall conform to the relevant sections of SSRN 302, and for quality control to SSRN 305 (c) and SSRN 313 (b) They shall be transported, laid, jointed and backfilled in accordance with the manufacturers written instructions except where this specification is more rigorous in which case this shall be followed.

To ensure that the Employer benefits from superior materials with enhanced useful life, at all times, latest and updated standards and procedures for design and installation shall be used and adopted but governed by cost effectiveness. In the same context the Contractor may provide, with the approval of the Engineer, superior materials using other standards

not listed here provided that they do not affect costs or programme and that they can demonstrate the superiority of the materials through tests and guarantee certifications.

All PVCu joints shall be of the spigot and integral socket type whilst solvent weld joints or joints with adhesives are not permitted. Fittings for use with PVCu pipes shall be either of steel or ductile iron and shall have socketed joints, save that injection moulded plastic bends and tees will be permitted with the approval of the Engineer. Aluminium alloy fittings are not permitted.

“Bulking up” with Chalk or use of any rework material during manufacture of PVCu pipes is however strictly forbidden and the Manufacturer shall provide certification to this effect.

The Contractor shall supply pipeline materials to the pressure classes referred to on the Drawings and in the Bills of Quantities, which classes are design and NOT solely hydraulic pressure classes. In all cases minimum cover shall be 900 mm and the bedding shall be restricted to S1, save that S2 bedding may be used with the approval of the Engineer, but only if he is fully satisfied with the Contractors initial performance in regards to excavation, embedment, compaction and backfilling.

The maximum allowable deflection after laying of thermoplastic pipes shall be 2% at a joint.

Where specific design is carried out during construction, the equivalent pressure rating shall be calculated taking into consideration: the operating and test pressures, surges if applicable, external pressures, PVCu pipe strength characteristics, temperature, soil conditions, trench width, depth, appropriate traffic loads and impact fatigue.

Minimum pressure ratings and cover for PVCu pipes shall be as follows:

Nom. Diameter (mm)	Minimum Pressure Rating (bars)	Minimum Cover (m)	Pipe Bedding
≤ 125	10	0.9	S1, (or S2 if approved by the Engineer)
150 – 275	12.5	0.9	
≥ 300	To suit specific design calculations, agreed design criteria, using SSRN 267 design code of practice, and with the approval of the Engineer		
Transmission Mains and off- takes			
All pumping mains	Not Permitted		

The following subsections are related to manufacturing, handling, transportation and storage of PVCu pipes and fittings and shall be in conformance to SSRN 300, SSRN 301 and SSRN 305.

a. Manufacture of PVCu Pipes and Fittings

All the fittings to be used with PVCu pipes shall generally be of ferrous material as specified for steel and ductile iron fittings. Injection moulded PVCu bends and tees shall be allowed with prior approval of the Engineer. Steel fittings shall meet the requirements of SSRN 213 (a), (b) and (c) and SSRN 228 (a)

b. Suitability of Production Process to meet Long Term Minimum Required Stress

The Contractor shall ensure that his pipe manufacturer is capable of meeting the minimum required stress (MRS) in Long Term Hydrostatic Tests and shall have carried out such a test in the past 36 months in accordance with appropriate standards. Such tests shall also have been carried out by the manufacturer at 20

deg. C over at least 10,000 hours with 18 data points, and the minimum required stress for 50 years at 20 deg C by extrapolation shall be 25 MPa.

c. Quality Control Records

The Contractor shall ensure that the manufacturer keeps accurate records of all types of component raw materials such as polymer powder, additives, stabilizers, lubricants, etc. used in the manufacture of PVCu pipes, together with detailed manufacturer's test reports carried out on the raw materials, date produced and date received, and batch or lot numbers.

During production, records shall be kept for mixing ratios of all the components used in the PVCu blend and these mixing ratios shall not be changed without the prior approval of the Engineer.

PVC material silos shall be equipped with appropriate sized sieves.

Pipes shall each be identified individually by a unique number. Such numbers shall be recorded along with the Blend and Lot number they were manufactured from.

The pipe lot shall be the pipes manufactured during a single work shift. The Contractor shall state in its bid the length of shift the manufacturer intends to use. The number of pipes in a lot shall be the number of pipes manufactured during the specified shift period.

d. Polymer Certification

The manufacturer shall state for each batch and lot of pipes and fittings manufactured the K value of the polymer which shall have certifications from the polymer supplier. If required by the Engineer, tests will be carried out to determine that the K value is in accordance with the relevant standards.

e. Inspection and Testing during Production

The manufacturer shall carry out the necessary inspections and tests during production in accordance with the relevant standards and such tests shall include all tests relevant for PVCu pipes and fittings as required by SSRN 313 (b).

The number of pipes to be tested and the frequency of testing shall be in accordance with SSRN 319.

f. Inspection of pipes and pipe fittings

The inspection will consist of visual examining the external surfaces of the pipe that must be smooth and free of the following defects:

- grooving
- blistering
- scoring (scratches)
- cavities
- impurities
- other surface defects which will be deleterious defects

In addition the pipes will be inspected for correct chamfering at 15 degrees to half the wall thickness on the spigot end and squareness of both ends to the pipe longitudinal axis.

The numbers of samples that do not comply with the above requirements during inspection shall not exceed the quantities given in the relevant standards.

g. Testing of Pipes and Fittings

For each Lot, the pipes and fittings shall be tested at the factory before shipment in accordance with the relevant standards such as SSRN 310, SSRN 311, SSRN 313, SSRN 315 (a) and 316 (c) among others for softening temperature, resistance to creep, pipe dimensions, ovality, thermal reversion, resistance to dichloromethane, freedom from toxicity, hydrostatic pressures, vacuum, fracture toughness and resistance to impact etc. The whole Lot will be rejected if the quantity of non-compliant pipes exceeds the acceptable level.

h. Marking of Pipes and Fittings

Each Pipe or Fitting shall be marked clearly with indelible ink with the following data:

- the manufacturers trade name or trade mark
- the designation PVC-U
- the pressure class and/or SDR ratio of the pipe
- the nominal diameter of the pipe
- the individual pipe number or fitting number
- the week number of manufacture
- the Lot Number the pipe belongs to
- the Blend Number the pipe belongs to

i. Release from manufacturers works

No PVCu pipes and fittings shall be released from the manufacturer's works until all tests results on the particular Blend and Lot it belongs are in conformance with requirements. In addition no pipe shall be delivered from the manufacturers premises before a full lapse of 6 weeks from its production to allow for positive results of accelerated resistance hydrostatic test pressure testing.

j. Determination of pipe and socket wall thickness

All pipes shall be manufactured in accordance to SSRN 300 and SSRN 301 and the design pressure rating stated or based on specific design using the internationally acceptable design code of practice for PVCu pipes.

The Contractor shall demonstrate and obtain approval from the Engineer that the pipe thicknesses proposed achieve the necessary operating and test pressures, and can withstand the external pressures and that they are in conformance with the acceptable international standards for the purpose of its use in this project

k. Pipe Lengths

Pipes shall be in effective lengths (i.e. overall length minus the depth of engagement in the socket) not exceeding 6.0 m length.

l. Pressure Classification

All PVCu Pipes supplied shall be classified by their PN operating pressure rating and their SDR ratio as required under this contract.

m. Protection of Fittings used with PVCu Pipes

All types of fittings shall be protected in conformance with their respective required standards.

- (i) Protection of extruded PVCu fittings - Protection shall be in conformance with SSRN 301 and their other respective standards.
- (ii) Protection of Steel Fittings: - Steel fittings shall be coated and lined with fusion bonded epoxy to SSRN 241(a) with a thickness of between 305 to 406 microns.

In addition, for transport, fittings shall be shrink wrapped in 0.2 mm polythene packing to reduce the risk of transport damage.

- (iii) Protection of DI fittings: - DI fittings shall be coated and lined with fusion bonded epoxy to a thickness as for the steel fittings above and shall similarly be shrink wrapped in 0.2 mm polythene packing for transport.

n. Packing for Shipment – PVCu Pipes

Pipes up to 300 mm diameter may be bundled; with larger sizes packed loose. Containerised packing and transportation is also acceptable and if proposed shall be so indicated by the Tenderer. Notwithstanding any intention to utilise containers, all nuts, bolts, rubber gaskets etc. shall be packed in wooden boxes and protected against the elements. Nesting of pipes is not permitted. Fittings up to and including DN 200 mm and flanged pipe pieces up to DN 200 mm and length not exceeding 1 metre shall also be packed and supplied in wooden boxes. All other fittings, protected for shipment as described above may be packed loose. All flanges shall be protected with discs of wood, wool, fibre or timber. Flexible couplings shall be bundled if not containerised. Pipe sockets, spigots, and plain ends shall be protected by suitable wrapping prior to transportation.

The Contractor shall further have described in his Tender in full detail the method(s) of offloading for imported items or on-loading for locally manufactured ex-works items, the methods of road/rail transportation and of site off-loading including the lifting methods intended.

He shall further have described in his Tender in full detail the method(s) of stacking and storage. His Tender rates shall also be deemed to have included for the transportation as described and for the provision of all the necessary facilities for off-loading at the storage sites, and for proper stacking and storage.

At the time of tendering the Contractor shall also have stated the approximate areas of land required for the off- loading, and stacking of the pipes and for the storage of the fittings and of any special protection/storage facilities needed for any particular item(s) of his goods

o. In-country Storage, Handling and Transportation of PVCu Pipes

(i) Storage Areas

The Contractor shall provide storage for PVCu pipes in a manner and in facilities approved by the Engineer's Representative. For pipes of local manufacture, this may include a temporary fenced-off area at the manufacturers premises, provided a Contractor in his Tender has so indicated his intention to do this and the area to be fenced off is shown to be sufficient for the purpose.

(ii) Pipe Stacking and Storage

Upon arrival at the pipe storage area, all pipes delivered in containers shall be immediately removed therefrom and stacked in properly protected pipe storage sheds.

Pipes shall be stacked at the pipe storage areas using one or all of the following methods.

- square stacking for small diameter pipes
- parallel stacking using wooden roller boards
- pyramidal stacking

All pipes shall be stacked on raised wooden battens at least 100 mm thick and 225 mm wide. The PVCu pipes should be uniformly supported throughout their length or at not more than 1 m centres. Pipe stacks shall be suitably wedged and

the Contractor shall be deemed to have included for an adequate number of timber, wedges, etc., in his Tender.

Where socket and spigot pipes are stacked, the sockets should be placed at alternate ends of the stack with the sockets protruding.

The Contractor shall further have described in his Tender in full detail the method(s) of offloading for imported items or on- loading for locally manufactured ex-works items, the methods of road/rail transportation and of site off-loading including the lifting methods intended. He shall further have described in his Tender in full detail the method(s) of stacking and storage. His Tender shall also be deemed to have included for the transportation as described and for the provision of all the necessary facilities for off- loading at the storage sites, and for proper stacking and storage.

At the time of tendering the Contractor shall also have stated the approximate areas of land required for the off-loading, and stacking of the pipes and for the storage of the fittings and of any special protection/storage facilities needed for any particular item(s) of his goods

The following table indicates the maximum stacking heights allowable:

Pipe Outside Diameter (OD) in mm	Maximum number of layers in stack, PVCu pipes
Up to 100	7
150	7
200	5
250	5
300	4

In addition PVCu pipes shall not be stored out in the sun unless they are fully protected by a free-venting, opaque cover (tarpaulin or black polyethylene). Except immediately prior to transfer to trench side, PVCu pipes shall not be stored at temperatures exceeding 25 deg. C at any time, whilst the requirements of SSRN 302 shall be met with regards to storage, handling and transport.

- (iii) Vehicle used to transport PVCu pipes shall have flat beds free from projections. Pipes shall be uniformly supported along their entire length and shall not overhang the end of the vehicle. Upright side supports on vehicles shall be flat, at 2m spacing and free of sharp edges. Socket and spigot pipes shall be stacked on vehicles in alternate layers so that the socket carries no load. Thicker wall pipes shall always be loaded before thin wall pipes.
- (iv) Where PVCu pipes are delivered from abroad in containers, such containers shall not be exposed to sunlight on their upper surface during either dockside storage or shipment and all pipes shall be immediately removed and stored as indicated in e(ii) above upon arrival on site. Site storage in the supply containers is not permitted, unless all pipes are first removed and then stored in accordance with e(ii) above.
- (v) Care shall be exercised in the transporting, handling, off-loading and loading of the pipes. For PVCu pipes, a minimum of two persons per pipe shall assist in the loading and offloading and pipes shall be neither thrown down nor dropped or rolled.

p. Distribution of PVCu Pipes from Storage

All PVCu pipes shall be distributed to the trench side and laid without being out in the sun for more than the day of installation unless they are to be protected from the sun's rays in which case this period may be extended at the discretion of the Engineer's Representative up to an absolute maximum of 5 days.

They shall then be supported at not less than three approximately equally spaced intervals so as to be fully clear of the ground.

When pipes are being loaded into vehicles, care shall be taken to avoid their coming into contact with any sharp corners such as cope irons, loose nail heads, etc. Whilst in transit, pipes shall be well secured over their entire length and not allowed to project unsecured over the tailboard of the lorry.

Pipes may not be offloaded from lorries by rolling them, nor shall pipes be rolled or dragged along the ground. Visual inspection shall be done along the whole length at trench side before laying.

526 MATERIALS & STANDARDS, HIGH DENSITY POLYETHYLENE PIPES AND FITTINGS

HDPE (PE100 and PE100 layer) pipes and fittings shall meet the requirements of SSRN 307 and SSRN 317. All manufacturing materials used shall be in conformance with SSRN 320.

HDPE pipes shall be transported, laid, jointed and backfilled in accordance with the manufacturers written instructions except where this specification is more rigorous in which case this shall be followed.

At all time, latest and updated confirmed standards and procedures for design and installation shall be used and adopted. This will help ensure that the Employer benefits from superior materials with enhanced useful life. In the same context the Contractor may provide with the approval of the Engineer superior materials using other standards not listed here provided they can demonstrate so through tests and guarantee certifications.

The polyethylene used shall be of a high molecular type with average to high density. For the manufacture of the pipes, not less than Third Generation polyethylene, known as PE 100 shall be used. Second Generation polyethylene (PE 80) shall not be offered. The polyethylene shall be stabilised against the effects of ultraviolet radiation by the addition of carbon black.

The Contractor shall provide pipeline materials to the pressure classes and SDR ratios referred to on the Drawings and in the Bills of Quantities. Unless otherwise indicated on Tender Drawings or in the Bills of Quantities, the pressure ratings shall not be lower than PN 10.

In all cases minimum cover shall be 900 mm and the bedding shall be restricted to S1 or S2 if specified by the Engineer. Where S2 material is permitted, it may comprise or include screened 'as-dug' materials that meet this requirement.

Where specific design is carried out, the pressure rating shall be calculated taking into consideration: the operating and test pressures, surges if applicable, external pressures, HDPE pipe strength characteristics, temperature, soil condition, trench width and depth, appropriate traffic loads and impact fatigue.

Maximum Allowable Deflection of HDPE (PE100) Thermoplastic Pipes

PE pipes with electrofusion joints	5%
PE pipes with mechanical joints	2%

Minimum pressure ratings and cover for HDPE pipes shall be as follows:

Nom. Diameter (mm)	Pipe thickness and SDR to suit following minimum Pressure Rating (bars)	Minimum Cover (m)	Pipe Bedding
0 – 125	10	0.9	S1, S2 if approved by the Engineer
150 – 275	12.5	0.9	
≥ 300	To suit specific design calculations, agreed design criteria, using SSRN 267 design code of practice, and with the approval of the Engineer		
Transmission Mains And off-takes			
All pumping mains			

For diameters up to and including 110 mm, PE pipes can be supplied in coils of up to 100 m long. For coils of diameters greater than 63 mm each layer shall be bound separately to facilitate safe unwinding. For diameters from 125 mm upwards they shall be supplied in lengths not exceeding 12 m. Installation – including fusion jointing work on HDPE pipelines – must be directed and supervised by suitably qualified and experienced persons and the Contractor shall have demonstrated his ability to provide this in his Tender, if necessary from his intended manufacturer.

a) Inspection and Testing during Production

The manufacturer shall be carrying out the necessary inspections and tests during production in accordance to the relevant standards and such tests shall include all tests relevant for HDPE pipes and fittings as required by SSRN 306(f). Steel fittings shall meet the requirements of SSRN 213, SSRN 228 and SSRN 229.

The number of pipes to be tested and the testing frequency shall be in accordance with SSRN 319.

b) Electro-fusion Fittings

All HDPE fittings shall be injection moulded from recognised top quality PE 100 resin and will conform to SSRN 307. Where jointing or connection is not done by electro-fusion, joints shall be of the compression type, or alternatively ferrous fittings connected by flange assemblies shall be used. Jointing with adhesives, cement glue or threaded joints is not acceptable.

Fittings shall be suitable to be used in conjunction with pressure pipes from polyethylene manufactured to the appropriate international standards, and all fittings must be packed in such a way as to allow their use on site without additional cleaning.

The heating coils contained in each individual fitting and saddle should be so designed that only one complete process cycle is necessary to fully electro-fuse the fitting to the adjoining pipe or pipeline component as applicable. No heating element may be exposed and all coils are to be fully imbedded into the body of the fitting for protection purposes.

The pipe fixation device shall be an integral part of the body for all fittings in the sizes up to and including nominal diameter 63 mm and on saddles up to 250mm.

An individual data carrier card in compliance with SSRN 321 and SSRN 322 containing a magnetic strip and an appropriate barcode or codes as well as manual setting information for data transfer purposes must be supplied with each fitting.

All fittings must have moulded-in identification and appropriate product information. Fittings without such identification will be rejected.

Process voltage of all fittings must not exceed a maximum of 39.5 volts.

Insulated contact heads for the terminal pins are to be provided, and terminal pin size shall be 4 mm in diameter.

A limited path style fusion indicator acting for each fusion zone as visual recognition of completed fusion cycle should be incorporated into the body of the fitting or saddle near or adjacent to the terminal.

The design of the fusion indicators must prevent the escape of fusion melt.

All couplers in the sizes up to and including nominal diameter 160 mm must have an easily removable centre stop not requiring tools for removal.

All internal or externally threaded transition adaptors in the nominal sizes up to and including 63 mm diameter must be designed with an integrated polyethylene collar from PE 100 for jointing purposes not relying on rubber or synthetic seals for leak prevention.

Threaded adapter bodies may be from brass or stainless steel and should be of the modular principle, not being supplied moulded into an electrofusion fitting socket.

c) Product training and Technical Information

The manufacturer or the material supplier shall provide a specialised theoretical and active practical product training given by qualified instructors to enable installers of the above mentioned products to be able to understand and use the products correctly and efficiently under site conditions. The courses are to be held on the purchaser's own premises upon demand.

The manufacturer is to provide accurate and easy-to-understand assembly instructions in English which can be used at any subsequent time for reference purposes.

d) Manufacturing, Testing, Handling, Transport and Storage

The quality control procedure in manufacturing, transporting, handling and storage of HDPE pipes and fittings shall be in accordance Clause 529 (a) to (o) where appropriate and in conformance to their respective standards if not covered in this section.

e) In-country Storage, Handling and Transportation of HDPE Pipes

(i) Before transporting HDPE pressure pipes, the loading surface of the vehicle must be cleaned and free from projecting nails, screws or other sharp objects. The bottom layer of all pipes must as far as possible be in contact with the loading surface throughout their entire length and not project beyond it. The pipes must be secured from slipping and shall not be pulled over sharp edges when loading and offloading. Pipes shall not be dragged along the ground.

(ii) Pipes, fittings and coils of HDPE pipes shall be stored in such a way that they are completely protected from direct sunlight. When covered they must be well ventilated to avoid accumulation of heat and resultant deformation. Transparent coverings shall not be used. The storage location shall be flat and shall, for pipes, support the pipes throughout their length. Stones and sharp objects shall not be present. Pipes shall not be stacked to a height exceeding 1 m. The pipes must be secured at the sides to prevent them from rolling. Contact with harmful materials shall be avoided. As far as possible, coils shall be stored in a horizontal position. The area shall be free of stones and sharp objects. If stored upright they must be secured to avoid tilting.

(iii) HDPE Pipes supplied in coils of up to 63 mm diameter may be unrolled with the coil in the vertical position. For larger diameters an unwinding device shall be used. A turnstile can be used with the coil laid in a horizontal position on it or with the coil mounted vertically on a slow moving lorry. The pipe shall never be removed from a coil in a spiral manner as this may cause kinking. Should

kinking nevertheless occur the Contractor shall cut the pipe on either side of the kink, prepare the ends, and then use an approved joint after laying. All costs of dealing with kinking shall be to the Contractors expense. A minimum bending radii of 35 x the diameter shall be observed.

f) Distribution of Materials from Storage

The Contractor shall make his own arrangement for storage including for temporary occupation of the necessary land, provision of suitable fencing, preparation of site and security, and the selected storage areas shall be suitably close to the final pipeline alignment to allow for speedy transfer to the installation location.

HDPE pipes shall be distributed to the trench side and laid without being out in the sun for more than the day of installation unless they are to be protected from the suns rays in which case this period may be extended at the discretion of the Engineer's Representative up to an absolute maximum of 5 days. Pipes not in coils shall then be supported at not less than three approximately equally spaced intervals so as to be fully clear of the ground.

When pipes are being loaded into vehicles care shall be taken to avoid their coming into contact with any sharp corners such as cope irons, loose nail heads, etc. Whilst in transit, pipes shall be well secured over their entire length and not allowed to project unsecured over the tailboard of the lorry.

Pipes may not be offloaded from lorries by rolling them. Pipes shall not be rolled or dragged along the ground.

527 MATERIALS & STANDARDS, GLASS REINFORCED POLYESTER (GRP) PIPE

Scope

This specification applies to the furnishing of all labour, materials and services in connection with the manufacture, testing, delivery and installation of large diameter underground glass reinforced plastic piping, joints, fittings and specials as specified in the engineering documents and drawings.

Codes and Standards

All pipes, joints and fittings supplied under this specification shall, as a minimum, meet the requirements of the AWWA C950, AWWA Standard for Fibreglass Pressure Pipe, and ASTM D3517, Standard Specification for "Fibreglass" (Glass-Fibre Reinforced Thermosetting-Resin) Pressure Pipe, for pressure pipes and ASTM D3262 Standard Specification for "Fibreglass" (Glass Fibre-Reinforced Thermosetting Resin) Sewer Pipe, in the case of gravity sewer pipes and ASTM D3754 Standard Specification for "Fibreglass" (Glass Fibre-Reinforced Thermosetting Resin) Sewer and Industrial Pressure Pipe for pressurised sewer and industrial waste pipes.

Test Methods

- ASTM D638 Standard Test Method for Tensile Properties of Plastics.
- ASTM D1586 Standard Method for Penetration Test and Split-Barrel Sampling of Soils.
- ASTM D2290 Standard Test Method for Apparent Tensile Strength of Ring or Tubular Plastics and Reinforced Plastics by Split Disk Method.
- ASTM D2412 Standard Test Method for External Loading Properties of Plastic Pipe by Parallel- Plate Loading.
- ASTM D2487 Standard Test Method for Classification of Soils for Engineering Purposes.
- ASTM D2583 Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor

- ASTM D2992 Standard Method for Obtaining Hydrostatic Design Basis for "Fibreglass" (Glass- Fibre Reinforced Thermosetting Resin) Pipe and Fittings.
- ASTM D3567 Standard Method Determining Dimensions of "Fibreglass" (Glass- Fibre Reinforced Thermosetting Resin) Pipe and Fittings.
- ASTM D3681 Standard Test Method for Chemical Resistance of "Fibreglass" (Glass-Fibre Reinforced Thermosetting Resin) Pipe in a Deflected Condition.
- ASTM D3754 Standard Specification for "Fibreglass" (Glass Fibre-Reinforced Thermosetting Resin) Sewer and Industrial Pressure Pipe
- ASTM D5365 Long- Term Ring Bending Strain of Fibre Glass (Glass-Fibre Reinforced Thermosetting Resin) Pipe.

Product Standards

- ASTM D3754 Standard Specification for "Fibreglass" (Glass Fibre-Reinforced Thermosetting Resin) Sewer and Industrial Pressure Pipe
- ASTM D4161 Standard Specification for "Fibreglass" (Glass-Fibre Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals.

Product Description

Materials:

- Only approved polyester resin systems for which documented performance is available shall be used in this particular application. The data shall have been acquired from a composite material of similar construction and composition as the product proposed for this project.
- The reinforcing glass fibres to be used to manufacture the components shall be of highest quality commercial grade of glass filaments suitably treated with binder and sizing compatible with impregnating resins.
- Silica sand or other suitable materials may be used as fortifiers in the laminates.
- Resin additives, such as pigments, dyes and other colouring agents, if used, shall in no way be detrimental to the performance of the product nor shall they impair visual inspection of the finished product.
- Elastomeric sealing rings must be supplied by recognised, acceptable, quality manufacturers. The elastomeric compound used must be approved for use in potable water systems.

Manufacture and Construction

- The pipes shall be supplied in accordance with the diameters and tolerances specified in "Dimensions". They shall be manufactured by a controlled, reproduction process using the materials described in the PGRP 3.1 to result in corrosion resistant, composite structure to meet the operating conditions for the pipe classes as specified on the drawings. Stiffening ribs may be used to increase the overall pipe stiffness.
- Plain-ended pipes shall be field connected with glass reinforced plastic sleeve couplings that utilise elastomeric sealing rings as the sole means to maintain joint water- tightness. Spigot and socket pipes shall be field connected using the bell and spigot joint with double O-ring and pressurisation socket. The joints must meet the performance requirements of ASTM 3754 and ASTM D4161.
- Flanges, bends, reducers, tees of various descriptions, wyes and other fittings shall be Grade B mild steel. Couplings shall be GRP collars or VI couplings or a combination of the two with the ends fabricated to suit the contractor's requirements.

Dimensions

- Pipes will be supplied in accordance with the nominal diameters as shown on the longitudinal section drawings or in the Schedule of Quantities.
- Pipes shall be supplied in accordance with an OD series.
- Pipes shall be supplied in 12 metre lengths, + 25 mm.
- Other section lengths may be supplied for special orders, subject to the Engineer's approval. A maximum of 10% of the pipe sections may be supplied in random lengths, again subject to the approval of the Engineer.
- The minimum average wall thickness shall be the thickness as stated. The minimum single point thickness shall not be less than 87.5% of the stated thickness.
- All pipe ends shall be square to the pipe axis + 6 mm or 0.5% of the nominal diameter, whichever is the greater.
- The tolerance of the angle of a bend and the angle between the main and a leg of a wye or tee shall be 2 degrees. The tolerance on the laying length of a fitting shall be 50 mm.

Product

Pipes shall be supplied to the minimum initial specific stiffness of SN 5000. Pressure class shall be PN 25.

Qualification Testing

The physical properties and characteristics of the pipes shall be determined by prototype testing of the manufactured product. These tests need not be conducted specifically for this project if prior tests on similar products have been previously completed. Testing may be conducted on one diameter and extrapolated to other diameters if the pipes are of similar composition and material arrangement and are manufactured from the same materials specification using a similar process.

All prototype tests results must be retained by the manufacturer and be available for inspection by the purchaser or his representative upon request.

The Hydrostatic Design Basis (HDB) will be obtained in accordance with procedure B of ASTM D2992, being established at an extrapolated 50-year value.

The long-term ring bending strength (Sb) will be determined in accordance to ASTM D5365 for water projects. The ambient test temperature for maximum operating temperatures not to exceed 50 degrees C. Minimum values for Sb, expressed as relative pipe deflection, are 12% for SN 5000

Coupling joints shall be qualified per the tests of Section 7 of ASTM D4161.

Product Use

The maximum allowable operating temperature of the pipes shall be 50 degrees C.

The minimum allowable operating temperature of the pipes shall be -40 degrees C. The actual operating temperature shall range between 0 and 20 degrees C.

Standard Installations

Glass Fibre Reinforced Pipes shall be installed in accordance with the Manufacturer's Installation Instructions. The minimum standard installation for each station and corresponding stiffness class based on this specification is SN 5000, 90SPD sand, full burial.

Unless otherwise noted, trenches shall be constructed in accordance with the dimensions given in the Standard Specification or as shown on the drawings

Quality Control Testing

Quality control testing on pipes shall be conducted in strict accordance with this specification. These tests will, as a minimum, cover:

- Raw materials
- Pipe stiffness
- Hydrostatic testing (as agreed with the Engineer)
- Load capacity
- Barcol hardness
- Critical dimensions
- Visual appearance

Adequate records must be kept by the manufacturer; such reports must be readily available for inspection by the Contractor, the Engineer or the Engineer's Representative. Quality control tests may be witnessed by the Contractor, the Engineer or the Engineer's Representative.

Raw materials for use in pipes covered in this specification shall be sampled and tested by the manufacturer prior to their use to ensure that they comply with the specifications in effect at the time of purchase. Any materials failing to meet the requisite standards shall immediately be rejected.

All materials shall be delivered with appropriate vendor certificates to demonstrate their compliance with the Manufacturer's specification.

Samples of pipe shall be tested for compliance with the pipe stiffness. The frequency of pipe ring samples shall be once per shift/machine or one per 100 pipes, whichever is the most frequent. If the one sample fails it should be retested. If it still fails, cut two (2) additional samples from the lot (from the preceding and following pipes). If they both pass, then the entire batch except the failed pipe is considered acceptable. If not as above, the pipes must be proven individually acceptable. Testing will be carried out in accordance with ASTM D2412, with the stiffness value rated at 5% deflection.

Hydrostatic Leak Testing Pipes shall be hydrostatically tested in accordance with section 3.1.1 of AWWA C950. The pressure class of pipes will be that specified. Any pipes failing to pass this test will be rejected. Rejected pipes may be repaired and retested; if they pass, they will be accepted.

Tests shall be performed in accordance with the requirements of AWWA C950 and ASTM D3517 to check load capacity (or strength) in both the hoop and axial directions. One of each test shall be made per 100 pipes. Should samples fail to meet or exceed the stated values for each test, two additional samples shall be cut from the preceding and following pipes. If they both pass and the average of all three sets also passes, then the entire lot is considered acceptable.

Barcol hardness tests will be conducted in accordance with ASTM D2583. Pipes failing to reach the required level of cure will be rejected. Rejected pipes may be retested in accordance with this specification. If their cure at this time has reached the required standard, they will be acceptable.

Pipes will be measured for compliance with critical dimensions as specified in PGRP 3.3 including diameter, thickness, end squareness and length. Measurements will be made in accordance with ASTM D3567.

Checks on diameter will be made at each change of diameter manufactured. Tolerances will be such that joints meet the performance requirements of ASTM D3754 and ASTM D4161.

All pipes will be checked for compliance with thickness stated. The minimum average thickness must be greater than or equal to stated thickness. The minimum single point thickness must be greater than or equal to 87.5% of stated thickness.

Any pipes with stepped ends shall be checked to ensure compliance with tolerances.

All pipes will be measured to ensure compliance with the requirements.

The pipes shall be free from all defects, including delaminations, bubbles, pinholes, cracks, pits, blisters, foreign inclusions, and resin-starved areas that, due to their nature, degree or extent, detrimentally affect the strength and serviceability of the pipe.

The pipe shall be as uniform as commercially practicable in colour, opacity, density and other physical properties.

Submittals to be Given Before or at the Time of Tendering

At tender stage and in a covering letter, the Manufacturer, through the Contractor, shall, in addition to the items specified, provide sufficient data for the broad evaluation of his proposed pipe. This data shall include, a minimum, the following specific information:

- Details of the proposed pipe wall thickness and properties including Pressure Class and Stiffness Class.
- Details of joints.
- Hydrostatic testing plan.
- Exceptions
- Details for nesting and packaging of pipe together with methods for de- nesting and unpacking of pipes
- Instruction for the storage and handling of pipes and couplings
- Installation Instructions including inter-alia bedding requirements, backfilling procedures and proposals for measuring initial diametrical deflections.

528 TRENCH EXCAVATION AND EARTHWORKS FOR THERMOPLASTIC PIPES

This clause for excavation shall apply except for thrust boring as specified in Clause 549 below.

- (i) All trench excavation will as a minimum precaution be taped off to alert members of the public to its existence.
- (ii) The excavation shall be made in open cutting unless tunnelling or heading is specified by the Engineer's Representative or it is specified in the Bills of Quantities.
- (iii) Trenches for pipes shall be excavated to the lines and depths shown on the Drawings, or as directed by the Engineer's Representative, and shall be of sufficient width to give an equal clearance on both sides of the barrel of the pipe or pipes such that in general the total trench width is $3/2$ 'D' where 'D' is the outside diameter of the pipe or the average outside diameter of the group of pipes or will be equal to the outside diameter or the pipe plus 300 mm whichever is greater. For pipes bedded in concrete sections, the breadth of concrete bedding for the pipes will be equal to the width of the trench. Excavation for fire hydrants, valve chambers or any other water works structures shall be carried out to the levels and outlines of such structures, and the rates shall include for any additional excavation or other temporary Works required.
- (iv) If in the opinion of the Engineer's Representative due to delays in laying which are the fault of the Contractor the ground becomes weathered prior to the laying of the pipes, the Contractor shall remove the weathered soil and replace it with suitable compacted material to the original formation level at his own expense.
- (v) Where pipes are not laid on concrete, the bottoms of the trenches as excavated shall be smooth and shall be free from stones or other projections. Holes cut out for joints in the lower bedding shall be of as small a size as possible throughout their entire length. The trench shall be dug to within 150 mm of its formation and proper grade pegs shall then be set in the bottom of the trench by the Contractor for the

accurate taking out of the rest of the excavation. Grooves about 50 mm deep shall be cut across the trench in the lower bedding at the required positions to enable the easy removal of pipe slings.

- (vi) The materials excavated from trenches shall be laid completely and neatly on the sides of the trench except where in the opinion of the Engineer's Representative's Representative this would so obstruct a road or footpath as to prevent the passage of traffic or pedestrians. In such cases the Contractor must dig out the pipe trench in such lengths as directed and keep his excavated material at such a distance as may seem advisable, and the rates shall be deemed to cover for this.
- (vii) During excavation, the Contractor shall ensure that all material suitable for re-use and which he intends for re-use are kept separate and set aside and protected as necessary to prevent loss or deterioration. Materials forming the surface and foundations of roads shall when excavated and if required for further use, be carefully separated. Paving slabs, bricks and similar surfaces shall be carefully removed and stacked for re-use, or as otherwise instructed by the Engineer's Representative.
- (viii) No pipes shall be laid nor lower bedding introduced and no excavation filled in or covered with concrete until the formation has been inspected and written permission to proceed with the Work obtained. The Contractor shall provide to the Engineer, a weekly schedule in advance indicating the dates and approximate times he expects to request such inspections.
- (ix) Where pipes are to be laid under a road formation or in open country, or in cutting, trenches shall generally be excavated after the earthwork is completed. The Engineer's Representative may permit these pipe trenches to be excavated before the earthwork is complete, but payment for the excavation of the trench will only be made upon the volume excavated below the road formation.
- (x) The unit of measurement for the excavation of trenches shall be per linear metre or per cubic metre of void calculated from the deemed width of the trench, and the average depth of excavation as mentioned in the Bills of Quantities. Unless otherwise indicated, for valve chambers and other water works structures, the unit of excavation will be per number or per cubic metre of excavated material calculated to the exact outer dimensions and depths of the Permanent Works. In neither case will allowance will be made for bulking.
- (xi) The rates for excavation of trenches in "normal" material shall include removal of all material except "rock", selecting and segregating material to be backfilled in special layers, supporting or sheeting, shoring and strutting, any additional working space or room for timbering or sheeting required, dealing with water, maintenance of the trench, and all labour, tools, materials, plants, supervision, overheads and profit.
- (xii) The provisions of the above Clause shall also apply to the rates of excavation in "rock" and in addition the Contractor shall allow in his rates for back-filling the invert with Class 15 concrete or other materials as directed by the Engineer's Representative and removing to a spoil dump all "rock" excavated.
- (xiii) Where rock is encountered and should the Contractor wish to excavate the rock in advance and temporarily to refill the excavated trench with the excavated material until he is ready to proceed with the laying of the pipe, he shall be permitted to do so, which permission must be given in writing by the Engineer. Such work shall normally be included in the Contractors rates unless he can show that the amount of rock is in excess of the amount billed to an extent that his work programme will be unduly delayed if he does not do so in which case he may seek to be paid both the E.O. item rate for the rock and twice the rate quoted for excavation in class III material.

PIPE LAYING FOR THERMOPLASTIC PIPES**Individual Pipes not supplied in Coils**

- (a) Pipes shall only be laid in the presence of the Engineer's Representative unless written authority from the Engineer has been granted.
- (b) Pipes generally shall be laid and jointed in accordance with the manufacturer's or his licensor's instructions. Extra excavation must not be carried out so as to avoid backfill, excessive deviation in joints and other irregularities. Otherwise, the pipe grade will follow the Drawings, with a continuous (but not necessarily uniform) fall towards washout-valves and rise towards air-valves.
- (c) Every pipe shall be laid separately and shall bear evenly upon the lower bedding or concrete for its full length, holes to receive sockets, couplings or flanges being cut in the bottom of the trench of such size and depth as to allow the joints to be properly made. The pipes shall be laid to true inverts, straight lines and falls, each pipe being separately boned between sight rails. The pipes shall be thoroughly brushed inside insofar as is practicable and outside prior to laying, and no foreign matter shall be allowed to enter the pipe during or after laying. At the end of each working day the exposed pipe end shall be stoppered up with a stopper plug of appropriate diameter and not merely covered in polythene sheet tied around the end.
- (d) Trenches shall be bottomed up only immediately in advance of pipe laying, although at least 15 metres shall be prepared in advance of any given pipe. Trenches and joint holes shall be kept free from water, until the pipes are laid and the joints completed and no ground water shall be allowed to enter the new pipes.
- (e) Prior to laying in trench the lower bedding in the trench must provide support throughout the entire length of the pipe. The pipe shall never be laid directly on cohesive, rocky or stony material. Where the natural trench bottom meets the bedding class required, this shall initially be loosened to a depth of 100 mm and then re-compacted to at least 90% MPD and then the surface loosened on the day of and prior to laying
- (f) In rock excavation, the pipes shall be bedded on concrete or selected granular fill, e.g. gravel, to a minimum thickness of 150 mm and the exclusion of rocks and other hard material to at least 300 mm around the pipe, leaving proper joint holes and subsequently making good with selected materials to the Engineer's Representative's approval.
- (g) All flanged joints shall be made with jointing rings, which shall be carefully inserted concentric to the bore of the pipe, so that undue stresses shall not be caused in any of the bolts or on the flanges when bolting up. The joint ring shall be compressed gradually and evenly by taking a few turns on each diagonal bolt in succession. Manufacturers' recommendations on the maximum tightening torque shall be followed, and over-tightening shall be avoided. Where one or both of the flanges is itself of plastic, torque-wrenches shall always be used, and the bolts shall first be hand tightened and then diagonally tightened progressively to achieve 5%, 20%, 50%, 75% and finally 100% torque. For metal to metal flanges and if the Engineer is dissatisfied with the degree of care being taken, the Contractor shall provide and use torque-wrenches for this purpose at no extra cost.
- (h) Mechanical joints shall be made in accordance with the manufacturer's instructions. After successful testing of pipelines, the joints will receive external protection as specified or to the Engineer's Representative's approval.
- (i) The threads of any screw connections shall be coated with red lead before the joint is made.
- (j) Concrete anchor blocks shall be provided at bends, tees, stopped ends, etc as shown on the drawings or as directed by the Engineer's Representative.

- (k) Where a pipeline crosses under roads or railway lines, the pipe shall be sleeved or surrounded with concrete or protected by reinforced concrete slabs as instructed by the Engineer's Representative, and Tenderers shall have been deemed to have made allowance in their rates for compliance with the requirements of the relevant authority. Where roadside verges are liable to receive traffic, this protection shall be extended under the areas concerned and Tenderers shall have been deemed to have made allowance in their rates for compliance with this requirement.
- (l) For the insertion of valves and other fittings into existing pipelines, pipes may need to be cut. Approved tools and machines specially made for the purpose, shall be provided and used by the Contractor.
- (m) The Contractor shall provide and fix wooden drumheads to the open ends of the mains, and similar drumheads shall be used to close the ends of any pipes to exclude dirt and stones, etc. when the pipe laying is not actually in progress. Wooden markers properly inscribed, shall be left projecting out of the ground to indicate the ends of all pipes, where these are buried in the ground in open country. In public highways, a danger sign or other suitable means as approved by the Engineer's Representative shall be adopted.
- (n) At every point of loading or unloading, pipes must be handled by approved lifting tackle. (Unloading by rolling them down planks of any form or including ramp will not be allowed except with the special consent of the Engineer's Representative).
- (o) The stacking of pipes shall be used such as to prevent damage during storage. Timber runners shall be laid to keep the upper row separated from the lower and the bottom row shall be staked to prevent any rolling. The whole arrangement shall be subject to the approval of the Engineer's Representative.
- (p) Care should be taken to minimise the risk of bush fires damaging any pipes laid out along the line of the mains.
- (q) Refilling of pipe trenches shall conform to the specifications provided in Clause 530. (r) The requirements for making good subsidence after refilling are provided for in Clause 531.
- (s) Reinstatement of surfaces shall conform to the specifications provided for in Clause 532.
- (t) For Thermoplastic Pipes Laid in Trenches:
 - (i) The soil cover shall be a minimum of 900 mm. and the embedment material shall be S1 or S2 (single size or graded gravel). For details of the trench specifications, and backfill material sizes and grading refer to Clause 530. Tenderers shall allow for the price of such trenching and importation of necessary backfill material and compaction as part of the pipe installation price.
 - (ii) For all bedding classes, compaction shall be 90% MPD minimum.
 - (iii) Marker tapes made of a pigmented low density polyethylene and aluminium foil in a bright colour or other approved material not less than 100 mm wide and 0.15 mm thick shall be placed in the ground above the PVCu and HDPE pipelines laid underground as a measure to detect the pipe and at the same time to reduce the risk of accidental damage which may be caused by future excavations. The tape shall be laid about 300 mm above the crown of the pipe. The tape shall be continuously labelled with black printing "DANGER-PLASTIC PIPE. The price tape shall be deemed included in the price for the supply and installation of the pipe.

Pipes supplied in Coils

- a. All sub-clauses of Clause 525 that are appropriate to pipe coils shall also apply and in case of any dispute, the Engineers ruling shall be final.
- b. Pipe coils generally shall be laid and jointed in accordance with the manufacturer's written instructions. A re-rounding and straightening tool shall be used prior to making each joint. Extra excavation must not be carried out so as to avoid backfill, excessive deviation in joints and other irregularities. Otherwise, the pipe grade will follow the Drawings, with a continuous (but not necessarily uniform) fall towards washout-valves and rise towards air-valves. Horizontal alignment shall be as straight and central to the trench as is practicable, and if necessary, wooden pegs shall be used initially to ensure this until the upper bedding has been compacted at which juncture they shall be carefully withdrawn.

- c. **Electrofusion Control Units for HDPE Pipes**

The Contractor shall provide electrofusion control units as recommended by the HDPE pipe manufacturer and confirming to EN 60335, EN 5008, EN 55014 and EN 61000. The workmanship shall be in accordance to the manufacturer's recommended procedure and quality.

530 BACKFILLING OF PIPE TRENCHES FOR THERMOPLASTIC PIPES

All excavation of pipe trenches shall be of such form and to dimension as shown on the drawings or as the Engineer's Representative may direct, and in all respects provide with embedment configurations and minimum covers as detailed here below. As a general rule trench width shall be not less than 1½ times the OD of the pipe but subject to the following figure and tables.

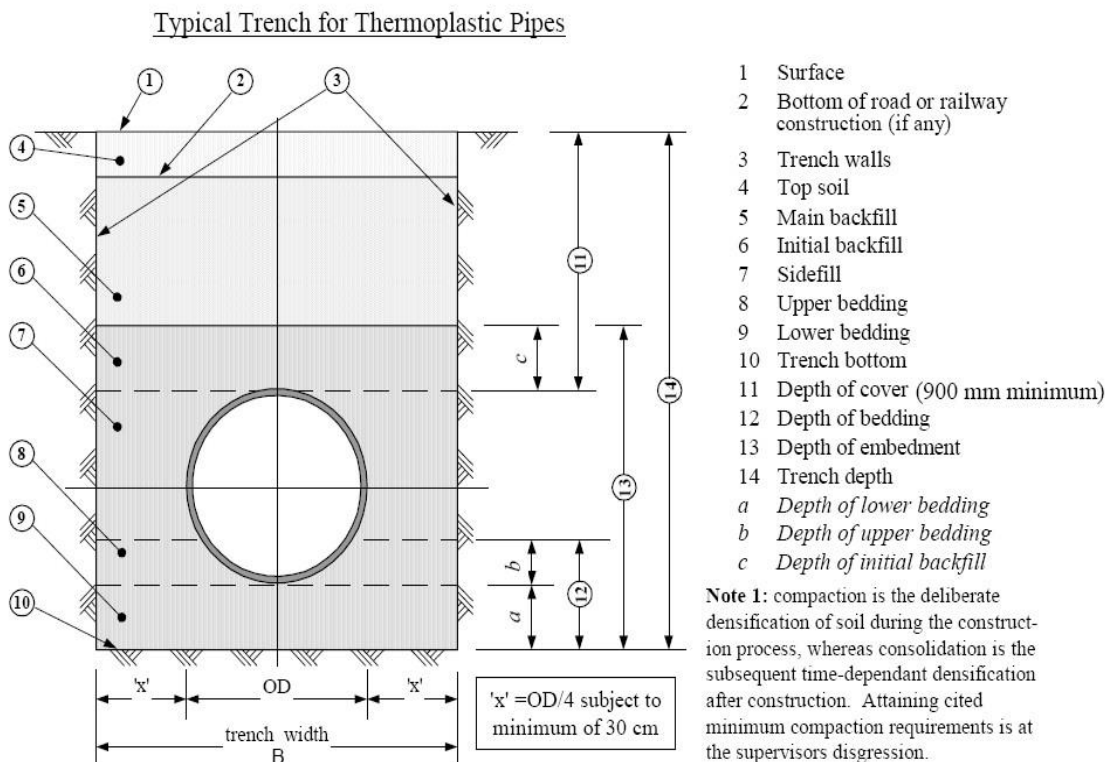


Figure: Trench Installation

Lesser trench widths may only be authorised if the Contractor can prove to the satisfaction of the Engineer that he can consistently achieve the required compaction for a lesser width in which case an absolute minimum of OD + 450 mm may be permitted.

Minimum Trench Width

Pipe Size	Trench Width
General	OD + minimum 600 mm
≤ 125 mm	OD + 450
150 – 300	OD + 600
> 300	To suit site condition and to the approval of the Engineer

If called for in the Bills of Quantities or if in the Engineer opinion, the risk of vandalism in a particular area is higher than anticipated at the time of design, cover shall be increased to a minimum of 1.2 m and the Contractor shall be paid for the removal and replacement of the additional materials at the same rates as quoted in the Bills of Quantities for the depth range indicated.

Embedment for PVCu and HDPE (PE100) Thermoplastic Pipes

Embedment Class	Bedding, Sidefill & Initial Backfill Material Allowed	Notes
S1 and S2	Class S1: Gravel – single size Class S2: Gravel – graded	processed granular materials required for all plastic pipes

S1 and S2 Embedment Material for Thermoplastic Pipes

Nominal Pipe Diameter (mm)	Grading [to ASTM Sieve Sizes]	
	S1 Embedment	S2 Embedment
80	10 single-size gravel	10 single-size gravel
100	10 single-size gravel	10 single-size gravel
150	10 or 14 single-size gravel	14 to 5 graded
200 to 500	10, 14 or 20 single-size gravel	14 to 5 graded or 20 to 5 graded
> 500	10, 14, 20 single-size crushed rock, or gravel	14 to 5 graded or 20 to 5 graded

- (i) The placing and compaction of pipe embedment shall only be undertaken in the presence of the Engineer's representative unless written authority from the Engineer has been granted.
- (ii) No pipes shall be laid nor lower bedding introduced and no excavation filled in or covered with concrete until the formation has been inspected and the permission to proceed with the Work obtained.
- (iii) In every instance, embedment material (consisting of bedding, side fill and initial backfill) filled around the pipe and for 300 mm over the top of the pipes shall be totally free from stones, rock fragments, tree roots or similar objects which through impact or by concentrating imposed loads might damage the pipes and shall not include black cotton type soil. The filling shall be carried out with utmost care, special attention being paid to tamping of material around the pipes and to joint holes so as to obtain the greatest possible compactness and solidity. The material shall if necessary, be screened to exclude material which would damage the pipes. The embedment material shall be in accordance with the relevant pipe embedment drawing but shall be no less stringent than a class S2 material for thermoplastic pipes and the source and any material brought to the site from elsewhere shall be approved in writing by the Engineer's Representative before excavation

commences. Any delays as a result of not seeking this approval in good time shall be entirely to the Contractor's account.

- (iv) Where the 'as-dug' trench material contains material which meets the bedding class requirements as specified and providing that this is carefully screened to the sizes indicated above, and segregated from material that does not, the Contractor may, at his discretion, use it as such or incorporate such material into the imported embedment material being used.
- (v) The lower bedding for the pipes shall have a minimum thickness of 100 mm in normal trenches, and 150 mm where rock/stones are present and at designated road crossings. In trenches where there is a continuous accumulation of groundwater, the trench shall after obtaining the approval of the Engineer's Representative, be over-excavated by 150 mm and shall be backfilled using compacted granular material. Bedding material shall be compacted in layers not exceeding 50 mm thickness. Compaction of fill around the pipe shall be in layer thickness not exceeding half the pipe diameter or 75 mm whichever is the lesser. Layer thickness is however subject to consistently achieving 90% MPD (Modified Proctor Density) or better, failing which layers shall be reduced in depth as necessary to achieve the % compaction.
- (vi) The upper bedding shall be introduced as carefully and thoroughly as practicable to the underside or haunch of the pipe such that no large spaces remain before it is compacted.
- (vii) The sidefill and backfill material within the embedment shall be placed in layers of not more than 150 mm thickness when compacted and where hand ramming is employed the number of men filling shall not be more than half the number of men ramming. Sidefill shall be placed simultaneously on both sides of the pipe. Where mechanical-ramming of the remaining backfill is employed, the machines shall be to the approval of the Engineer's Representative and soil shall be replaced and well rammed down by hand for a depth of not less than 600 mm to give sufficient cover to the pipes and obviate risk of damage to them before the mechanical rammer is brought into operation. The rammer shall not cease to be used on any length of trench until thorough compaction has been obtained. All backfill soil shall be free from clay lumps, boulders stones and rock fragments greater than 20 mm and 90% MPD shall be attained in all instances. All backfill soil above the embedment shall be free from clay lumps, boulders and rock fragments greater than 50 mm and as far as practicable 90% MPD shall be attained, but this may be relaxed (e.g. in fields and open areas) by the Engineer's Representative.
- (viii) The Contractor in excavating the trench from which he wishes to use 'as-dug' material for bedding shall ensure that materials from strata containing no stones or rock-fragments and suitable for filling around the pipes as described above, shall be kept separately and used for this purpose. The Contractor shall not be entitled to claim for any extra costs (as provided for below) for screening if this requirement is not complied with. If no such strata occur in the excavation, the excavated material shall either be screened or suitable material transported to the Site from other excavations as the Engineer's Representative shall direct. The cost of such work shall be paid for according to the rates in the Bills of Quantities.
- (ix) Before commencing the placing of embedment in the trenches, the Contractor shall obtain approval from the Engineer's Representative as to the methods he proposes to use and he shall demonstrate by means of tests that the specified compaction can be achieved (according to SSRN 601 using the "sand replacement" method). The method of compaction and the testing thereof shall be at all times to the approval of the Engineer's Representative and in general at a frequency of once every 30 metres unless this is specifically relaxed based on continuously good in- situ test results.

- (x) The pipe trench shall be backfilled entirely without leaving out areas around and at pipe joints uncovered, for subsequent filling. To facilitate the subsequent location of any suspected leaking joints during pipe testing, should this become necessary, the Contractor shall provide marker pegs at regular intervals and/or use a handheld GPS to be able to relocate joint positions.
- (xi) Where for pipes other than those used for service connections a minimum cover of 900 mm cannot be maintained, including highways and trafficked areas then the pipe must either be laid in a protective ferrous sleeve or be protected by a 150 mm thick reinforced concrete slab above the pipe. A minimum of a 150 mm layer of appropriate grade granular bedding material must first be placed and lightly compacted as a cushion above the crown of the pipe before the slab is laid, and the slab must extend at least 150 mm out beyond either side of the trench.

531 MAKING GOOD SUBSIDENCE AFTER REFILLING

Should any but very localised subsidence occur of the pipe trench after refilling and before the expiry of the maintenance period, the Contractor shall first demonstrate that such subsidence is only to the backfilling above the pipe and not to the pipe, embedment, bedding or sub-soil itself.

Should this not be so demonstrated then the Contractor at his own expense shall, excavate and remove the pipe or pipes affected and return the bottom of the trench to grade through a process of over-excavation, re-compaction or use of a lean concrete mix as determined by the Engineer's Representative, who shall also determine whether or not the affected pipes may be re-used or replaced.

The affected section or sections will in any event be liable for a further twelve months maintenance period.

All subsequent refilling shall be thoroughly compacted by ramming as with a newly completed trench. Any subsidence due to consolidation shall be made up by the Contractor at his own expense with extra compacted material. Should subsidence occur after any topsoil has been replaced, the topsoil shall first be removed before any hollows in the backfilling are made up before being replaced.

532 REINSTATEMENT OF SURFACES

- (i) All surfaces of roads, fields, paths, gardens, verges, etc. whether public or private which are affected by the operations of the Contractor shall be temporarily restored by him in the first instance and permanently reinstated in the second instance when the ground has consolidated fully. Separate payment for reinstatement shall be made only for surfaced roads (e.g. tarmac, concrete, paving bricks or similar material), and for officially designated dirt roads of at least 6m width, grassland, cultivated lands and sports fields. All other reinstatements both temporary and permanent are deemed to be covered by the pipe installation rates.
- (ii) The Contractor shall be responsible for the temporary reinstatement and permanent reinstatement of all surfaces whether or not the area requiring restoration is within the limits of his excavations if the necessity for the restoration arises from causes due to the operations of the Contractor. The Contractor's prices shall include for restoring all surfaces so damaged to their original condition, as no extra payment will be made for any such work. The Contractor shall take all necessary measures to ensure that no toxic materials that may cause damage to vegetation or livestock or pollute streams or water-courses are used in any temporary restoration or permanent reinstatement and shall indemnify the Employer against any claims arising out of the use of such materials.
- (iii) Temporary restoration shall be carried out immediately after the excavations have been refilled by returning the excavated material to the position from which it was removed and adding such suitable materials as may be required and consolidating the various materials as the Work proceeds in order to provide a surface that is

adequate for the purpose that the original surface fulfilled. Temporary surfaces shall be maintained in a condition satisfactory to the Engineer's Representative and/or responsible Authority until the permanent reinstatement is made. In the case of roads and streets the surface shall be necessary to consolidate the filling and keep the surface fit for traffic, suitable material being added to all placed which have sunk or become rough.

- (iv) Permanent reinstatement shall not be made until the ground has consolidated permanently and until sanction to do so is received from the Engineer's Representative. It shall be carried out with materials similar to those that were used in the original Work to the entire satisfaction of the Engineer's Representative and/or responsible Authority.
- (v) In all verges and other, grassed surfaces, the topsoil shall be removed, stored and replaced after consolidation of the filling and planted or seeded with approved grass. Should subsidence occur, it shall be made good with additional topsoil and be replanted with grass or re-seeded. New grass shall be planted if for any reason the grass fails to grow or is destroyed.
- (vi) The trenches, channels, gutters and kerbs shall be reinstated to the condition in which they were before excavation was commenced. The final surface of the trench shall be flush with the surrounding ground.
- (vii) If the work of restoration or reinstatement as carried out by the Contractor is not to the satisfaction of the Engineer's Representative and/or the responsible Authority and should the Contractor not remedy the defect forthwith, any remedial work considered necessary may be undertaken by the Engineer's Representative and/or the responsible Authority and the cost thereof shall be borne by the Contractor.
- (viii) If at any time any trench becomes dangerous, the Engineer's Representative shall be at liberty to call upon the Contractor to restore it to a proper condition at three hours' notice and should the Contractor fail to carry out the work, have it done at the Contractor's expense.

PART IV - ALL PIPELINES DURING DELIVERY, INSTALLATION, TESTING AND COMMISSIONING

533 ON-SITE INSPECTION

All pipes, valves and fittings shall be inspected upon arrival at the pipe storage areas for damage to:

- the pipe or fitting itself
- external coatings (if any)
- internal linings (if any)
- jointing surfaces (incl. sockets if any)

The Contractor shall be responsible for and shall undertake any work required by the Third Party Inspector or by the Engineer's or his Representative as appropriate or where deemed necessary, replace defective pipes and fittings. All expenses in connection with such remedial works or replacements shall be deemed covered by the Tender.

534 HANDLING FROM STORAGE TO TRENCH

All pipes shall be handled from storage to trench in accordance with the manufacturer's recommendations.

The Contractor shall obtain and keep on Site copies of all the manufacturer's literature relating to the proper handling, storage, laying, installation and testing of their products and shall make them or copies thereof available to the Engineer's Representative on Site.

535 MEASUREMENT FOR PIPE LAYING

Pipe laying and jointing where in trench is included in the Bill of Quantities with excavation, backfilling, and temporary reinstatement, all as described in the Bills of Quantities. Measurement of the work done will be along the centre-line of junctions in the pipe network, and branches, unless otherwise indicated in the Bills of Quantities

536 WORKING WIDTH

Where pipelines are within 20 metres of a motorable track, or through light bush or thicket a wayleave clearance of 2 metres plus nominal bore of pipe will be allowed. Where pipelines are through dense bush, thicket or forest a wayleave clearance of five metres plus nominal bore of pipe will be allowed. Payment for Site Clearance will be based upon this width except that the Engineer reserves the right to restrict this width due to the presence of obstructions, roads, houses and the like. Payments will then be according to the actual area cleared. No claims for additional space nor for inconvenience and the like caused by obstructions, will be allowed.

537 LOCATION OF UNDERGROUND SERVICES ETC.

It shall be the Contractors obligation when trenching, to locate and avoid the damaging of any existing services, be they water, drainage, sewage, electricity or telecom. Notwithstanding this obligation and should damage occur, it will be the Contractor's further obligation at his own cost to urgently liaise with the utility organisation concerned and to bear the cost of the repair or replacement of the damaged article to the entire satisfaction of the utility concerned.

538 CONCRETE PROTECTION

Unless otherwise provided in the Special Specification or Bills of Quantities or directed by the Engineer, a concrete surround of not less than 0.15 m shall be provided to water mains in the following circumstances:-

- (a) Water mains with less than 0.6 m or more than 6.0 m of soil cover over the pipes.
- (b) Water mains under carriageways if depth of soil cover is less than 1.30 m
- (c) In the places where shown on the Drawings or directed by the Engineer.

All concrete for beds and surrounds shall be class 15 concrete.

Alternatively under carriageways and where indicated on the drawings, the pipeline shall be laid in a stepped trench with the immediate surround backfilled with approved granular material and then across the step shall be laid precast reinforced concrete slabs of class 25 concrete.

The unit of measurement shall be cubic metre or linear metre as indicated in the Bills of Quantities.

The rate shall include for the provision, transporting and placing of concrete, all strutting and formwork, protection and curing and all labour, tools, plant, supervision overheads and profit.

539 ANCHOR BLOCKS

Pipelines with mechanical (or flexible) joints shall be adequately anchored at bends, tees, sluice or butterfly valves, tapers, blank ends, etc. Anchor blocks shall be constructed from Class 20 concrete to the dimensions indicated on Drawings unless otherwise directed by the Engineer. Support blocks shall be constructed from Class 15 concrete and allowed to cure for 7 days. Soil around anchor blocks shall then be compacted thoroughly before the hydraulic testing of the pipeline. Payment for anchor blocks will be per unit volume of concrete in the blocks and shall include for all the earthwork, formwork and other operations required for their construction. No separable payment shall be made for any temporary or permanent anchor blocks constructed by the Contractor specifically for the testing of the pipeline.

Anchor and Thrust blocks at proposed tie-in points between old and new pipework will be cast at least 7 days prior to the proposed tie-in works and post tie-in pipeline testing for the affected section. Where this is impracticable then a thrust wall shall be constructed similarly in advance first instead and the final connecting fitting propped initially from this thrust wall by means of a horizontal steel joist with the contact face with the fitting curved to the outside diameter of the fitting and fitted with a protective rubber insert. Immediately after re-commissioning, the space between the thrust wall and the propped fitting shall be filled with class 20 concrete, thereby permanently encapsulating the steel joist. The proposed tie-in works described in Clause 550 will therefore be preceded by the required anchor/thrust block casting.

540 INDICATOR PLATES AND MARKER POSTS

Precast concrete indicator plates to the dimensions indicated on the Drawing shall be installed at all sluice valves, single-air valves, double air valves, fire hydrants and washouts, with letters SV, AV, FH, WO, respectively, indented in them. The plates shall be painted with at least two coats of all-weather plastic emulsion paint of approved colour.

Marker posts to the dimensions indicated on Drawings shall be installed at 100 m spacing along the pipelines installed in open country or as directed by the Engineer. Marker posts shall be painted with at least two coats of all weather plastic emulsion paint of approved colour.

541 ADDITIONAL PROTECTION TO FLEXIBLE COUPLINGS AND FLANGE ADAPTORS IN CHAMBERS AND/OR ABOVE GROUND

Such mechanical joints e.g. flexible couplings, flange adaptors, etc. in chambers and/or above ground shall have been factory epoxy coated and where indicated on drawings or in the Bill of Quantities shall after installation be cleansed by brushing away soil and then shall have an approved mastic blanket moulded around them so as to provide a contour suitable for wrapping the component with an approved petrolatum anti-corrosion tape suitable for tropical climates which shall then be done so as to achieve a clean and neat good tape finish..

542 PROTECTION TO FLEXIBLE COUPLINGS AND FLANGED ADAPTORS FITTED TO EPOXY COATED PIPE SPIGOTS.

Where factory coated flexible couplings have been used on pipes whose exposed surfaces beyond other protection materials have been factory protected using epoxy, then such joints shall be site protected by a polythene outer wrap sheathing of minimum thickness 200 microns that shall extend beyond the pipe epoxy coating by at least 500 mm. This outer wrap shall be double strapped using a non-metallic strap to each pipe end beyond and not to the epoxy coating.

543 BURSTING DISCS AND BURSTING DISCS DEVICES

Bursting discs and bursting disc devices shall be in general accordance with SSRN 233. A minimum pack of 5 such bursting discs shall be provided with each bursting disc device.

544 IN-SITU WELDING OF STEEL FITTINGS AND FLANGES

Wherever it is necessary to undertake in-situ welding of steel fittings and flanges the work shall be undertaken under cover, temporary or otherwise. Outside of buildings, the cost of providing such cover shall be deemed included in the Contractors rates. Only suitably qualified welders shall be employed.

Welding procedures used shall comply with SSRN 670.

Prior to deployment of any welder he shall within the preceding 3 months have satisfactorily undergone an 'approved testing' in accordance with SSRN 671 and certification thereof shall be provided to the satisfaction of the Engineer. Each welder deployed shall at intervals of not more than 6 months undergo similar approved retesting

and only those who pass such retesting will be allowed to continue to undertake the in-situ welding works.

All testing and retesting will be deemed to be covered in the Contractors rates.

545 PIPE SUPPORTS

Pipe supports shall meet the requirements of SSRN 406.

546 SERVICE PIPE CONNECTIONS

All tapping shall be carried out using tapping saddle clamps (sleeves or collars type – surrounding the pipe). Self tapping directly on pipes shall not be permitted. Ferrules alone shall not be permitted

The form of the customer connection tapping clamp shall be two equal halves held together by threaded ends, washers and bolts. The tapping clamp for flexible pipes shall be double band with a minimum thickness of 1.5 mm if made from stainless steel. The body part of the tapping clamp shall be of robust ductile iron or stainless steel with a fusion bonded epoxy coating of not less than 300 microns dry film thickness. The seal shall be of elastomer or nitrile rubber material and shall surround the pipe circumference completely and shall be suitable for use with potable water. The tapping clamp shall be supplied complete with removable and lockable ferrule (if indicated on drawing). They shall be of approved manufacture which shall not be unreasonably withheld.

The customer connection tapping clamp shall have following features:

- They shall be impressed with the logo of the Employer.
- All stainless steel parts shall conform to high corrosion protection grade (AISI 316 L).
- The rubber lining shall eliminate metal to metal contact or metal to plastic contact and insulate against galvanic corrosion between two different types of metals.
- They should be able to fit range of pipe diameters and also be able to adapt to pipe irregularities and ovality
- Double band or wide bodies to allow large surface area contact with the pipe body for supporting the pipe.

Any Tenderer who in his Tender offers service pipe connections that are not fully in compliance with these requirements will be required to confirm in writing that he will meet the requirements of this clause in full without any price adjustment to his offer if his Tender is to be considered for possible award.

547 HYDROSTATIC TESTING OF PIPELINES

After laying, new pipelines shall be tested under pressure and where in trench, such tests shall be made before it is completely back- filled. During the test, all joints shall be clear of earth, timber, etc. to allow visual inspection. Testing shall commence when not more than 20% of all pipework has been laid and at no time may there be more than that remaining untested.

Where old pipelines that are yet to be taken into service are involved they shall be similarly tested, except that the Engineer may specify at what stage testing is required.

The pipeline shall be tested in lengths between valve locations or in such shorter lengths as the Engineer may approve on the understanding that no extra cost will be incurred to the Employer but the maximum length of main to be tested, shall not normally exceed 1 km.

The Contractor shall supply all necessary materials to carry out the test in accordance with the requirements including force pumps, water pressure gauges, including tools for the use of the Engineer, interconnecting pipework, feeding tank, blank flanges, temporary

stop-ends, struts and water for the test. The test section shall be capped or flanged off at each end and all branches. Testing shall not take place against closed valves.

For a pipeline incorporating flexible joints, testing shall not commence until after all the permanent anchor blocks along the pipeline have been constructed and soil around them backfilled and compacted. Capped or flanged ends along the pipeline shall also be anchored adequately to withstand the force due to test pressure. The Contractor shall submit his proposals for temporary anchoring to the Engineer for approval.

After the main has been clear of debris, and all necessary stop-ends and gauges fitted to the Engineer's approval, the Contractor shall fill up the pipe with water free from silt, and sand and grit and bring up the pressure steadily to the nominal pressure of the pipe or incorporated fittings, whichever is the lesser, (except for old pipelines where a lower value may be specified by the Engineer), and maintain it with a force pump for 24 hours.

The pressure shall then be increased steadily in increments of 1.0 kg/cm² with a pause of one minute between each increment to the specified test pressure for the section. Unless otherwise specifically mentioned, the applied test pressure shall be measured at the lowest point along the section being tested.

Where test pressure has not been specified, it shall be assumed to be 1.5 times the rated nominal pressure (PN or NP) of the pipe.

After a period of half an hour, the fall in test pressure shall be recorded and sufficient water again pumped into the line under test to bring the pressure back to the test pressure. The procedure shall be repeated every half-an-hour for a total period of 3 hours, or longer, if the Engineer so directs, and the amount of water pumped in recorded.

The rate of leakage shall be calculated from the amount of water pumped in during testing and if it is less than 1 litre of water per 10 mm diameter of pipe per km of length of pipeline, for each 24 hours and for every 30 m head, the pipeline will be considered to have passed the test.

Leaks exceeding permissible amounts shall be made good. And faulty pipes, fittings, and specials, shall be replaced by the Contractor at his own expense and the section tested again before approval is given for backfilling. Payment for the section will not be certified, until the test has been passed and backfilling completed.

548 FLUSHING AND STERILISATION

This shall be done in accordance with the recommendations set out in SSRN 651.

All tested pipework shall be flushed and cleaned and all treated water pipework shall additionally be sterilised. The rates inserted are to be for the flushing and sterilising, and where appropriate for cleaning shall be inclusive for, sampling, testing and inclusive of the reports on the bacteriological quality of water.

549 HORIZONTAL DIRECTIONAL DRILLING (HDD) FOR ROAD AND RAIL CROSSINGS

The Contractor shall install pipes using horizontal directional drillings at the locations specified in the drawings and the bills of quantities. The locations are normally across heavily trafficked roads and railway crossings where bypass or diversions cannot be readily made. The Contractor shall be responsible for all the design, permit acquisition from the relevant authority responsible for roads or rail and for implementation and restoration. The following procedure shall be applicable for HDD:

A. Design Guidelines

Prior to submitting an application for a Right-of-Way Permit to the relevant authority responsible for roads or rail that will involve horizontal directional drilling (HDD), the Contractor shall ensure that the following decision process and tasks are completed and approved by the Engineer:

- (i) Prepare or obtain scaled mapping for the planned installation

- including all exiting surface facilities and improvements.
- and including any indication of underground facilities or improvements.
- (ii) Collect existing underground utility information
 - including the horizontal location of all known substructures (expected).
 - and including the depth of all known substructures (whenever possible).
- (iii) Obtain Right-of-Way information from the relevant authority responsible for roads or rail.
- (iv) Obtain general and/or specific geotechnical information as required or deemed necessary
 - including soil data for the project area.
 - and possibly including site-specific geotechnical sampling and analysis to confirm the soil data.
- (v) Prepare Design Drawings using the information noted above
 - including the location of all planned improvements,
 - including existing underground utility information, and
 - including right-of-way limits and property ownership information (as required).

In addition to the design requirements listed above, the Contractor shall take into consideration the following:

- (vi) the minimum horizontal and vertical clearance requirements when determining the HDD alignment
 - including road setbacks and existing surface features,
 - and including exiting underground utilities and other underground facilities;
- (vii) pipe sizes to be installed and their corresponding reamer diameter requirements;

Pipe Diameter	Reamer Diameter
< 200 mm	Diameter + 100 mm
200 – 600 mm	Diameter + 150 mm
> 600 mm	Diameter + 300 mm
- (viii) the bore geometry for the given ground profile
 - including bore length(s) and depth requirements, and
 - including bending radii for the final product pipe (Typically 13 m radius per 10 mm pipe diameter, with 200 m to 330 m radius minimums depending on subsurface materials and equipment requirements);
- (ix) drilling equipment requirements for the given geotechnical conditions, geometry and final product diameter
 - including thrust and pullback ratings
 - including mud motors vs jetting heads and
 - including wire line vs walkover tracking systems;
- (x) equipment and material handling requirements
 - including drilling fluid and drilling fluid containment
 - and including drill operation and final product staging.
- (xi) material strengths, capacities, and coupling methods.

B. Right-of-Way Permit Application Requirements

The Contractor shall submit the following information with the application:

- (i) Provide proposed HDD Location Information
 - Pipe diameters, type, pressures etc.,
 - Locations, length and depths, covers, clearances.
- (ii) Provide Design Drawings on scalable mapping and shall include:
 - the proposed alignment (dimensioned),
 - existing utility information (within 10m of the proposed crossing), and
 - the road right-of-way information
- (iii) Provide specific installation requirements or typical installation parameters indicating the design bending radii and diameter(s).
- (iv) Provide assumed subsurface geotechnical conditions based on local knowledge or based on specific site soil tests.
- (v) Provide a Traffic Control Plan
- (vi) Provide a Storm Water Pollution Prevention Plan
- (vii) Provide a Construction Schedule indicating the proposed start date(s), completion date(s), and restoration schedule.

C. Construction Safety Guidelines

Prior to performing work involving HDD under a Right-of-Way Permit, the Contractor shall consider the following safety guidelines and shall obtain approval of the Engineer:

- a) Perform all operations in compliance with safety guidelines and ensure that all personnel are properly trained and equipped to work in the public right-of-way;
- b) Ensure that the approved traffic control plan (required with the permit application) is implemented and followed at all times;
- c) Ensure that all storm water pollution prevention measures (required with the permit application) are implemented and followed at all times;
- d) Ensure all setbacks, offsets, and clearances are maintained;
- e) Ensure that **the relevant authority responsible for roads or rail** or other utility coordination requirements have been met;
- f) Positively identify from records or by potholing all crossed utilities that are expected to be
 - above and within 2 m of the proposed vertical alignment,
 - below and within 1 m of the proposed vertical alignment,
 - and additionally as requested by the relevant responsible authorities;
- g) Positively identify from record or by potholing all parallel utilities at the beginning and ending of all bores and
 - every 70 m if it is within 2 m of the proposed alignment,
 - every 15 m if it is within 1 m of the proposed alignment,
 - and additionally as requested by the Engineer.
- h) The HDD Contractor shall have a planned response in the event of a utility strike including utility owner notification and
 - avoiding electrocution in the event of an electric strike,
 - avoiding combustion in the event of a gas line strike,

- avoiding contamination in the case of a sewer strike.

D. Drilling Fluid Containment and Disposal Requirements

The HDD Contractor shall contain, handle, and dispose of drilling fluids in accordance with the following requirements:

- a) The use and composition of all drilling fluid and fluid additives shall be disclosed to the Engineer in advance.
- b) Excess drilling fluid shall be confined in a containment pit at the entry and exit locations until recycled or removed from the site.
- c) Precautions shall be taken to ensure that drilling fluid does not enter roadways, streams, municipal storm or sanitary sewer lines, and/or any other drainage system or body of water.
- d) Unintended surfacing of drilling fluid shall be contained at the point of discharge and recycled or removed from the site.
- e) Drilling fluids that are not recycled and reused shall be removed from the site and disposed at an approved disposal site.
- f) Drilling fluids shall be completely removed from the construction site prior to back filling or restoring the site.
- g) Collection, transportation, and disposal of drilling fluids shall be environmentally safe and comply with local ordinances and government regulations.

E. Construction Requirements

All construction work shall be performed in accordance to the following unless stated otherwise by **the relevant authority responsible for roads or rail**, and as outlined below. For all work involving horizontal directional drilling under a Right-of-Way Permit, the Contractor shall perform the following:

Prior to Construction:

- a) The HDD Contractor shall familiarize itself with the work area and the technical requirements of the plans;
- b) The Contractor shall establish construction marking/staking, prior to construction, to indicate
 - HDD entry and exit locations, and
 - proposed HDD alignment at 10m (max) intervals;
- c) Provide the Engineer with a contact list of all crew foremen.

During Construction:

- a) The HDD Contractor shall calibrate its tracking and locating equipment at the beginning of each work day;
- b) The HDD Contractor shall monitor and record the alignment and depth readings provided by the tracking system
 - every 10 m for normal conditions,
 - every 2 m where precise alignment control is necessary;
- c) The HDD Contractor shall complete the HDD installation as designed and permitted both horizontally and vertically unless otherwise authorized by the Engineer;
- d) The HDD Contractor shall attempt to maintain drilling fluid circulation throughout the HDD process;
 - during the initial pilot hole installation, and

- during the reaming and back pull process(es)
- e) The HDD Contractor shall not expand the bore hole by more than 150mm using only compaction reamer(s);
- f) The HDD Contractor shall plan its reaming and back pulling operations carefully to insure that, once started, all reaming and back pulling operations can be completed without stopping and within the permitted work hours;
- g) The HDD Contractor shall at all times and for the entire length of the HDD alignment be able to demonstrate
 - the horizontal and vertical position of the alignment,
 - the fluid volume used, return rates, and pressures;
- h) The HDD Contractor shall inspect the work and surrounding area to insure that no construction-related damage has occurred
 - including heaving or humping of paved surfaces, and
 - including drilling fluid fractures or releases.
- i) At all times the Contractor shall provide access to the Engineer's representative for inspection of the HDD operations;

Following Construction:

- a) The Contractor shall notify the Engineer as appropriate upon completion of the authorized work;
- b) Prior to the start of backfilling excavations under paved surfaces, the Contractor shall notify the Engineer to schedule an inspection. Upon completion of all right-of-way restoration activities, the Contractor will schedule a closeout inspection;
- c) The Contractor shall insure that all cleanup and restoration is in compliance with the requirements for restoration, reinstatement and cleaning up;
- d) The Contractor's 1 year maintenance period will not begin until any corrective actions required have been completed and inspected to the Engineer's satisfaction.

F. Storm Water Pollution Prevention

All construction activities shall be performed in accordance with the acceptable international standards and Best Management Practice, to ensure that storm water runoff is not contaminated by sediment caused by land disturbances associated with construction activities. The following seven main objectives shall be applied for all Storm Water Pollution Prevention planning:

- a) ensure that sediment controls are in place prior to disturbance.
- b) Maintain sediment controls throughout the construction and restoration processes.
- c) Minimize the overall disturbance whenever possible.
- d) Protect disturbed areas throughout the construction process.
- e) Prevent storm water runoff from entering disturbed areas.
- f) Never intentionally discharge construction contaminants directly into creeks, rivers, ditches, or storm systems.
- g) Complete permanent restoration as soon as possible.

In addition to those overall goals stated previously, the contractor shall, at a minimum, implement the following specific Best Management Practices:

- h) Provide temporary erosion protection whenever possible:

- Mulch, seed, or gravel may be applied even if a disturbed area may and/or will be disturbed again or other permanent measures of stabilization are to follow;
- Cover spoil piles with a tarp or contain with a sediment barrier. i)

Contain disturbed sediment on site:

- Use sediment barriers such as silt fence, sand bags, straw bails, rock checks and/or sediment traps to contain sediment on the construction site;
- Existing vegetation may be used as a sediment filter where minimal grades and sheet flow runoff will occur;
- Ensure that all sediment barriers are installed and functioning properly. j)

Avoid causing flooding in roadways and adjacent right-of-way:

- Do not block existing culverts and storm inlets except as a last resort;
- Ensure that sediment is removed from sediment traps and filters after storm events.

G. Construction Records and As Built Plan Requirements

The HDD Contractor shall keep detailed and accurate records of all activities associated with the HDD process. Upon completion of HDD installations, the Contractor shall provide the Engineer with As Built plans and any supporting documents within 60 days of project completion. As Built plans are preferred in AutoCAD format but may be submitted in paper form. HDD construction records and As Built plans shall include the following:

- a) HDD tracking data and operator logs shall be maintained daily and shall be made available upon request from the **relevant authority responsible for roads or rail**. These field records and operator notes shall specify:
 - the type of tracking equipment used,
 - the length and depth of the HDD installation,
 - additional information that may include steering adjustments and other equipment performance parameters;
- b) As Built plans shall be derived from the tracking data and operator logs. At a minimum, the drawings shall indicate:
 - horizontal and vertical HDD alignment,
 - existing utility horizontal locations and depths at all exposed locations,
 - existing utility horizontal locations where indicated with field locates.

550 TIE-IN WORKS BETWEEN EXISTING AND NEW PIPELINES

a) General

This specification clause shall apply to any tie in works between existing operational and new pipelines which involve closing down of any main which is in service supplying water, either Raw or Treated, within the existing supply system. It shall further apply to any new fitting that has to be inserted into an existing operational pipeline.

The Contractor shall be responsible for the execution of the works except under circumstances where the execution of the tie in operation is assumed by Engineer as mentioned under (f) below, from the date of the Engineer's instruction to perform described under (g) below. The Engineer's instruction to perform the tie in will be given at least 14 days before the date on which the tie in is to be executed.

b) Fittings

The Contractor shall take delivery of any fittings required at the Works not less than 96 hours before the commencement of the tie in operations. He shall provide all the necessary guarding to ensure that such fittings do not get misplaced or stolen. The Contractor shall, check the suitability of such fittings including checking of all dimensions, particularly the external diameter of the pipe into which the connection is being made and the internal diameter(s) of couplings which are to be used for such connection. This shall be done by measuring diameter at 4 positions to a tolerance of 0.25 mm. The Contractor shall certify the suitability of such materials to Engineer not less than 48 hours before the commencement of tie-in operations.

The Contractor shall prepare a schedule of fittings including those on existing pipes that are to be used for such tie-in or redeployed elsewhere as instructed on the drawings and shall obtain approval of the Engineer not less than 48 hours before the commencement of tie in operations of such schedule.

The Contractor shall ensure that all materials are at the site of the works not less than 24 hours before the commencement of the tie-in operation and shall inform the Engineer who shall check the materials against the schedule as approved where he deems this necessary

Any non-standard fittings which are required for the execution of the tie-in works shall be fabricated under the Engineer's supervision and shall be hydro statically tested to at least one and a half times the maximum working pressure.

c) Personnel

The Contractor shall ensure that at least one senior member of his field supervisory staff who has proven experience of such operations and fluent in English and the language of his labourers is on site throughout the whole duration of the tie in operation.

The Contractor shall also ensure that all necessary skilled artisans for the operation of all his plant are on site for the whole duration of the tie-in operation.

The Contractor shall furnish the Engineer's Representative a list of the key personnel to be involved in the tie in exercise at least 48 hours before the commencement of the exercise and shall get the Engineer's approval at least 24 hours before the commencement in respect of such personnel. To gain this approval the Engineer may require that operative is tested in the performance of his duties in the operation of the plant for which he is in attendance. In particular this requirement shall apply to all welders, pipe cutters using either mechanical or flame cutting equipment and lifting plant operators.

The Contractor shall ensure that an adequate number of labourers are in attendance upon the site during the period of the tie in operation.

d) Pre Tie-in Works

The Contractor shall execute all works possible before the commencement of the operations which shall include:-

- Excavation and supports to the excavation.
- Blinding with concrete the bottom of the excavation and (where instructed by the Engineer) immediate working areas.
- Provision of any required drains a sump of adequate size from which any accumulating water is to be pumped out.
- Casting of the floor of any chamber which is to be constructed around such tie-in works.

- Casting of any thrust blocks or thrust walls or any other works necessary for effective execution of the tie-in works as may be required by the Engineer.

The Contractor shall complete these works at least 96 hours before the commencement of the tie-in operation or within a period that may be otherwise set by the Engineer upon issue of the Engineer's instruction to perform the tie-in works, and obtain the Engineer's approval not less than 24 hours before commencement of the tie-in operations.

e) Plant

The Contractor shall prepare a schedule of the plant which he proposes to have on site either to use, or on standby, or for emergency use and shall obtain the approval of the Engineer not less than 48 hours before the commencement of the tie-in operations.

Such Plant shall include:

- Excavation plant
- Cutting equipment
- Lifting equipment
- Pumping equipment (unless a drain is provided)
- Concrete Mixer
- All tools necessary for the erection and assembly of the plant.

The Contractor shall also ensure that all plant is on site not less than 24 hours before the commencement of the tie-in operation and shall inform the Engineer who shall check the plant against the schedule as approved where he deems this necessary.

f) Actual Tie-in Works

The Contractor shall prepare a programme giving details of the proposed scheduling and sequencing of tie-in works necessary for minimising the interruption to the existing water supply. Approval of such programme by the Engineer shall be obtained not less than 72 hours before commencement of the tie-in operation.

The Contractor, unless relieved of the responsibility by the Client or the Engineer, shall first empty the section of the main on which the tie-in is to be made and shall ensure that the nearest air valves and washouts immediately upstream and downstream are all open and the washout dry.

Where the Contractor is relieved of this operation, which shall be notified to him by the Engineer not less than 96 hours before the tie-in operation is due to commence, he shall check that air-valves and washouts mentioned above are in the state described.

When the Engineer is also satisfied that the main is empty of water he shall verbally give the order to commence the works from which time the Contractor shall be solely responsible for the execution and completion of the tie-in works unless relieved of such responsibility by the Engineer.

In event that the Engineer directs that the required tie-in works be carried out during the night for purposes of minimising the effect of such tie-in on the respective consumers/authority, the Contractor shall make all required preparation for provision of lighting (including standby and emergency) and any other measures as the Engineer may direct.

The Contractor shall provide all the insurance normally required by the Engineer and the operating FIDIC Condition of Contract and shall obtain an endorsement if necessary to ensure that the insurances remain valid in the event that the Engineer takes over the direction of the works.

When the Engineer is satisfied that the tie-in works are completed he shall give notice for the main to be re-commissioned, when this has been satisfactorily accomplished the Contractor shall re-deploy his staff on the Engineer's verbal instructions of completion of the tie-in.

g) Post tie-in Works

Within 48 hours of the completion of the tie-in works the Contractor shall have completed all permanent works required to support the plant installed during the tie in operation, and shall remove all temporary supports within a further 48 hours after the permanent support works have been approved by the Engineer. The temporary supports shall not be removed before such approval has been given.

Within 14 days from the date of the completion of the tie-in the Contractor shall have completed all the other permanent works required to allow operation of the plant installed during the tie-in operation, or other plant for which the tie-in executed, and shall obtain the approval of the Engineer on the completion of such works.

The Engineer shall issue the Contractor with a notice stating the operations for which the plant installed during the tie-in operation may be used, which shall remain in force for a period extending for 28 days from the date of approval of the completion of the Post tie-in works as described above.

Before the expiry of the 28 day period described above the Contractor shall obtain the approval of the Engineer for the completed works when the Engineer shall issue a notice allowing full operation of the plant on the expiry of the above mentioned period upon which the Contractor's responsibility for the works, unless requested otherwise shall cease.

h) Form to be Used

A copy of the Form to be used for each tie-in work is given below.

SCHEDULE OF INSTRUCTION, SUBMISSIONS AND APPROVALS FOR THE TIE-IN WORKS			
1) Engineers Instructions to Perform Tie-in		14 Days
2) Materials: Acceptance by Contractor		96 hours
	Certificate of Suitability by Contractor	48 hours
	Schedule of those needed submission	
	approval	48 hours
	Arrival on Site	24 hours
	Checked on Site by the Engineer	
3) Works Programme of Execution	submission	
	approval	72 hours
	Schedule of plant submission	
	approval	48 hours
	Plant arrival on site	24 hours
	checked on site by engineer	
	Artisans approved by engineer	24 hours
	testing of by engineer	
4) Notice of Responsibility for Drawing Mains		96 hours
5) Pre-tie in Works	completion of	96 hours
	inspection by engineer	24 hours
6) Engineer's Verbal Instruction to Commence when Main is Dry			
7) Engineer's Verbal Instruction to Re-commission Main		
8) Engineer's Verbal Approval of the Tie-in Completion		

9) Engineer's Notice of Plant Operations Allowed	
10) Support Works:	completion 48 hours
	approval by engineer
	removal of temporary
11) Post tie-in Works	completion 14 days
	approval by the engineer
12) Final Approval by the Engineer of Whole Works	42 days
NOTE:		
A)	Times given are the latest	
B)	Where items are not given the Contractor shall ensure execution of that item so as not to cause any other item to be delayed.	

PART V – VALVES, METERS, FITTINGS AND OTHER RELATED ITEMS

551 VALVES - GENERAL

Isolating Valves up to and including DN 300 shall be gate valves, and valves larger than DN 300 shall be butterfly valves, except where otherwise specified on drawings or in Bills of Quantities.

All valves shall bear an identification mark on the upper body that shall include:

- the name of the manufacturer and/or his trade mark
- the nominal diameter (DN)
- the nominal pressure (PN)

The manufacturer's full technical leaflets shall be supplied to the Engineer in triplicate by the Contractor for approval prior to confirmation of any order for valves.

The valve body shall be cleaned and shot blasted to SSRN 937 before being internally and externally protected.

All isolating valves shall be protected by fusion bonded powder epoxy or equivalent, internally suitable for potable water and to a minimum thickness of 150 microns, or in aggressive soils of 300 microns thickness indicated as such on drawings and in the Bills of Quantities.

All valves shall be designed for a maximum permissible pressure of 16 bar except where otherwise specified on drawings or in bills of quantities. All valves shall close when the stem rotation is in a clockwise direction unless otherwise specified.

552 GATE VALVES

Unless otherwise specified gate valves of nominal diameters up to and including DN 300 shall be made of epoxy coated cast ductile iron in accordance with SSRN 501. The epoxy coating shall be not less than 150 microns thickness. The gate shall be completely rubber encapsulated, the gate valve being of pocketless type with a straight through port. Gate valves shall be capable of sustaining a maximum permissible working pressure of 16 bar except where otherwise indicated on drawings or in bills of quantities. Gate valves shall be provided with integral flanged ends unless otherwise indicated on drawings or in bills of quantities.

Unless otherwise specified the face to face dimensions of gate valves with integral flanged ends shall be in accordance with SSRN 518 basic series 14 (short) or basic series 15 (long) as indicated on the drawings or in the bills of quantities.

Where specified, valves for replacement washouts shall have valve bodies of epoxy coated ductile iron and the flanges shall be undrilled. Face to face dimensions for these valves shall be to EN 558 and EN 12627 basic series 14 (short).

Gate valves shall be of the non-rising stem type except where specifically indicated otherwise. The stem seal shall be of toroidal sealing rings (O-rings) with at least two such seals. Seals shall be capable of being replaced with the valve under pressure and in the fully open position.

The gate shall be of ductile iron fully rubber encapsulated, the gate sealing in the body being ensured by compressing of the rubber. Wedge/gate guides of wear resistant plastic with high gliding features shall be provided in the body, optimally placed to guarantee low wear and tear of the gate and low closing torques.

The bonnet gasket shall be of elastomer (suitable for potable water). The bonnet studs or allen screws shall be corrosion-protected. In addition the studs/allen screws shall be placed in countersunk holes in the bonnet and completely sealed with wax or a suitable material, which can be removed by low-temperature melting in case they have to be disassembled.

The gate valves bodies shall be works cleaned and shot-blasted in accordance with SSRN 937 before being coated internally and externally. The body, the bonnet and the gate of the valve shall be made of ductile iron to SSRN 240, the gate being encapsulated with elastomer EPDM, nitrile or equivalent.

The operating stem shall be made of stainless steel at least equivalent to SSRN 936/A, except in areas of aggressive soils where this shall be to SSRN 936/B, indicated as such on drawings and in bills of quantities.

The stem nut shall normally be made of high tensile brass to SSRN 941, except in areas of aggressive soils where this shall be aluminium bronze to SSRN 942, indicated as such on drawings and in bills of quantities.

Furthermore and in aggressive soils indicated are such on drawings and in bills of quantities, outside bolts and nuts shall be made of stainless steel to SSRN 936/C or as detailed on drawings.

553 BUTTERFLY VALVES

Butterfly valves for manual operation shall comply with SSRN 506 and shall be double flanged, resilient and metal seated tight shut-off design and of the eccentric disc type supported from two shafts placed in self lubricating bearing bushes.

Butterfly valves shall be capable of sustaining a maximum permissible differential working pressure of 16 bar except where otherwise indicated on drawings or in bills of quantities.

They shall operate with a clockwise closing direction. The valve disk shall rotate through an angle between 0 degrees and 90 degrees inclusive. The sealing ring shall be made of EPDM rubber and shall be attached at the disk edge circumference by a retaining ring without adjustment to form a resilient and durable seal.

The valve disc seal shall be replaceable without dismantling the operating mechanism, disk or shafts, and without removing the valve from the pipeline.

The Butterfly valve shall be equipped with an inversible and proportional worm gear operator. This shall be either with or without an additional primary reduction gear placed within a waterproof housing dependant upon nominal valve diameter and maximum working conditions as stated in the bills of quantities.

The operating mechanism shall be permanently lubricated, not in contact with the water and tilted with an OPENED/CLOSED proportional position indicator in order to indicate the disk angular position. The mechanism shall be sized in order to minimise torque for ease of manual operation under maximum differential pressure and shall be with high-class enclosure IP67 to SSRN 038. Valve body, disk and disk retaining ring shall be in ductile "SG" iron casting to SSRN 240. Disk shafts shall be in stainless steel to SSRN 936/A.

The valve body shall be cleaned and shot blasted to SSRN 937 and internally and externally protected with paint suitable for potable water.

Each butterfly valve shall be works pressure tested in accordance with SSRN 517

- body test at a minimum pressure of 1.5 times the maximum permissible pressure
- seal test at a minimum pressure of 1.1 times the maximum permissible pressure.

554 HANDWHEELS AND VALVE CAPS AND VALVES

Handwheels are to be provided for all valves in chambers. They shall have cast into them the words 'open' or 'closed', together with an arrow indicating the direction for such opening or closing.

Valves for tee-key operation shall be provided with valve caps conforming to the appropriate tender/contract drawing.

555 VALVE KEYS

These shall be of mild steel with ends to suit either valves to SSRN 501, valves to SSRN 506 or valves to SSRN 511 fitted with valve caps, dimensioned to the appropriate Tender Drawing.

556 NON-RETURN VALVES

These shall have bodies made from bronze for DN not greater than 40 mm and they shall be of the swing pattern and shall be rated for at least PN 10 or greater as specified. The ends shall be either screwed to SSRN 223 or flanged to SSRN 207, PN 10 or as the installation demands.

For DN greater than 40 mm they shall be of a profiled poppet type with non-slam characteristics (surge suppressing type) and be of approved manufacture. The proposed valve shall be of low pressure loss and maintenance free with PN 16 rating (unless otherwise specified) and shall achieve a movement from fully open to fully closed on pump stoppage in 0.1 to 0.3 seconds. The valve housing shall be of epoxy-coated cast iron and flanged with the closing system of stainless steel.

With his tender, a Tenderer shall have supplied full technical details of the valves he proposes to supply and install. If the Engineer deems the valve proposed to be appropriate he will accept the offer. If however the Engineer considers the offer to be inappropriate he will reject the offer from the Tenderer and instruct him instead as to the

acceptable manufacturer(s) of these items. Should a financial offer from a Tenderer in this regard be obviously under-priced then the cost of supplying an appropriate valve shall be fully to the account of the Contractor.

557 AIR RELEASE AND VACUUM BREAK VALVES

Automatic air relief and vacuum break valves (air valves) shall be of the anti-shock anti-surge type (Ventomat RBX or approved equivalent) design.

Bids which apparently contain non-compliant offers will be required to confirm that they will meet these specifications in their totality at the rates quoted in their offer.

Such valves shall meet the following requirements:

The required valves shall provide all of the functions described below.

i. Pipeline filling

Uninterrupted high volume air discharge through the large orifice.

ii. Pipeline draining or Column Separation

Uninterrupted high volume air intake through the large orifice.

iii. Pipeline full and operating

Discharge of disentrained pressurised air through the small orifice.

iv. Rapid Filling / Column Separation

The valve must incorporate an integral surge alleviation mechanism that will automatically dampen surge pressures due to rapid air discharge or the subsequent rejoining of separated water columns.

The air release and vacuum break valve shall be of a compact single chamber design with solid cylindrical High Density Polyethylene control floats. These shall be housed in a tubular stainless steel or corrosion protected body with epoxy powder coated cast iron, or s/steel ends secured by means of stainless steel tie rods.

The valve shall have an integral surge alleviation mechanism which shall operate automatically to limit transient pressure rise or shock induced by closure due to high velocity air discharge or the subsequent rejoining of separated water columns. The limitation of pressure rise must be achieved by deceleration of approaching water prior to valve closure. Relief mechanisms that act subsequent to valve closure cannot react in the low millisecond time span required and are therefore unacceptable.

Large orifice sealing shall be effect by the flat face of the control float seating against a nitrile rubber 'O' Ring housed in a dovetail groove circumferentially surrounding the large orifice. Discharge of pressurised air shall be controlled by the seating and unseating of a small orifice on a natural rubber seal affixed to the control float.

The intake/discharge area shall be equal to the nominal size of the valve i.e. a 150 mm valve shall have a 150 mm intake/discharge orifice.

The valve construction shall be proportioned with regard to material strength characteristics, so that deformation, leaking or damage of any kind does not occur by submission to twice the designed working pressure.

The valve design shall incorporate an over pressure safety feature that will fail without an explosive effect, such as is normally the case when highly compressed air is released suddenly. This feature shall consist of easily replaceable components such as gaskets, seals or the like.

The air valve shall be provided with a separate isolating gate valve or if so specified with a separate isolating butterfly valve.

Unless otherwise specified all air valves shall be provided with an integral flanged inlet with studs appropriate to SSRN 207 NP 10 or as the installation demands and complying with the appropriate nominal pressure.

All air valves at new installations shall be fitted to an air accumulator tee with the branch of a diameter not less then 0,6 times the diameter of the main. Where necessary, a concentric taper either integral with or as a separate fitting shall be inserted between the branch and the isolating valve immediately beneath the air valve and an abrupt diameter change between branch and isolating valve shall be avoided.

558 SURFACE BOXES

These shall be of cast iron, (hinged and locked) and from an approved manufacturer to SSRN 513. They shall be sized to suit the purpose required and as otherwise shown on the relevant drawings.

The number of keys required (if any) is indicated in the Bills of Quantities.

559 VALVE CHAMBERS

New chambers shall be constructed in accordance with the drawings, and where indicated shall incorporate thrust walls.

Rehabilitated chambers shall be constructed or rebuilt or repaired in accordance with the original drawings or as directed by the Engineer's Representative using materials approved by the Engineer's Representative.

Notwithstanding the size and shape of the valve to be supplied the Contractor shall ensure that the minimum clearance as indicated on the drawings are provided within the

chamber and that where chambers have pre-cast roofs, the manhole cover provided shall be of a size sufficient to allow for the removal and replacement of the valve without disassembly.

560 VALVES CHAMBER COVERS

Unless otherwise indicated in the Bills of Quantities, valve chamber covers shall be reinforced concrete with a weight of minimum 50 kg per piece and provided with embedded steel device for lifting at each end. They shall be supplied complete with lifting keys. Except where a chamber is provided with pre-cast roof slabs to facilitate placing and removal of the valve or valves within the chamber, the clear opening in the chamber cover shall in all cases allow for this. It will be the Contractor's responsibility to ensure that the covers he provides are of an appropriate clear opening size.

561 RESERVOIR INLET VALVES

All reservoir inlet float operated valves shall be of one of the following types as specified: (a)

Of the streamline type wherein operation is effected automatically by change of displacement of the float, the alternate actuating forces provided by weight and buoyancy being transmitted by lever mechanism to the valve element.

The float action shall operate the pilot valve housed within the plunger thereby ensuring sensitive response to the small mechanical forces applied. Closure shall be drop tight and the valves shall discharge vertically downwards. The valve shall act from fully open to fully closed with a change in reservoir water level of the order of magnitude indicated below.

Inlet Diameter (Nominal) (mm)	Reservoir Level Change (valve open to close) Approx. (mm)
80	130
150	230
200	260
250	320
300	380
400	850

Where controlled closing and opening of the float valve is required the valve will be provided with a stilling basin to ensure gentle transition on valve closure so as to avoid sudden pressure rise in the incoming main as a result of closure.

- (b) Of a type that has been specifically designed to overcome problems of influence in operation by water surface turbulence and of the risk of causing surge pressures in the upstream pipeline as a result of the closing mechanism deployed. They should further be simple to service without the need for special tools or lifting equipment.

In either case, the valves shall be of approved manufacture.

562 TWO-POINT TIME-MODULATED PRESSURE REDUCING VALVES

To facilitate pressure management, the tender may call for shall supply and installation of two-point time-modulated pressure reducing valves as indicated on the drawings and in the Bill of Quantities.

The time modulated Pressure Reducing Valves shall comprise a main valve and a pilot control system. The valve gate shall comprise a horizontally mounted resilient disc moving upward to open the valve and downward onto a seat so as to close the valve. It shall be held in place by a diaphragm assembly and spring, accessible from above via a removable cover. Opening, closing and throttling shall be achieved through the connection of upstream, cover chamber and downstream compartments of the valve through appropriate restrictions and throttling controls.

The throttling control shall be capable of being adjusted automatically from outside of the valve at a minimum of two outlet pressures through a time based modulator such that both the pre-set time of adjustment of outlet pressures and the outlet pressures themselves can be changed if circumstances require it. The time modulating device shall be an encapsulated, self contained, watertight device inclusive of a power pack. The power pack shall have a minimum guaranteed usable life of two years. Means of replacing battery pack, and adjusting time and pressures shall be straightforward.

If included, a Tenderer shall be specifically required with his tender to have supplied full technical details of the valves and PRV controllers he proposes to supply and install. If the Engineer deems the valves and controllers proposed to be appropriate he will accept the offer. If however the Engineer considers the offer to be inappropriate he will reject the offer from the Tenderer and instruct him instead as to the acceptable manufacturer(s) of these items. Should a financial offer from a Tenderer in this regard be obviously under-priced then the cost of supplying an appropriate valve and controller shall be fully to the account of the Contractor.

563 BULK METERS ELECTRO-MAGNETIC TYPE

General

Electromagnetic flow meters shall be of new technology microprocessor based electronic water flow meter and be capable of monitoring flow totals and flow rate in both forward and reverse flow direction. The flow meter shall have no moving parts to ensure that there is no damage from particulate matter, e.g. stones, weed, etc.

The meter shall be suitable for 85 to 265 Volt AC, 40 to 400 Hz supply without the need for link setting or voltage selection and shall be supplied with an uninterrupted power supply (UPS) inclusive of voltage protector. In addition, automatic battery backup must be included to ensure no loss of metering during AC power loss periods.

Alternatively, the meter shall be suitable for operation from two internal 3.6V lithium batteries which provide an operating life of three years. It shall be possible to change the batteries in the field.

Performance

The accuracy of + 0.25% for AC meters and + 0.5% for battery meters shall be achieved. The meters shall be suitable for a maximum working temperature to 70°C at pressure up to at least 16 bars.

Spare Parts

The manufacturer shall also supply a full and complete list of all parts of the meters offered duly named (In English) and numbered together with the prices for each separate part. The normal usage and cost of the spares will be considered when assessing the cost of each meter which will be a factor in the selection of the Tenderer.

564 BULK WATER (WOLTMAN) METER (HELICAL VANE TYPE)

Meter Characteristics

Bulk water meters for either major consumers or for monitoring district flow measurements shall comply with SSRN 510 and SSRN 520.

The meters shall be approved as Class B water meters for horizontal, vertical or inclined installation. The meter shall be of the Woltmann type with the axis of the turbine parallel to the flow direction. The mechanism shall be removable and shall be of an approved standard.

The bulk meters shall be supplied as follows:

- Meter calibrated in cubic metres
- Volt-free pulser for interface with datalogger
- Suitable In-line strainer with Stainless Steel screen

Performance

The maximum flowrate (Q_{max}) is the highest flowrate at which the meter can function over limited periods without damage, and without exceeding the maximum permissible error ($\pm 2\%$) and the maximum permissible value for loss of pressure.

The nominal flowrate (Q_n) is equal to about half the maximum flowrate, Q_{max} . It is expressed in cubic metres per hour and is issued to designate the meter.

At the nominal flowrate, Q_n , the meter should be able to function in normal use, i.e. in continuous and intermittent operating conditions, without exceeding the maximum permissible error ($\pm 2\%$).

The minimum flowrate (Q_{min}) is the flowrate above which the meter must not exceed the maximum permissible error ($\pm 5\%$), and is fixed as a function of Q_n .

The transitional flowrate (Q_t) is the flowrate which divides the upper and lower regions of the flow range and the rate of the maximum permissible error is $\pm 2\%$.

The flowrate values shall (as a minimum) meet the following (for diameters up to and including DN 300 mm this shall be in both forward and reverse flow for network management):

The minimum and maximum flows must be stated by the Tenderers and supported by test certificates from the National Standards Institute of the country of manufacture. Tenderers should state the equivalent International Standards Institute e.g. ISO, BS, DIN, AWWA. The class of meter must also be stated. The minimum flows to be registered for the following meter sizes are specified below but the Tenderers are to state the minimum flow for other sizes:

Nominal Diameter mm	50	80	100	150	200	250	300
Maximum flowrate Q_{max} , m ³ /h	30	80	120	300	500	800	1200
Nominal flowrate Q_n , m ³ /h	15	40	60	150	250	400	600
Minimum flowrate Q_{min} ,m ³ /h	0.45	1.2	1.8	4.5	7.5	12	18
Transitional flowrate Q_t , m ³ /h	3	8	12	30	50	80	120
Head Loss at max. flowrate, bar	0.05	0.04	0.10	0.10	0.10	0.09	0.21

Sizes

The length of water meters should be standard and not exceed the following:

Nominal Diameter mm	50	80	100	150	200	250	300
Overall length, mm	300	350	350	300	350	450	500

Tightness, Pressure and Temperature Resistance

The water meter shall permanently sustain (without leakage, malfunctioning or permanent deformation) a working pressure of 16 bar and a maximum water temperature of 50 degree Celsius, unless otherwise specified in the BOQ.

Headloss

The head loss shall not exceed 0.2 bar at Q_{max} for all nominal diameters.

Materials

The water meter shall be made with materials appropriate to each specific use. The body shall be made of high quality cast iron with an internal and external epoxy powder coating.

Inner plastic parts shall be non-toxic and non-tainting.

The Counter

The transmission between the turbine and the totalizer shall be of the magnetic type properly shielded against any magnetic external influence. The helical vane shall revolve in direct proportion to the flow of the water.

Totalizer and transmission gears shall be hermetically capsuled in a brass box and a scratch resistant mineral glass sealed to IP 68. The dial and the cover shall rotate through 360° without using of any tools and without breaking the meteorology seal.

The indicator shall, as minimum requirement, record the following values:

Size of Meter (ND)	Minimum Registration (m³)	Maximum Registration Before Self Re-Set (m³)
50 – 100mm	0.01	1,000,000
150 - 300mm	0.1	1,000,000,000

The meter shall be fitted with an uni-directional pulsar suitable to interface with datalogger products (4-20mA). The pulsar shall be of the reed switch type and shall deliver different pulse values depending on their position in the totalizer. The following pulse values shall be available:

Pulse Values	DN 50 to 100	DN 150 to 300
Reed pulse unit	1 m³ and 10 litres	10 m³ and 100 litres

Accuracy

Characteristic curves of accuracy with parallel tables up to the maximum operation capacity are to be provided by the Tenderer. These characteristic curves must be supported by test certificates from the National Standards Institute of the country of manufacture or an equivalent International Standard. The accuracy curves must be comparable with the standard and shall be equal to or better.

The maximum error permitted must be indicated. The maximum error at maximum and recommended continuous flow shall not be more than +2% and +5% at minimum flow.

Head Loss

Characteristic curves of heads plotted against the rate of flow up to the safe maximum operating capacity shall be provided by the Tenderer. The head losses must be plotted against the whole range of flows.

Flanges

All bulk meters shall be flanged. Flanges shall be drilled to NP 16 according to SSRN 207 (unless otherwise indicated in the BOQ) and shall be supplied complete with flange gaskets, bolts, nuts and washers.

Weight

The weight of the meter should not exceed the following:

DN (mm)	50	80	100	150	200	250	300
Weight (kg)	13.5	18	24	45	55	90	110

Marking

On the body an arrow on both sides shall show the direction of flow. In addition, an individual serial number, the manufacturer's sign or name, initial inspection date to conform to the obligatory marking standard.

Strainer

The bulk meters shall be supplied with suitable in-line strainers. The strainers shall be able to withstand a working pressure of 16 bar and a temperature of 50 degree Celsius.

The sieve element shall be of stainless steel grade 316 with a hole size of 3 mm to prevent large particles from damaging the measuring mechanism. The sieve element shall be removable without disturbing the flange joints.

Materials and Design

The materials uses in the construction shall be designed to withstand raw and treated water and normally operate for 5 years without normal need for maintenance or repair and the maximum error shall not exceed the specified limits. The Tenderers shall specify the optimum pH and the aggressive water quality for which the meter has been designed. The tenderers are also required to give details of any water quality parameter that may adversely affect the normal operation of the meters to be supplied.

Meter Bodies

The meter shall have a durable outer case protecting the inside of the meter through which the vane operates. The casting shall not be repaired in any manner. The outer body casing shall be of the split case type with the upper part fitted to the lower part by means of the cap bolts and nuts. Alternatively for the smaller meters the outer casing may consist of two parts which are screwed together. The meter body casing must be made from materials with a life expectancy under normal use in excess of over 20 years.

On all the meter sizes, model and direction of flow shall appear in indelible marking cast in raised characters on the outer case of the meter. The letters of the water company followed by the serial number shall also appear in raised characters in an easily visible position on the outer case of the meter but not on the lid.

External Case Bolts

Where external case bolts screw cap blots, nut and bolts form part of the meter design these shall be arranged for easy removal after a long service. They shall be of the same composition as the meter casing as appropriate or of stainless steel.

Registers

Internal mechanisms of the register shall not be in fluid contact with the water being measured. Registers may be of the fully sealed pattern with the external parts running in a mixture of glycerine and water of similar mixtures appropriate to the design of the counter. The viewing window shall be of a transparent material which will not shutter, discolour become opaque or distort in normal use. A lid shall over-lap the viewing window when in closed position. They should comply with the local standard or equivalent or better international standards.

Intermediate Gears

Intermediate gear trains shall be made of materials which can be shown by the manufactures to have satisfactory characteristics and designed for performance expectancy of at least 5 years. Gear trains exposed to the water being measured shall be constructed from materials designed to be lubricated by water.

Helical Vanes

These shall be made of vulcanised hard rubber or other materials having satisfactorily characteristics including sufficient rigidity and strength to operate at the rated capacity of

the meter. They should have sufficient dimensional stability to retain operating clearance at working temperature of up to 50° C. Designed life expectancy in excess of 5 years is expected of all moving parts of the working chambers.

Seal Wire Holes

Meter casing, register box screws inlet and outlet coupling nuts shall have holes drilled for seal wire. The meter shall be sealed at the factory before dispatch. The holes shall be 2.5mm in diameter.

Spare Parts

The manufacturer shall also supply a full and complete list of all parts of the meters offered duly named (In English) and numbered together with the prices for each separate part. The normal usage and cost of the spares will be considered when assessing the cost of each meter which will be a factor in the selection of the Tenderer.

565 CONSUMER WATER METERS

General

Domestic water meters for house connection shall comply with SSRN 510 and SSRN 520. In addition, it shall comply with the EEC Council Directive No. 75/33/EEC as well as with the norms and regulations that govern their manufacturing and final tests, whether the latter are specifically mentioned in this specifications or not.

The domestic water meters shall be approved Single Jet velocity type - Class C or volumetric type - Class C. The meter shall provide the specified flow accuracy when installed as detailed here below.

The domestic meters shall be supplied as a complete kit comprising the following items:

- Meter, Single Jet water meters with extra dry dial and magnetic protection of up to 2000 Gauss, calibrated in cubic metres
- Volumetric type of meters shall be the semi positive rotary with grooved piston
- The meters shall have no external calibration screw to prevent fraud
- Meters are to be corrosion proof copper alloy or polymer plastic
- The outer body casing shall be of the split case type. The outer casing may consist of two parts which are screwed together and a watertight seal between the two
- Isolating/disconnection valve
- Union sockets;
- UV resistant plastic meter box complete with lid and with security master key
- DN 15 BSP threaded inlet and outlet tail pieces complete with unions on each end, suitable for connection to galvanised iron pipe
- Built-in strainer
- Built-in non return valve to prevent meter reversal

The meter and the box shall be complete as a package for instant connection and use. The domestic meters shall have threaded connections.

Performance

The maximum flowrate (Q_{max}) is the highest flowrate at which the meter can function over limited periods without damage, and without exceeding the maximum permissible errors (+/-2%) and the maximum permissible value for loss of pressure (1 bar).

The nominal flowrate (Q_n) is equal to half the maximum flowrate, Q_{max} . It is expressed in cubic metres per hour and is issued to designate the meter.

At the nominal flowrate (Q_n) the meter should be able to function in normal use, i.e. in continuous and intermittent operating conditions, without exceeding the maximum permissible errors ($\pm 2\%$).

The minimum flowrate (Q_{min}) is the flowrate above which the meter must not exceed the maximum permissible errors ($\pm 5\%$), and is fixed as a function of Q_n .

The transitional flowrate (Q_t) is the flowrate which divides the upper and lower regions of the flow range and the rate of the maximum permissible error is $\pm 2\%$.

The flowrate values shall (as a minimum) meet the following:

Nominal Diameter	mm	15	20	25	40
Nominal flowrate..... Q_n	m ³ /h	1.5	2.5	3.5	10
Maximum flowrate Q_{max}	m ³ /h	3	5	7	20
Minimum flowrate Q_{min}	l/h	15	25	35	100
Transitional flowrate..... Q_t	l/h	22.5	37.5	52.5	150

Metrological Classes

The meters performance specification shall be to SSRN 510 Class C or to equivalent internationally recognized Standard according to the value of Q_{min} and Q_t as shown in the following table:

Class	Q_n = Less than 15m ³ /h	Q_n = 15 m ³ /h or more
<u>Class C</u> Value		
of: Q_{min}	0.01 Q_n	0.006 Q_n
Value of: Q_t	0.015 Q_n	0.015 Q_n

The Supplier shall provide the reference metrological signature (error curve) for each type of water meter. The metrological signature shall be established on a representative sampling of water meters. The water meters shall have the ability to be verified by any certified laboratory (in liquid flow metering) without requiring the purchase of special equipment or the undertaking of special works. For DN 15 and DN 20, the Q_{start} shall be 6 litres/hour or less to reduce unaccounted for water for consumers with storage tanks. Error curves of meters provided shall not vary more than $\pm 2\%$ when testing flows between Q_2 and Q_4 (or between Q_t and Q_{max}) and shall not vary more than $\pm 5\%$ when testing flows between Q_1 and Q_2 (or between Q_{min} and Q_t).

The meters must be able to retain their accuracy when installed in either horizontal, vertical or inclined planes and maintain the accuracy for not less than 6 years.

Tenderer shall provide certificate of the metrological class of the meters offered and an approval certificate indicating clearly that the meter is approved for both horizontal and vertical installations.

Sizes

For each meter size designated the corresponding fixed set of dimensions must correspond to SSRN 510 and no deviations from this shall be accepted. The lengths of water meters shall not exceed the following:

Nominal Diameter	mm	15	20	25	40
Length	mm	165	165	199	300

Tightness, Pressure and Temperature Resistance

The water meter shall permanently sustain (without leakage, malfunctioning or permanent deformation) a minimum working pressure of 10 bar (DN 15 mm) or 16 bar (DN 20 mm) and be suitable for water temperatures up to 50 degree Celsius. The meter should also be able to operate at minimum network pressure of 0.5 bars or less.

Headloss

Characteristic curves of head losses plotted against the rate of flow from the minimum flow rate shall be provided by the Tenderer. The meters shall show a loss of head not exceeding 1 Bar at Qmax and 0.25 bar at Qn in accordance with SSRN 510.

Materials

The materials used in the construction shall be designed to withstand raw and treated (potable) water and operate for at least 5 years without normal need for maintenance or repair and without the maximum error exceeding the specified limits.

Tenderer shall specify the optimum pH and the water quality for which the meters have been designed.

They must be constructed throughout of materials which are resistant to internal and external corrosion and if necessary be protected by some suitable surface treatment. All materials of the water meter which are in contact with the water flowing through the water meter shall be food grade, non-toxic and non-tainting as attested by a reputable and certified international laboratory. Water temperature variations within the working range shall not adversely affect the materials used in the construction of the water meter.

The outer body casing shall be of the split case type. The outer casing may consist of two parts which are screwed together and a watertight seal between the two. The meter body casing must be made from materials with a life expectancy under normal use in excess of 20 years.

The water meter shall be made with materials appropriate to each specific use. The body of domestic meters (DN15 - DN25) shall be manufactured from copper alloy or polymer. For water meters designed for domestic use (DN15 – DN 20mm), single jet water meters manufactured from a special thermoplastic material with highest technical characteristics will be given preference over any other material if all the technical requirements are met (pressure, metrology, life etc)

The measuring element shall be of high grade polymer to ensure minimum wear and a high degree of reliability.

Counter

The indicator shall provide for reliable and unambiguous direct reading of the volume of water measured in cubic metres or in cubic meters and litres.

The indications of volume shall be by any of the two types as follows:

- Type 1 By a row of inline consecutive digits in one or more apertures (drum counters); or
- Type 2 A combination of drum counters for whole units of cubic meters and pointers on circular scales for fractions of cubic meters.

Drum counters shall be black for indication of a cubic metre and its multiples shall be red for indication of fractions of a cubic metre. Visible movements of the digits shall be upwards and the actual or apparent height of the digits on the drums shall be not less than 5 mm. The advance of a digital unit shall be completed while the next lower valued digit is within the last tenth of its travel. The drums showing digits of lowest value shall move continuously in Type 1, and may move continuously in Type 2. Indicators with pointers (Type 2) shall rotate in a clockwise direction. The value of each division on the scales shall be expressed in multiples or sub-multiples of ten. Each scale shall be graduated in cubic meters or accompanied by a multiplying factor (x0.01 x0.1 x10 x100) according to

the value of the scale. The symbol m^3 shall appear on the dial. The gear unit and the counter shall be combined and completely sealed.

The number drums shall be contained in a non-toxic fluid for lubrication and protection. The counter shall be placed in a window in the meter body and be placed so as to allow for ease of meter reading. Counter window shall be of minimum 7mm thickness to prevent hot wire needle tamper. Any fraud or fraud attempts be indicated and easily detected when reading the water meter. The Supplier shall provide in his technical brochures the tests carried out to prevent fraud or to detect it, particularly for the following types of fraud (if applicable): software frauds, magnetic, intrusion, electromagnetic, clamp-joint, hot needle.

There shall be no occurrence of condensation or deposit in the counter under the mineral glass lens. Black numbers on white shall denote cubic metres and white numbers on red shall denote litres. The counter shall reset to zero at a reading of not less than 10,000 m^3 .

The indicator shall, as minimum requirement, record the following values:

Size of Meter (DN)	Minimum Registration (m^3)	Maximum Registration Before Self Re-Set (m^3)
15mm	0.001	10,000
20mm to 40mm	0.001	100,000

Protection

A suitable in-built strainer (0.75 mm aperture and 2,844 mm^2 mesh area) shall protect the measuring mechanism and an in-built non return valve shall prevent meter reversal.

Marking

Each water meter shall be marked on the casing with the following information:

- Direction of flow of water on both sides of the meter
- Maximum flow rate ($3m^3/hr$)
- Individual Serial number (engraved)
- Individual Serial Number in bar code;
- Manufacturer's name
- Meter Class
- Country of manufacture
- Year of manufacture
- Operator's name (max 10 letters)

Sealing

Water meters shall be provided with a means of sealing so that after sealing, both before and after the water meter has been properly installed, there shall be no possibility of dismantling or altering the water meter or its adjustment device without visibly damaging the seal. The meters shall be sealed subsequent to manufacture and before delivery to the purchaser.

The preferred method of sealing is by a corrosive resistant wire inserted through 2.5 mm diameter holes in the halves of the body, and secured by a circular metal seal impressed by a device which provides a unique imprint on the seal.

Tenderer's shall provide details of the sealing wire type with proof of corrosive resistant and method proposed.

Meter Box

Domestic water meters (DN15 and DN 20) shall be preferably installable in a meter box complete with a stop valve (high quality plastic ball valve with chrome plated brass ball), external inlet and outlet BSPT male connections, lid with a special key and base. Joints to all fittings in the meter box are to be fusion welded to prevent leaks. The meter box shall be made of a highly resistant composite material resistant to UV rays.

The meter box shall be of an appropriate size to accommodate the sizes of meters and the water meter assembly shall be suitably keyed to prevent it from rotating during installation. The meter box will have risers to allow installation at varying depths (existing service connections) and a box bottom. The box must incorporate a lock mechanism, built into the lid. Locking mechanisms using screws shall not be accepted.

Packing and Transportation

Packing shall be made of strong wooden crates, and inside such crate, each meter shall be packed in its own carton box. The water meters' performance shall not be deteriorated during sea, air or land transportation. The threads and pipe extremities shall be protected with appropriate devices. All protections shall be easily removable before the water meters' installation. The water contained in the water meters shall not deteriorate the protection level offered by the conditioning, nor the internal elements of the water meters. Upon delivery, the conditioning shall include on the sides a summary of the water meters' model and diameter, as well as the serial numbers. The packaging sealing shall allow the detection of any previous opening attempt. Upon delivery, the wrapping shall show (prior to its opening) traces of shocks or dents that may have damaged the water meters.

Workmanship

The meters shall be guaranteed against defects in materials and workmanship for a minimum period of one year from date of delivery. Parts to replace those in which a defect may develop within such period shall be supplied without charge, piece for piece, upon the return of such defective parts to the supplier thereof or upon proof of such defects.

Meters should be designed for easy disassembly and re-assembly without the use of special tools or equipment and should be easy to maintain and repair. Meters designed to resist vandalism will be preferred.

The Supplier shall prove the resistance of his water meters to disinfection agents, like for example chlorine dioxide, within the limits of the thresholds set by regulations in relation to potable water. The Supplier shall submit in his technical proposal documented evidence of the resistance of his water meters to suspended particles, describing the devices used to diminish the risk of blockages.

Consumer Water Meter Repair Kits

The manufacturer shall also supply a full and complete list of all parts of the meters offered duly named (in English) and numbered together with the prices for each separate part with his tender.

Quality management system

The Supplier's manufacturing sites shall be certified to SSRN 673. Any other certification, for example SSRN 675, shall be favourably taken into consideration. The Supplier shall highlight in his technical proposal the pre-established and current dispositions taken to manage the manufacturing process, particularly:

- The list of controls and tests carried out during and at the end of the manufacturing process;
- The external control by a certified body for aspects related to regulatory certifications and approvals;
- The arrangements taken to measure the products' performances after their commercialization

- The procedures used to manage client's claims and corrective/preventive actions taken

Training & manufacturing

The Supplier shall describe the training arrangements proposed for the Client. Details of such training, additional costs if any and training programme shall be provided in the proposal.

The Supplier shall communicate in advance all the information related to planned modifications on the purchased water meters (nature of the modification, tests carried out, results and starting date), to allow the Engineer to validate these modifications prior to delivery.

The Supplier shall allow the visit of auditors designated by the Client to his manufacturing sites. During these audits, calibration and sampling of water meters might be carried out for testing in laboratories certified by Engineer.

The Supplier shall describe in his technical proposal the means at his disposal for Customer Service. Addresses of Local Agents and details of after - sales - service shall be given. Information on stocks of meters, meter spares, workshop facilities, meter testing facilities, etc., with the Local Agents shall be provided.

566 PREPAID CONSUMER WATER METER

General

This specification covers supply and installation of cold water consumer meters complete with equipment, materials, software, installations and training and other technical services for the implementation of prepaid water metering system for prepaid consumer meters and standpipes.

The Bidder shall demonstrate that the hardware/ software package that he is proposing meets the minimum functionality requirements laid out. To do this the Bidder shall include with his bid:

- Catalogues and specification sheets for all equipment proposed.
- Details of software packages, their functionality and capabilities, sample inputs, outputs etc.
- Details of currently operating systems based on the proposed equipment & software or its predecessors. These shall include details of the community types, housing types, customer numbers, pay point numbers method of commercial operation implementation problems encountered and solutions developed.

Metering

Except as otherwise modified or supplemented herein, SSRN 510 Class C for cold-water meters or the latest revision thereof shall govern the materials, design, manufacture, and testing of all meters furnished under this specifications. The metering unit shall comply in all aspects with Clause 565 of these specifications.

In addition the meter should have the following capabilities:

- The meter should have a leak detection installation system
- The meter should have provision for a pulse output with possibility to link to AMR system

Display

The unit shall have a simple LCD or similar display capable of informing the customer of the balance remaining and reporting fault codes.

Power Supply

The unit shall draw power from an internal battery power supply and shall not require any mains power feed. Battery life shall be guaranteed for at least 5 years under normal operating conditions.

Prepayment Component

The hardware and software part of the prepaid meter shall as a minimum comprise of;

- Smart card for each prepaid water meter with a service life of at least 10 years
- Credit dispensing unit (CDU) software + PC
- System Master Station (SMS) +PC
- Security spanner for yard meter
- Credit dispensing unit (CDU) software
- Printer POS TM-U210

The supplier will be required to offer the following services:

- Meter Installation
- Installation of master station
- Provide training to client's Staff in the use of the metering system. The training shall be conducted immediately after delivery of the units. The supplier shall propose a training plan for approval by the Engineer. The bidder will include in his bid costs related to venue and transport.

Performance Warranties

The prepaid meters and associated equipment must come with a minimum of 1-year direct guarantee from the contractor/tenderer. All costs associated with offering such a guarantee are to be built in the rates for supply and installation of the equipment.

Tariff System

The proposed tariff system calls for a rate per m³ of water which shall take into account the applicable tariff bands. In addition there shall be different rates for different customers as per the Client's Tariff structure. For example:

- The services billed for include water, sewerage, sanitation levy.
- The system should be capable of tracking arrears for recovery on an agreed percentage of the current consumption.
- The meter rentals shall be included in the Tariff System.
- The technology shall be able to add other charges as the Client may decide on, at very short notice.

Billing and Management

The billing system to be implemented shall consist of a prepayment centre where consumers go to pay for their water and are issued with a token or card which can transfer the units purchased to the meter unit. The units uploaded shall be non-transferable from one meter unit to another.

The system shall utilise rechargeable tokens or cards which the metering units shall be capable of reading. Systems requiring scratch cards and any form of keyboard entry on the meter unit or vending unit shall not be accepted.

The tokens or cards to be used shall be capable of not only transferring units bought to the meter but also of reading consumption data from the meter for transfer back to the management software. The software should seamlessly integrate with the existing Client

billing system. The bidder may need to familiarize himself with existing billing system prior to tendering

Prepayment Centre

The Client shall make an office available for the installation of the equipment for the prepayment centre. The Supplier under this contract will be limited to:

- Supply and installation of all management and billing software and all other software required for the correct operation of the system on the PCs.
- Supply and installation of the token or card reader/ writer hardware.
- Supply of all other necessary equipment for the management of the system, including but not limited to:
- Additional specialised tokens /cards for configuration, testing and tariff setting of meters and vending units.
- The system must not be limited to billing the number of consumer indicated in the Bidding Documents but must accommodate any expansion in the customer base.

Management Software Capability

The software to be provided with the system shall have the following capabilities:

- Secure Management and reconciliation of payments and recharges
- Upload of consumption data from tokens/cards brought for recharge
- Receipt printing showing amount of recharge, deductions for debt collection etc.
- Recovery for arrears on the account
- Any other services as the customer would require, as specified from time to time on the tariff sheet.
- Configurable to local currency
- Automatically synchronize arrears on the client computer, Server, and token or smartcards
- Keep a record of initial arrears and subsequent payment towards arrears
- Handle variable tariff bands according to tariff category which should be alterable as and when necessity arises
- Handle accumulated customer water consumptions weekly and monthly and the related payments for the consumptions
- Generate various reports (Financial and technical reports) that can be exported to excel or PDF and flexibility to create additional reports when need arises
- The system should have a customer complaint resolution module
- Operate on both Windows XP Professional and Windows 7 Professional or higher
- Determine battery status on customer meter and customer interface unit
- The server side of the system should run on Microsoft SQL 2005 SP3 or higher as a database and should have report writer. The server side of the management system should be supported by Window Server 2003 and Windows Server 2008 or higher operating system
- Be able to categorise customers as either Domestic (Institutional, Government, Private) or Commercial (Institutional, Government, Private)
- The system should be able to categorise properties according to Town, Branch, Townships, Walk routes

- Should be able to integrate with other computer applications running on SQL 2005 or higher such as SAGE Accpac and other systems
- The management system should be able to accommodate mobile payment systems/solutions
- Client machines should be able to run without a stable dedicated connection to server for a predefined period and be able to re-establish connection and synchronise with the server
- System should handle payments by cash, cheque or other means

Token/Card Reader and Control Unit

Meters shall be capable of reading tokens/cards issued for metered customers, transferring balance from the token/card to the meter and writing to the token/card the consumer's consumption pattern information for use in system management.

Meter units shall automatically disconnect supply when the balance is exhausted. The control unit shall handle all of the billing and tariff functionality laid out in this specification.

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CATHODIC PROTECTION AND TEST STATIONS

General

Cathodic protection systems shall comply with SSRN 273 on cathodic protection for land applications. The cathodic protection system or works shall be guaranteed against faulty design, materials and workmanship. Normal wear and tear and malfunctioning due to major changes in the conditions under which such systems or works have to operate, other than weather and which could not have been reasonably foreseen at the time of installation, shall be excluded. The Contractor shall supply all labour, supervision, installed and consumable materials, services, equipment, tools, and each and every item of expense necessary for the design, procurement, installation, commissioning and testing of cathodic protection systems for ferrous materials in contact with soil (buried piping).

Cathodic protection shall include, but not be limited to, the following tasks:

- Obtain, generate and evaluate necessary information to confirm design, installation, testing, commissioning and documentation of the cathodic protection systems.
- Provide detailed design for permanent cathodic protection and testing systems in compliance with this Specification and referenced standards and suitable for the pipeline works environmental conditions.
- Supply and install permanent testing facilities to monitor the cathodic protection systems using proven technology that will be subject to approval by the Engineer.
- Commission, test and adjust the newly installed temporary and permanent cathodic protection systems
- Test for, locate and mitigate any shorts in the cathodic protection systems.
- Test for, evaluate and mitigate possible interference caused by cathodic protection system on communication and low energy control systems.
- Test for, evaluate and mitigate stray currents generated by newly installed cathodic protection systems.
- Provide documentation for system design and installation.

After installation, the insulating joints must be inspected to ensure their compliance with the specifications and drawings and to test their efficiency for satisfactory electrical insulation. The Engineer, the designer of the cathodic protection installation and the Contractor shall witness the inspection.

Soil Resistivity

The Contractor shall confirm the soil resistivity of the soils proposed for bedding and backfill and confirm the proposed cathodic protection system of the pipeline and

appurtenant fittings. This shall be submitted to the Engineer at least 24 working days before pipelaying commences.

On acceptance and approval by the Engineer the Contractor shall be responsible for installation of the systems and works required for the cathodic protection of the pipeline. Acceptance and/or approval of any report by the Engineer shall however not relieve the Contractor from his obligation to provide and install a protective system and works which shall effectively and sufficiently afford protection to the pipeline and fittings under current and reasonably foreseen conditions.

Stray Current Survey and Report

As soon as possible after pipelaying has commenced, keeping in mind the inherent danger of damage within a short time to unprotected pipelines exposed to stray currents, the Contractor shall carry out a stray current survey along the pipeline route.

A full report of such survey together with the Contractor's proposals for protection against stray currents shall be submitted to the Engineer. On acceptance and approval of the recommendations by the Engineer, the Contractor shall be responsible for installation of all systems and works which might be required for protection of the pipeline.

Workmanship

All materials and plant installed shall be the best of their respective kinds and spare parts, replacements and servicing facilities shall be readily available from local sources.

All bonding cables across flexible pipe joints shall be double insulated copper cables 2 x 16 mm² for pipe smaller than 700 mm nominal bore or 2 x 35 mm² for pipe greater than 700 mm nominal bore fixed by thermowelding only.

Bonding cables across flexible pipe joints shall be given sufficient slack to maintain flexibility at joints or fittings. Where joints are provided to provide routine access, provision shall be made that bonding cables can be removed and replaced without permanent damage to the cable or its electrical continuity.

Where joints are bonded across, the Contractor shall carry out tests to prove complete electrical continuity over the pipeline sections bonded.

All thermowelds and bare metal areas on bolts, nuts, lugs and cables shall be protected by means of a reinforced, hot applied bitumen layer of 5mm minimum thickness or other acceptable means compatible with the pipe coating.

Test points shall be brought up from the pipe to the ground surface by means of polyethylene or PVC double insulated 10 mm² cables. The cables to terminate in weather and corrosion proof test boxes fixed to firmly concreted-in precast concrete posts. Whenever feasible these test post shall be concreted in hard up against air valve chambers or other suitable pipeline concrete structures. Test points shall be at locations as dictated by conditions prevailing at any particular pipeline route.

Anodes

High Potential magnesium anodes shall have the following chemical composition:

- Al 0.02% maximum
- Mn 0.80% to 1.5% maximum
- FE 0.03% maximum
- Ni 0.002% maximum
- Cu 0.003% maximum
- Zn 0.02% maximum
- Other 0.001% maximum
- Mg Remainder

Perforated galvanized steel core not to exceed 0.15 kg per metre of core.

Permeable cloth bag, containing the anode and backfill material is to consist of:

- Ground Hydrated Gypsum 75%
- Powdered Wyoming Bentonite 20%
- Anhydrous Sodium Sulphate 5%
- The grain size limits are:
- 100% passing the 850×10^{-6} m sieve size
- 50% or more retained by the 150×10^{-6} m sieve size

The mixture shall be firmly packaged around the anode by means of adequate vibration. Backfill material should be of sufficient quantity to cover all parts of the anode to a minimum thickness of 25×10^{-3} m. Anodes packaged in cloth bags shall be shipped in a plastic or heavy paper bag of sufficient thickness to permit normal handling without tearing. The shipping container shall be watertight plastic. The plastic shipping container is to be removed prior to installation. Anodes shall carry a label identifying the manufacturer, type of anode, metal and backfill composition, and the net weight of the anode.

Use at least one 7.7 kg magnesium anode at each end and one near the centre of the water main sections as specified by the Engineer. A minimum of 10 litre of water shall be poured on each anode to initiate the anode's operation.

CHAPTER 6

MISCELLANEOUS ITEMS

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CHAPTER 6 - MISCELLANEOUS ITEMS**601 TESTING OF WATER-RETAINING STRUCTURES**

Water retaining structures shall be tested for the water tightness at appropriate stages or on completion. They shall be filled with water in stages and held at each water level for such lengths of time as required by the Engineer. Should leakage occur at any stage, the water shall be drawn off and the defects remedied. The procedure shall be continued and finally the structure shall be allowed to remain full for 7 days. At the expiration of this period, the level of the surface of the water shall be recorded and further measurements made at intervals of 24-hours for 7 days. The structure shall be deemed to be watertight if the total drop in surface level does not exceed 10 mm in 7 days. For open structures, additional allowance shall be made for evaporation. If the structure does not satisfy the condition of the test and the daily drop in water level is decreasing, the period of test may be extended for a further 7 days, and if the specified limit is then reached, the structure may be considered as satisfactory.

The Contractor shall provide a hook gauge to measure variations in water level during the tests.

The testing shall be carried out before the excavations are backfilled and embankments placed.

The Contractor shall be solely responsible for the water tightness of the structure and any remedial measures necessary.

602 CLEANING AND STERILIZING OF WATER-RETAINING STRUCTURES

The inside of all water-retaining structures and all interior pipework and fittings, shall be thoroughly cleaned and washed to remove all contamination and the water from these operations removed by squeezing and drained away.

The inside of water-retaining structures shall be filled to overflow level with water containing 50 parts per million of chlorine and left for at least 24-hours. They shall then be drained and refilled with clean water from which samples and analyses shall be taken as instructed by the Engineer. If the results of the analyses are unsatisfactory, the sterilizing process and refilling and sampling shall be repeated until the results of the test are satisfactory.

The provision of all necessary water, labour and materials for carrying out the foregoing operations, shall be included in the Contractor's rates and prices. The cost of sampling, testing and the reports on the bacteriological quality of the water will be borne by the Employer, provided the results of the tests are satisfactory, otherwise the cost of such sampling, testing and reporting shall be borne by the Contractor.

603 STRUCTURAL STEEL

All structural steel work shall be of mild steel conforming to SSRN 905. All sections shall be at least equivalent to those shown in SSRN 913.

Ends of beams and joints, etc. shall be cut to exact lengths true and square and shall be cleaned of burrs or rough edges. Drilled or punched holes shall not be greater than 1/16" more than the bolt diameter and they shall be cleaned of burrs and rough edges. Punching of holes shall be allowed for plates thinner than 8 mm.

Prices for all mild steel shall include for removing all rust and mild scale and applying one coat of red lead or other approved priming paint to all surfaces before vising. Following erection, all structural steel not galvanised shall receive three coats of lead paint and be finished in an approved colour.

604 BOLTS, NUTS AND WASHERS

Bolts, nuts and washers shall conform to SSRN 914 threaded to SSRN 923. Washers shall be to SSRN 925 except that the outside diameter shall be at least 2.5 x the bolt diameter. Tapered washers shall be supplied where required.

Where specifically called for, nuts, bolts and washers shall be electroplated. For below ground environments including chambers, the electroplating shall be to SSRN 922. Elsewhere it shall be to SSRN 921.

605 HOT DIP GALVANIZING

All hot dip galvanizing shall conform to SSRN 903.

606 HANDRAIL

Handrailing shall be designed and manufactured in accordance with SSRN 848. It shall consist of 38 mm diameter galvanised steel sections of tubing to SSRN 203, screwed at each end. The sections shall be joined by 38 mm diameter galvanised steel equal crosses, equal tees or short radius 900 bends where appropriate, such that the top rail shall be 1 metre and the lower rail 0.5 metre above the concrete slab, and the spacing between standards shall be 2 metres maximum. A 38 mm diameter galvanised steel flange shall be screwed to the base of each standard and drilled for four 20 mm diameter, 100 mm long mild steel rag bolts which shall be cast into the R.C. slab.

All handrailing components shall be galvanised after cutting, screwing and drilling and shall be supplied complete with all bolts, nuts, washers and other fixings necessary to complete the installation

607 STEP IRONS

All step irons shall conform to SSRN 845 - General Purpose Pattern. The weight of each step iron shall be at least 2.15 kg.

608 CHEQUERED PLATE FLOORING

Chequered plate flooring shall be of mild steel and manufactured with diamond chequering or other non-slip pattern. The plates shall be of sufficient thickness not to bend or spring in ordinary usage and shall be fitted evenly and truly into steel angle frames or curbing with suitable attachments for building into concrete flooring.

609 FENCING

The fencing shall be as detailed on the Drawings, and in general shall follow the recommendations set out in SSRN 849, unless otherwise indicated.

Straining posts shall be 100 mm x 100 mm x 3 m long of reinforced concrete, and struts shall be 100 mm x 100 mm x 2.6 m long of reinforced concrete.

Straining posts to be provided at all ends, corners and changes of direction or acute changes of level and at intervals not exceeding 60 m in straight lengths, each shall be strutted in each line of fence.

Holes for straining posts shall be 450 mm square in plan and for struts 500 mm x 300 mm. All straining posts shall be set in foundation concrete for the full size of hole in plan and half the depth of the hole.

610 GATES

The gates shall be as detailed on the Drawings. They shall be complete with a sliding padbolt locking device and gate stops.

The gates shall be primed with calcium plumbate and painted with three coats of approved oil paint.

611 CHEMICAL WATERPROOFING OF CONCRETE

Should it become necessary or if indicated in the Bills of Quantities or directed by the Engineer, the Contractor shall apply a concrete waterproofing chemical to concrete surfaces. For surfaces in contact with potable water, such a chemical shall have been certified as suitable for use in potable water retaining structures by competent and internationally recognised authorities.

Products acceptable include waterproofing chemicals consisting of rapid hardening Portland cement, oven-dried quartz sand and active inorganic chemicals of a type that upon application to a concrete surface a crystal chain reaction starts as the active chemical ingredients react with the free lime and water in the concrete capillaries resulting in the formation of insoluble crystals which drive out the surplus capillary water ensuring a permanently water tight concrete but which however at the same time allow the concrete to breath.

612 REFURBISHED AND NEW PRESSED STEEL RESERVOIRS

Construction and Fittings

Pressed steel reservoirs shall be constructed (or reconstructed with panels of similar dimensions to existing panels) of pressed galvanised mild steel panels and in accordance with SSRN 909. They shall be externally flanged. The tanks shall be complete with all necessary stays, cleats, bolts, nuts, washers and jointing compound. Pipework and pipe connections shall be provided as shown on the Drawings.

Tanks that have a Central Division wall shall have this of similar construction to the external walls of the tanks and shall effectively divide the tank into two separate reservoirs which can be used independently.

For roof covers, weatherproof covers shall be provided. These shall be complete with all stiffeners, and supports, with pressed steel gable fillers where necessary, and with all necessary stays, cleats, bolts, nuts, washers and jointing compound. The connection between roof and walls shall be weatherproof.

Each tank, (or compartment in the case of tanks with Central Division walls) shall be equipped with an access manhole, 2 fresh air ventilators, internal and external access ladders, peripheral platform, a float indicator, a valve box with access manhole, and a float valve.

Galvanizing

For new panels galvanising shall be carried out at the manufacturers works and shall be in general conformity with SSRN 903. Re-usable existing panels shall be re-galvanised at an approved nominated subcontractor's works. Periodical inspection by the Engineer will be undertaken to confirm that the procedure followed for re-galvanising and the final quality of re-galvanised panels is satisfactory. Where painting is required, refer to Clause 625.

Fittings

a) Access Manholes

Each tank or compartment shall have one access manhole to permit inspection of the tank internally. In addition, one manhole may be located on top of the valve box in order to permit inspection of the ball valve without entering the reservoir. Manholes shall be of appropriate size and/or the same size as existing ones (for refurbished tanks) and shall be equipped with a hinged lid, which shall be provided with a means of locking into position (with a padlock) on a thick gasket of felt or bitumen.

b) Access Ladders

Internal and external access ladders shall be mild steel galvanised and shall be provided adjacent to access manholes. External ladders shall be fitted with a safety cage and intermediate landing platform.

Ladders shall be designed and manufactured in accordance with SSRN 847. They shall be of mild steel with 25 mm solid rungs at 250 mm centres. The stringers shall be 65 mm x 20 mm, 400 mm apart, turned over at top and bottom and drilled for 12 mm dia rag bolts. Stays shall be 75 mm x 10 mm, length to suit, bent to shape and drilled for 12 mm dia rag bolts, and shall be of such length that will give a minimum clearance of 200 mm behind the rungs. Finish to ladders and stays shall be galvanised to SSRN 903 unless otherwise directed by the Engineer or shown on the Drawings.

c) Fresh Air Ventilators

Two fresh air ventilators shall be fixed to the roof of each compartment. They shall be cowled to prevent rain from entering and fully mosquito-proofed with fine meshed gauze all fixed to the satisfaction of the Engineer.

d) Float Level Indicator

Float level indicators shall be attached to the side of each compartment with vitreous enamelled scales graduated at intervals of 0.5 metres and clearly marked in indelible paint. Pointer and float shall be connected by a steel cable. Guides for the cable shall be provided to prevent snagging or fouling of cable travel.

e) Valve box

Valve boxes shall be provided to maximise the capacity of the reservoirs where float valves are to be fitted.

Testing, Sterilising and Flushing

a) Testing

After refurbishment and/or erection and before testing the Contractor shall ensure that the tank is cleaned internally and ensure that no foreign matter is present. Where applicable each compartment shall be tested by being filled with clean cold water and left for twenty four hours. Throughout the test period there shall be no visible leakage and no measurable drop in water level in the compartment. In the case of reservoirs with central division walls each compartment shall be tested separately and not concurrently.

b) Sterilising

Tanks shall be sterilised by filling them with potable water containing 50 mg/l of chlorine and permitting them to stand 4 hours when full. Thereafter the residual chlorine shall be measured. If no residual is found the process must be repeated. Chlorine shall be added to the test water in a manner approved by the Engineer.

c) Flushing

None of the water used for testing or sterilizing shall be released for consumption but all shall be discarded via the scour to drain. Tanks and pipes shall be thoroughly flushed with potable water after sterilization.

Supporting Steel Structures

Elevated reservoirs shall be supported on structural steel towers of height as indicated on the relevant drawing or in the Bills of Quantities. These towers shall be designed by the Nominated Sub-contractor and approved by the Engineer prior to fabrication. They shall be designed in accordance with SSRN 863. The design shall cater for all vertical and horizontal loads including those imposed by wind forces and seismic disturbances.

The towers shall be provided with all necessary beams, adequate cross bracing, bolts, cleats, base plates and holding down bolts. The tower shall be provided with an adequate valve operating platform one metre wide. These platforms shall be of open steel flooring with 20 mm diameter tubular handrails and angle iron handrail stands, and shall be provided with toe-boards.

The Nominated Sub-contractor shall provide two sets of properly dimensioned working drawings showing sizes of all principle tower members and maximum and minimum stanchion loads together with two sets of supporting detailed calculations for approval by the Engineer before fabrication. All damage to paintwork during the course of erection shall be repaired. The final painting of the tower etc. shall comprise two coats of suitable primer and two coats of a thixotropic, aluminium pigmented, bitumen based barrier coating paint.

Foundations

Concrete pad foundations for the towers shall be designed by the Nominated Sub-contractor and approved by the Engineer prior to erection. The nominated Sub-contractor shall provide, for approval, two sets of properly detailed calculations supporting the designs. These drawings shall also show details and position of holding down bolts.

Lightning Protection

Where present lightning protection is found inadequate or obsolete, the water tower structures are to be re-earthed so that the maximum resistance to earth is 10 ohms. At a position at the base of the tower a test clamp shall be fitted and from this test clamp a copper strip 25 mm x 3.2 mm shall be installed to the earth rod. The earth rod shall consist of a 12 mm dia. hard drawn copper rod approx. 2.5 metres long. The head of the earth rod shall be located in a concrete inspection pit, complete with cover.

Pipes and Pipework Fittings

Where required by the Engineer or shown on Drawings each tank or each compartment shall be fitted with inlet, outlet, overflow and scour pipework.

All overflow pipes shall be mosquito proofed with fine meshed gauge fitted covering the pipe opening inside the reservoir, fixed with galvanised wire tightly bound or otherwise to the satisfaction of the Engineer.

All pipes and fittings shall be flanged ductile iron or steel and shall comply with the specification for pipes and fittings contained elsewhere in this specification. Suitably designed pipework supports shall be provided in order to minimise pipeline stresses. After erection all pipework shall be painted externally with two coats of a suitable primer and two coats of a thixotropic aluminium based barrier coating paint.

613 GEOMEMBRANE LINING TO WATER RESERVOIRS

Any geomembrane lining shall be suitable for potable water, and comprise an ultra - violet light resistant high density polyethylene (HDPE) to SSRN 307, suitable for on site fusion/extrusion welding. It shall be provided in seam free rolls of at least 7 m width, and of thickness not less than 500 micrometres, and breaking strength not less than 180 N/25 mm. When used to line compacted earth or sand, it shall be underlain by an appropriate geotextile layer. It shall be provided rolled on hollow cores of diameter not less than 150 cm, and each roll shall be provided with slings to assist handling on site. The length of rolls shall be such that only longitudinal welds between rolls are required. In situ jointing shall be undertaken by a person or persons well experienced in the technique and approved by the manufacturer. The Contractor will have specified both the proposed manufacturer, and provided full details of laying and jointing techniques, complete with examples of previous similar usage in a tropical environment. The material manufacturer shall have a locally based agent of technically proven capability.

614 FLOATING COVERS TO WATER RESERVOIRS

Any cover shall be of chlorosulphonated polyethylene, or other similar and approved geomembrane, mechanically fixed at the edges, and provided with floats. It shall be self draining under gravity and capable of being suspended on pre - positioned stainless steel wire ropes allowing access when empty for inspection, cleaning etc. It shall be provided to site in rolls and appropriately jointed together on site. In situ jointing shall be undertaken by a person or persons well experienced in the technique and approved by the manufacturer. The Contractor will have specified both the proposed manufacturer, and provided full details of the material, its thickness and properties and of the laying and jointing techniques, complete with examples of previous similar usage in a tropical environment. The material manufacturer shall have a locally based agent of technically proven capability.

615 PAINTING OF METALWORK

All work shall be carried out in accordance with SSRN 900, 908 and 917, as appropriate.

All paints shall be obtained from an approved manufacturer, and applied strictly in accordance with the manufacturer's instructions. The source of supply shall not be altered without the Engineer's approval. The colour of the paints used shall be to the Engineer's approval and where possible alternate coats shall be of different shades.

Where blast cleaning is specified prior to painting, the cleaned surfaces shall conform to First Quality finish to SSRN 933.

All preparation and painting shall be carried out under dry conditions and on completely clean and dry surfaces.

All preparation and painting at manufacturer's works shall be carried out under cover at a controlled ambient temperature in the range 15 to 21 degrees C. Site painting shall not proceed when the ambient temperature falls below 10 degrees C.

Where surfaces are joined during fabrication, they shall be brought together while the final protective coat is still wet.

After welding and fabrication, all weld areas shall be thoroughly cleaned and touched up as specified with the appropriate priming system.

Coatings and paints used for all structures, including tanks, pipes, valves, flow meters, fittings etc., which are in contact with potable water shall be non-toxic, and shall not foster microbiological growth or give rise to taste, odour, turbidity or discoloration of the water with which they are, or could be in contact.

The Engineer reserves the right to inspect all work prior to painting, and reasonable access shall be given for such inspection at any stage of the work.

616 SITE PAINTING

Equipment or plant that has to be refurbished on site shall be manually cleaned to the in compliance with SSRN 900, 908 and/or 917 as appropriate.

The protective system shall then, where possible conform to the requirements of Section 2.3 hereof. Any deviation shall be indicated in the appropriate schedule of Part 4.

617 TYPES OF PAINT PROTECTION

TYPE A (Hot Dip Galvanized)

- (a) Blast clean to first quality finish to SSRN 933.
- (b) Hot-dip galvanized to give a minimum coating weight of 610 g/m² in accordance with SSRN 903.

Finish dry film thickness shall both be less than 85 microns for metals in interiors of buildings and normally dry condition, and 140 microns for other conditions.

NOTE:

All fastenings including bolts, for use with materials having a Type A finish shall be sterilized in accordance with SSRN 934.

TYPE B (Zinc Rich 2-Pack Epoxy Primer And Heavy Duty Epoxy Coal Tar)

- (a) Blast clean to First Quality finish to SSRN 933.
- (b) Within 2 hours of blast cleaning apply by airless spray one coat of 2-pack zinc rich epoxy primer, to a finished dry film thickness of not less than 50 microns.
- (c) Apply by airless spray one coat of 2-pack zinc epoxy primer as in (b) above to a finished thickness of not less than 100 microns.
- (d) Apply by airless spray two coats of high build epoxy coal tar, to a final finished dry film thickness of not less than 350 microns.

TYPE C

As type B above but with sufficient number of coats in (d) to give a final finished dry film thickness of not less than 450 microns.

TYPE D (2-Pack Zinc Rich Epoxy Paint)

- (a) Blast clean to First Quality finish to SSRN 933.
- (b) Within 2 hours of blast cleaning apply by airless spray one coat of 2-pack zinc rich epoxy primer all as in Type B part (b) above.
- (c) Apply two coats of 2-pack zinc rich epoxy high build matt finish dry film thickness of not less than 300 microns.
- (d) Apply final coat of 2-pack epoxy gloss finish of approved shade to produce a total finished minimum dry film thickness of 350 microns.

Application shall be by airless spray and a minimum of 16 hours shall be allowed between coats.

TYPE E (Epoxy Paint)

- (a) Blast clean to First Quality finish to SSRN 933.
- (b) Within 2 hours of blast cleaning, apply by airless spray one coat of high build 2-pack cold cure epoxy resin primer to give a finished dry film thickness of 125 microns.
- (c) After a period of not less than 8 hours from the first coat ('b' above), a finish coat of high build pure epoxy shall be applied by airless spray to give a total dry film thickness of not less than 350 microns.

TYPE F (Epoxy Primer And Chlorinated Rubber Paint)

- (a) Blast clean to First Quality finish to SSRN 933.
- (b) Within 2 hours of blast cleaning, apply by airless spray one coat of 2-pack zinc rich epoxy primer to give a finished dry film thickness of 50 microns.
- (c) Apply 2 coats of 2-pack zinc epoxy high build to a matt finished dry film thickness of 300 microns.
- (d) Apply one coat of chlorinated rubber paint of approved shade to a gloss finished dry film total thickness of not less than 350 microns.

TYPE G (Chlorinated Rubber Paint) - Brush Application

- (a) Blast clean to First Quality finish to SSRN 933.
- (b) Apply 2 coats of chlorinated rubber paint primer to give a finished dry film thickness of 100 microns.
- (c) Apply 2 coats of chlorinated rubber based high build undercoat to give a finished dry film thickness of 220 microns.
- (d) Apply 2 coats of chlorinated rubber base gloss finish of approved shade to give a total dry film thickness of 280 microns.

TYPE H (Chlorinated Rubber Paint) - Airless Spray Application

- (a) Blast clean to First Quality finish to SSRN 933.
- (b) Apply 2 coats of chlorinated rubber based high build primer to give a finished film thickness of 150 microns.
- (c) Apply 2 coats of chlorinated rubber based high build semi-gloss finish of approved shade to give a total dry film thickness of 300 microns.

TYPE J (Lead Primer And Epoxy Paint)

- (a) Blast clean First Quality finish to SSRN 933.
- (b) Within 2 hours of blast cleaning apply one coat of 2-pack epoxy metallic lead primer to give a finished dry film thickness of 50 microns.
- (c) Apply 2 coats of 2-pack epoxy micaceous iron oxide undercoat to give a total dry film thickness of 150 microns.
- (d) Apply one coat of 2-pack epoxy gloss finish of approved shade to give a total dry film thickness of not less than 180 microns.

TYPE K (Lead Primer And Epoxy Paint For Galvanized Metal)

- (a) Thoroughly clean and degrease.
- (b) Apply one coat of 2-pack epoxy metallic lead primer to give a finished dry film thickness of 50 microns.
- (c) Apply one coat of 2-pack epoxy micaceous iron ore undercoat to give a finished dry film thickness of 120 microns.
- (d) Apply one coat of 2-pack epoxy gloss finish of approved shade to give a total dry film thickness of not less than 155 microns.

TYPE L (Bitumen Coating)

- (a) Blast clean to First Quality finish to SSRN 933 or pickle in hot dilute sulphuric acid.
- (b) After thorough washing, phosphate coating by immersion in a bath of hot dilute phosphoric acid.
- (c) Application of one coat of primer to SSRN 908.
- (d) Hot dip bitumen/bitumen coating applied to give a smooth lining having a minimum dry film thickness of not less than 300 microns.

TYPE M (Electro-zinc Plated And Stove Enamelled)

- (a) Blast clean to First Quality finish to SSRN 933 or pickling in hot dilute sulphuric acid.
- (b) After thorough washing, phosphate coating by immersion in a bath of hot dilute phosphoric acid.
- (c) Electro zinc plated.
- (d) Apply stoved zinc based epoxy primer (incorporating suitable pigments to act as acid scavengers and counteract the formation of adhesion destroying compounds).
- (e) Finishing coat(s) of stoved alkyd enamel to give a high standard of gloss finish of approved shade, and of not less than 150 microns dry film thickness.

TYPE N (Clean And Degrease)

Thoroughly clean using hand, and/or power tools where available, to remove all mill scale, rust and grease.

TYPE P (Lead Primer)

- (a) Blast clean to First Quality finish to SSRN 933.
- (b) Within 2 hours of blast cleaning apply by brush two coats of metallic lead primer to a finished thickness of not less than 100 microns.

TYPE Q (Bitumen Enamel Or Coal Tar Enamel Wrappings)

Apply bitumen enamel wrapping or coal tar enamel wrapping in accordance with SSRN 214.

TYPE R (Sealed Sprayed Aluminium Coating)

- (a) Blast clean to First Quality finish to SSRN 933.
Surface preparation shall be in accordance with to SSRN 900.
- (b) Apply suitable primer.
- (c) Apply sprayed - aluminium coating to give a finished dry film thickness of not less than 150 microns.
- (d) Apply suitable pre-treatment primer (e.g. Two-pack polyvinyl butyral or Two-pack polyvinyl butyral/phenolic, containing not less than 85% by weight of zinc tetroxychromate pigment).
- (e) Apply suitable sealer e.g. (Blend of vinyl chloride/acetate copolymers, or Two-pack phenolic binder or Two-pack epoxy or Two-pack polyurethane).

TYPE S (Sealed Sprayed Zinc Coating)

- (a) As in (a) type R.
- (b) As in (b) type R.
- (c) As in (c) type R but using sprayed zinc coating to give a finished dry film thickness of not less than 175 microns.
- (d) As in (d) type R.
- (e) Apply suitable sealer e.g. silicone resin containing not less than 95% by weight of aluminium pigment.

TYPE T (Decorative Painting)

Decorative paint (when specified) shall be compatible with the final finish paint or coating.

The final shade shall be as recommended by the Engineer.

The film thickness of decorative paint shall not be included in the total dry film thickness specified.

618 PAINTING SYSTEMS FOR METALWORK

The applications shall be to the approval of the Engineer but generally in accordance with the schedule below.

Item	Application	Type
1.	All steel ladders, staircases, guardrails, guardrail stands, safety cages, open steel flooring, small bore pipework and steel conduit. All small metalwork such as pipe supports, steel flooring supports and safety chains.	A
2.	All steelwork, castings and other metal surfaces which are immersed in water (non-potable water), sewage, and other effluents, or in contact with liquid or subject to splashing, or buried in the ground.	C
3.	All steel, ductile and cast iron pipes, valves, flow meters and fittings 75 mm diameter and larger, used for the conveyance of sewage and other effluents as in 2 above.	B
4.	All steelwork, castings, pipes, valves flow meters and other surfaces which are exposed (exterior) and frequently damp or wet.	B

Item	Application	Type
5.	As 4 above but in interior of building and normally dry.	D or F
6.	All steel pipes laid underground.	Q
7.	All valves, penstocks, flow meters, tanks and fittings which are in contact with potable water.	E, F or H
8.	Potable water pumping plant installed inside pumping station-normally dry condition.	
	(a) <u>Suction and delivery pipes</u>	
	Internal protection	L
	External protection	E,F or H
	(b) <u>Valves</u>	
	Internal protection	E or L E,
	External protection	F or H
	(c) <u>Pumping Casing</u>	
	Internal protection	E or L
	External protection	E,F or H
	(d) <u>Flow meter (body)</u>	
	Internal protection	E,F or L
	External protection	E,F or H
	(e) <u>Extension shaft and couplings</u>	E,F or H
	(f) <u>Pump motor casing and support steelwork</u>	E, F or H
9.	Screw pumps (screws and shafts) used for potable water.	E or H
10.	Filter internals (potable water)	A
11.	Over painting of galvanized items (not in contact with potable water)	J
12.	Switchboard, multi-motor control panels and other similar enclosures.	M
13.	Metal cable trays, conduits and fixings	A
14.	Section of pipe to be built into concrete.	N
15.	All steelwork and castings in contact with potable water	A, D, E, F or H

619 REPAIR OF DAMAGED PAINTWORK COATINGS

Any damage to the protective coating shall be made good as soon as possible, and shall not be left until the time of general finish painting. Damaged areas shall be cleaned down to bright metal by power wire brushing or sanding and feathered off to the surrounding area. A new protective system approved by the Engineer shall then be applied generally following the requirements of the system originally applied, modified if necessary to comply with the recommendations of the manufacturer of the protective materials used.

620 METALWORK SURFACE PREPARATION PRIOR TO PAINTING

Surface preparation shall conform generally to SSRN 900, 903 or 917 as appropriate, together with any additional preparation recommended by the paint manufacturer, and/or approved by the Engineer.

Prior to painting, protective coatings shall be thoroughly cleaned, degreased, and washed with clean water.

Where steelwork has been delivered with zinc rich epoxy primer and has been allowed to weather, the primed surface shall be washed with clean water to remove zinc salts and allowed to dry.

621 SITE PAINTING DURING ERECTION OF METALWORK

Site connections shall be given a second coat and be brought together wet. Where the finishing paint has been subject to damage during transit or erection, the areas affected shall be cleaned, repaired, and re-painted generally following the requirements of the system originally applied.

622 PAINTING OF STEEL TANKS AND TOWER SUPPORTS

(a) General

This clause shall be read in conjunction with the following sub-clauses described above, Cl. 613 "Painting of Metalwork", Cl. 617 "Repair of damaged paintwork coatings", Cl. 618 "Metalwork surface preparation prior to painting", Cl. 619 "Site painting during erection of metalwork"

(b) Painting internal tank surfaces with bitumen based paints

Internal surfaces of panel tanks shall be prepared by power brushing to remove all rust, scales and loose paint to the approval of the Engineer. Sand blasting shall not be allowed for tank panel unless if directed otherwise by the Engineer. On the prepared surface 2 coats of a bitumen based paint such as a single component, liquid coating, based on a blend of bitumen and solvents e.g. "Igol A" or a thixotropic high build fast drying bituminous coating e.g. "Intex No. 1", shall be applied in strict accordance with the manufacturer's specifications.

(c) Painting surfaces with epoxy paints

The surfaces shall be prepared as indicated in the Bill of Quantities. For steel hand rails, walkways, stairs and steel sections, this shall involve mechanical brushing. Sand blasting shall not be allowed for tank panels unless if directed otherwise by the Engineer. On the prepared surface 2 coats of an epoxy paint (a 2-component, solvent-free coating material based on epoxy resins) e.g. "Sikaguard 63", shall be applied according to the manufacturer's instructions.

(d) Painting of steel tower frames with aluminium paint

Removal of soil deposits at the base of tower shall be done prior to cleaning entire surfaces including corners and edges, ladder, platforms etc. by wirebrushing mechanically to the satisfaction of the Engineer. Alternatively surfaces may be prepared by blast cleaning to remove all rust and loose paint. Cleaned surfaces shall be painted with 2 coats of a suitable primer such as red oxide primer followed by 2 coats of an approved bituminous aluminium paint according to the manufacturer's instructions.

(e) Painting surfaces with oil-based gloss paint

Surfaces shall be cleaned by mechanical wire-brushing. Where surfaces are buried the material should be excavated and the surface cleaned using water and brush and after the surface is dry it shall be cleaned of all rust and loose paint by power-brushing. Cleaned surfaces shall then be painted with 2 coats of a suitable primer such as red oxide followed by 2 coats of an approved oil based gloss paint. The final shade shall be as recommended by the Engineer.

623 INSULATION OF DISSIMILAR METALS

Where dissimilar metals are likely to be in contact with each other a suitable insulating barrier shall be incorporated to prevent galvanic action occurring. This shall be to the approval of the Engineer.

624 EXPANDING RAWL BOLTS

These Bolts shall be expanding type and be made of stainless steel. Drilled or punched holes shall not be greater than 1.5 mm more than the bolt diameter and the depth shall be sized to suit the length of the bolt. The holes shall be cleaned of any loose material and rough edges before the bolts are fitted. Washers shall be at least 2.5 x the bolt diameter. Washers should be fitted under each bolt head.

625 FILTER MEDIA

The filter media (sands and gravels) shall be composed of hard and durable grains, preferably rounded, free from clay, loam and any organic matter and shall be to SSRN 684. Sands shall have a minimum silica content of 96% and a uniformity coefficient of less than 2 (preferably 1.25). Gravels shall be hard stones with a specific gravity of at least 2.5.

All the filter material has to be inspected and certified to the satisfaction of the Engineer. For rapid gravity sand filters, the following granule sizes are required for the filters (from bottom to top). When adding (and removing) Layer 1, particular care should be taken to avoid damaging the drainage pipe system. Each layer of media must be carefully and evenly distributed over the filter surface before adding the next layer.

Layer 1 size 40-60 mm, depth 245 mm

Layer 2 size 20-40 mm, depth 85 mm

Layer 3 size 10-20 mm, depth 85 mm

Layer 4 size 5-10 mm, depth 55 mm

Layer 5 size 2-5 mm, depth 55 mm

Layer 6 size 1-2 mm, depth 250 mm

Layer 7 size 0.6-1 mm, depth 500 mm

For slow sand filters, the following granule sizes are required for the filters (from bottom to top). When adding (and removing) Layer 1, particular care should be taken to avoid damaging the drainage pipe system. Each layer of media must be carefully and evenly distributed over the filter surface before adding the next layer.

Layer 1 size 50-100 mm, depth 100 mm

Layer 2 size 16-23 mm, depth 100 mm

Layer 3 size 4-6 mm, depth 100 mm

Layer 4 size 1-4 mm, depth 100 mm

Layer 5 size 0.15-0.35 mm, depth 1,000 mm

626 AUTOMATIC SURFACE WATER LEVEL RECORDER

Automatic water level recorder shall be a datalogger with a submersible pressure transducer for remote monitoring and recording of water level data. It shall be able to record at least 10,000 readings and be programmable for one reading per minute to one reading per day. The installation setting shall be for one reading per hour. The measuring range for the recorder shall be 0 to 10 m of water column.

The recorder shall be suitable for the water environment and for the ambient temperatures and have a maximum measurement error of 1 cm. It shall have automatic barometric pressure and temperature compensation. The datalogger shall be installed inside a secure, lockable and vandal proof metal housing but be readily accessible for readings.

The recorder shall be provided complete with a portable handheld computer for downloading the data and with the necessary software, which should be able to open in a PC spreadsheet programme for analysis (such as MS Excel).

627 RADIO COMMUNICATION SYSTEM**(a) General**

The system shall consist of DC power supply equipment including storage batteries, radio communication, antenna system and wiring, for communication between the Engineer's and Client's offices and the mobiles installed in the Engineer's vehicles.

The DC power supply equipment shall be designed for nominal A.C. supply at 240V + 10%, 50 Hz. single phase. An automatic voltage regulator shall be furnished to provide a constant voltage source for the radio components with the specified + 10% input voltage variation. Storage batteries shall be Ni-Cd type 80 AH. Ambient temperature will be 40 degrees centigrade or lower. All offered equipment must be suitable for operation at this temperature. All equipment shall be treated to prevent the growth of fungus or other living organisms. Equipment shall be completely solid and all active and passive elements shall be manufactured to industrial standard specifications unless otherwise specified.

All equipment and installation shall comply with all local national laws, rules and regulations and the Contractor will arrange for the necessary permits. All equipment and material shall be new and unused and in so far as is possible shall be supplied by one reputable manufacturer.

Lightning protection shall be provided for all equipment furnished under this clause including antennas and power supplies.

The radio communication system shall comprise of the necessary equipment as specified by the manufacturer and should include Base Stations and VHF FM Mobile Radios.

(b) Base Station

2 No. x 12 metre pipe masts to be fixed at each Base Station.

(c) Mobiles

Mobiles to be fixed in vehicles as directed by the Engineer. Range to be 80 kilometres minimum.

(d) Submission of Details

The Tenderer is to submit details of communications system proposed in sufficient details so as to enable the Engineer to scrutinise the suitability of such a system for the Project.

CHAPTER 7

**SEWERAGE, DRAINAGE AND
ROAD PAVEMENT WORKS**

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CHAPTER 7 – SEWERAGE, DRAINAGE AND ROAD PAVEMENT WORKS**701 DEFINITIONS**

For the purposes of these Specifications, the following definitions shall apply:-

(a) Sewerage Systems

Sewerage systems include the structures, devices, equipment and appurtenances intended for the collection, transportation and pumping of sewage and other liquid wastes, e.g. gravity pipelines, manholes, pumping stations, rising mains, etc.

(b) Culverts

A culvert is defined as any single structure composed of steel and/or concrete, the internal cross sectional area of which, measured in a place perpendicular to the culvert centreline, is less than 12 m². Multiple pipes or boxes whose total area exceeds 12 m², will be deemed as culverts providing the units of which they are composed do not exceed 12 m² cross-section area each. These definitions, though arbitrary, are aimed at providing a reasonable basis for the separation of different types of construction work, namely the installation of minor cross drainage and major pipe structures or bridges.

(c) Surface Water Drainage Systems

Surface water drainage systems include structures, devices, equipment and appurtenances intended for the collection, transportation and pumping of storm water, e.g. street gullies, street side drains, sandtraps, manholes, gravity pipelines, pumping stations, rising mains, open channels, etc.

(d) Access Roads

These are roads within the boundaries of the Site and/or roads connecting the Site to the public highway system.

702 ORDER OF WORK

(a) Culverts, Sewerage and Surface Water Drainage Systems in Embankments

The Contractor shall, wherever practicable, construct all culverts, pipelines or any structure of the sewerage or surface water drainage systems, required under embankments or fill ahead of the earthworks.

The Engineer may, however, permit this work to be inserted after the construction of an embankment or fills subject to the following conditions:-

- (i) that this concession shall apply only to concrete pipes not surrounded by concrete and to corrugated metal pipes;
- (ii) that the Contractor will be responsible for any damage or delays caused by the temporary omission of these works;
- (iii) that the construction of these works shall follow immediately upon the substantial completion of the earthworks above it;
- (iv) that the Contractor will be paid only for the volume of trench excavated, calculated from the height of trench excavated from commencing surface to the final surface; any additional excavation and backfilling will be at the Contractor's expense;
- (v) that, should the Engineer consider the Contractor is causing delay to the work or inadequately compacting the trenches, this concession may be revoked and the Contractor required to construct all the work ahead of the embankments or fills and bear all additional expenses arising therefrom.

(b) Drainage Work in Cuttings

Where drainage and culvert work is to be constructed under a road formation in cutting, it shall generally be excavated after the earthwork is completed. The Engineer may permit the culverts to be excavated before the earthwork is completed; but payment for the excavation of the trench will only be made upon the volume excavated below the final surface of the cutting.

703 EXCAVATION

Excavation and backfilling of trenches and the classification of excavated material shall be in accordance with the methods elsewhere described in these Specifications.

704 EXCAVATION OF TRENCHES

Trenches for pipes shall be to the lines and depth shown on the Drawings, or as directed by the Engineer, and of sufficient widths to give an equal clearance on both sides of the barrel of the pipe. The nominal and minimum trench width for different diameters shall be as shown in the following tables.

(a) PVC PIPES

NOMINAL DIAMETER (mm)	100	160	200	250	315	400	500
WIDTH OF TRENCH (m)	0.6	0.6	0.80	0.85	0.90	1.00	1.10

(b) CONCRETE PIPES

INTERNAL DIAMETER (mm)	100	150	225	300	375	450
WIDTH OF TRENCH (m)	0.85	0.90	1.00	1.05	1.10	1.20

(c) D.I. PIPES: The width of trench shall be the nominal pipe diameter plus 600 mm.

Excavation for manholes, head walls or any drainage structures, shall be carried out to the levels and outlines of such structures shown on the Drawings or as directed by the Engineer, to give clearance to construct the works efficiently. Quantities will be measured net, excluding working space.

705 LAYING OF PIPES

The methods of laying, jointing, bedding, backfilling trenches and reinstatement shall be in accordance with that elsewhere described in these specifications.

Unless otherwise approved by the Engineer, pipes shall be laid in an upstream direction and the socket of the pipes shall face upstream and every pipe shall be concentric with the previous one.

706 JOINTING AND TESTING OF PIPELINES

(a) General

No pipes shall be laid until the floor of the trench has been cleared of all stones and other debris to the approval of the Engineer. Prior to placing in the trench, all pipes shall be inspected for damage. Damaged pipes which in the opinion of the Engineer, cannot satisfactorily be made good shall not be used in the Permanent Works.

All concrete pipes shall be saturated with water, before jointing, and the inside of the joint flushed up with mortar, as specified. Surplus jointing material shall be removed and the pipes scraped and cleaned internally. Pipes shall be firmly bedded throughout their length to the required alignment and level so that they are concentric at each joint. All pipes

shall be suitably wedged, shored or otherwise restrained to prevent movement during testing and backfilling but such restraints shall not be left in place permanently unless so instructed or agreed by the Engineer

Unless otherwise agreed by the Engineer, a close fitting brush or swab shall be placed in pipelines having nominal diameters of 650 mm or less and shall be drawn forward progressively as pipelaying proceeds by means of a suitable rope which shall be threaded through each pipe as it is laid.

Pipelines having nominal diameters greater than 650 mm shall be kept clean by suitable means as pipelaying proceeds. No debris of any kind shall be allowed to remain in the pipeline. Where the pipeline has internal lining, persons entering shall wear rubber boots and equipment trolleys shall have rubber tyred wheels.

Pipes and joints shall be kept free of dirt, mud and other deleterious matter at all times. If pipelaying is stopped at any time, a cap shall immediately be placed on the end of the last pipe laid to exclude dirt.

(b) Rigid Spigot and Socket Pipes

When laying rigidly jointed pipelines with pipes having integral sockets, before entering a pipe spigot into its socket, both spigot and socket shall be clean and free from mud, oil, grease or other deleterious matter.

The spigot shall be entered into the socket of the previously laid pipe until it bears on the back face of the socket and is centred in it. Tarred yarn shall then, in two turns, be firmly caulked into the back of the socket, using an approved caulking tool, to a depth between 10 and 20 mm. The joint shall be completed by pressing 1:2 cement mortar firmly into the joint, finishing with a neat 45° fillet from the outside of the socket. The pipes shall not be pressure tested or disturbed in any way for at least 48 hours after jointing.

(c) Pipes with Ogee or Butt Joints

The joint faces shall be thickly covered with 1:2 cement/sand mortar and the newly laid pipe shall be driven hard up to the previously laid pipes. Excess mortar squeezed out of the joint shall be removed from both the inside and outside of the joint.

The outside of the joint shall be pointed up with a band of 1:2 cement/sand mortar, 75 mm wide and 25 mm thick, all the way round the barrel and central over the joint.

(d) All other Pipes

All other pipes shall be jointed as specified in Part 4 of these Specifications.

(e) Testing of Pipelines and Manholes

Before testing commences the Contractor shall ensure that all anchor and thrust blocks are complete or that temporary supports have been installed. Thrust from temporary pipe ends or branch pipes shall be adequately strutted and the section under test closed off with stop ends, blank flanges or other closure fittings. All pipes shall be cleaned before testing by flushing or as agreed by the Engineer. All tests shall be carried out in the presence of the Engineer and for this purpose the Contractor shall give the Engineer 24 hours notice in writing of any tests which he intends to carry out.

A water test shall be applied, as specified in BS 8301, after laying and jointing the pipeline and before backfilling or placing the concrete surround or bedding concrete, to reveal cracked or porous pipes and faulty joints. Any visible leakage and excessive sweating, which causes a drop in test water level, will be rectified by the Contractor at his expense. Wherever possible, testing shall be carried out from manhole to manhole. Short branch drains, connected to a main sewer between manholes, shall be tested as one system. Long branches shall be tested separately.

The tests shall be carried out by inserting suitable strutted plugs in the lower end of the pipelines and in the connections, if necessary, and by filling the system with water. A period of one hour shall be allowed for absorption.

For small pipes, a knuckle bend may be temporarily jointed in at the top end and a sufficient length of vertical pipe jointed to it in order to provide the required test head. Alternatively, the required test head may be applied by means of a small bore pipe leading from a suitable container and connected to a plug. Precautions shall be taken, by strutting or otherwise, to prevent any movement of the pipeline during the test.

A test pressure of 1.2 m. head of water above the soffit of the drain shall be applied at the higher end but not more than 2.4 m. at the lower end. Steeply graded drains shall be tested in stages where the above maximum head would be exceeded if the whole section were tested at once.

The loss of water over a period of 30 minutes, is to be measured by adding water from a measuring vessel at regular intervals of 10 minutes and noting the quantity required to maintain the original water level in the stand-pipe. The average quantity of water added shall not exceed 0.06 litre per hour per 100 linear metres per millimetre of nominal bore of the pipe for diameters up to 300mm. For larger diameter pipes, the average quantity of water to be added shall not exceed 0.12 l/hr/100 m/mm of normal bore.

On completion of the work, or at suitable intervals during construction, infiltration tests shall be carried out. The permissible amount of infiltration shall be 2 litres of water per minute per kilometre of pipeline of any diameter. All water for testing shall be provided at the Contractor's expense.

707 PIPE BEDDING MATERIAL FOR FOUL AND SURFACE WATER DRAINS

Unless otherwise approved, materials for pipe bedding or surround shall be a nominal single size granular material, natural crushed gravel or rock. The water soluble sulphate content shall not exceed 1.9 g of sulphate (expressed as SO₃) per litre when tested in accordance with BS 1377 Part 3 and the material shall be graded within the following range:

TABLE 7.1: PIPE BEDDING MATERIAL (FOUL AND SURFACE WATER)

BS SIEVE SIZE	PERCENTAGE BY MASS PASSING
37.5 mm	100
20.0 mm	95 – 100
10.0 mm	0 -10

708 BEDDING, LAYING AND SURROUNDING OF PIPES

Immediately following the excavation of the trench the pipes shall be laid and jointed on the pipe bed. Pipes shall be laid so that each one is in contact with the bed throughout the length of the barrel. The bed shall be cut away and removed at each socket or sleeve in the case of socketed or sleeved jointed pipes to give a clearance of at least 50 mm so that the socket or sleeve does not bear on the bed. Brick or other hard material shall not be used as temporary support.

Except where a concrete bed and surround is specified, pipe-bedding material shall be a granular material complying with relevant Clause

After jointing the pipes the bedding shall be brought up equally on both sides of the pipe to the level of the centre of the pipeline. Only after inspection and testing, as required by the Engineer, shall the bedding material be brought to a level 150mm above the top of the pipe collars. The remainder of the trench shall then be backfilled with backfill material as specified in relevant Clause.

709 CONCRETE BEDS, SURROUNDS AND HAUNCHES

The floor of the trench shall be cleaned, trimmed and compacted before any concrete bed is laid. The concrete bed shall be thoroughly cleaned before any surround or haunch is laid. No concreting shall commence until the previous work has been approved by the Engineer.

All concrete for beds, surrounds and haunches shall be Class 15 concrete, formed to the dimensions shown on the Drawings or as directed by the Engineer.

Unless otherwise written in the Specifications or Bills of Quantities or, directed by the Engineer, a 0.15 m. thick concrete surround shall be provided to pipes in the following circumstances:-

Pipes up to and including 600 mm diameter with less than 0.60 m. cover or more than 6.00 m cover.

710 SUBSOIL DRAINS

A subsoil drain includes any type of drain designed to collect groundwater whether this is rising from below or percolating from the surface and may or may not include a pipe. It may also include impermeable membranes above or below the pipe or permeable filter membranes all as detailed on the drawings.

Trenches for subsoil drains shall not be less than 0.3 m wide or the outside diameter of the pipe plus 0.15 m whichever is the greater.

Perforated uPVC pipes shall be used for subsoil drains and shall be laid with no gaps between their ends.

The trench shall be filled with approved stone of size not less than 10 mm nor greater than 40 mm and the grading of the stone between these limits shall be a reasonable curve and to the satisfaction of the Engineer.

711 MANHOLES, CHAMBERS AND GULLIES

Manholes, chambers and gullies shall be constructed from concrete Class C20/20 to dimensions and thicknesses as shown on the Drawings.

Unless otherwise agreed by the Engineer, Manholes shall be constructed after pipes have been laid, except that bases may be constructed earlier to avoid deterioration of the formation.

Manholes and chambers for foul water shall be constructed with sulphate-resisting cement and those for surface water drainage with Ordinary Portland cement.

Sulphate resisting cement is not required for entire manholes, except for the benching. sulphate resisting cement is required for the pipes and in chambers where sewage is allowed to fill into e.g. pumping stations and in the flushing tank. Wherever the Bills of Quantities contain indications for ordinary Portland cement those shall be expanded as to include also for cost of sulphate resisting cement.

The manhole foundation shall be cast from in-situ concrete Class 15. It will be thoroughly cleaned before pouring the benching concrete Class 15. The benching should rise vertically from the top edge of the channel pipe to a height not less than that of the soffit of the outlet and be sloped upwards to meet the wall of the manhole. It should be floated to a smooth hard surface with a coat of 1:2 cement mortar, using sulphate-resisting cement for foul water drainage, or floated to a smooth hard surface while it is green for surface water drainage. Where possible, main channel inverts shall be half round of vitrified clay, asbestos cement, precast concrete or, where the drain is of cast iron or steel, of the same material. Channel branch bends, up to 150 mm diameters, shall be of vitrified clay of half section, curved in the direction of flow, and set to deliver above the main channel invert. Channel branch bends over 150 mm diameter, curved in the direction of flow, may be clayware or formed in the concrete base, rendered and trowelled smooth as specified.

The connections with pipelines shall be watertight. Pipelines approaching manholes shall be surrounded with Grade 15 concrete, 150 mm thick and 600mm long.

Manhole covers, gully gratings and frames shall be fixed at the top of the manhole, or gully, and will be adjusted to the new road levels or to the levels as directed by the Engineer. They shall comply with B.S. No. 497, grade and shape being as shown on the Drawings. They shall be fixed in place using concrete Class 15. Where required, step irons shall comply with Part 6 of these Specifications. They shall have tails 80mm long built in at 300 mm vertical intervals and staggered 150 mm each side of a vertical centre line. The uppermost step iron shall be at least 600 mm from the top of the manhole/chamber cover and shall not be required when the depth from cover to benching is 900 mm or less. When the depth from cover to top of benching exceeds 4.5 m, an approved ladder shall be used instead of step irons. Deep manholes shall be provided with ladders and rest chambers as shown on the Drawings.

Precast concrete manholes shall be constructed as shown on the Drawings using precast concrete components set on bases cast from in-situ concrete. The lowest chamber element shall be bedded on and haunched with cement mortar, or approved bitumastic sealant, to the base. The precast concrete cover slab shall, similarly be bedded to the topmost element. The joints of intermediate precast concrete elements shall be liberally coated with approved bituminous material, of trowelling grade, prior to being fixed in position. Surplus bituminous material shall be neatly struck off.

The precast concrete elements shall be reinforced, as required, and provided with lifting holes which shall be cleaned and filled with cement mortar after placing the units. Step irons shall not be used for hoisting or lowering components.

Where the depth from ground level to the base of the precast elements exceeds 4.5 m, the precast units shall be encased in Grade 15 in-situ concrete, 150 mm thick, below this depth.

All manholes and chambers, upon completion, shall be filled and tested with water provided at the Contractor's expense. The loss of water shall not exceed 5 litres over a period of two hours.

Where manholes are constructed on drains of 600mm diameter and over, galvanised safety chains shall be placed across the mouth of the outlet and galvanised solid bar handrails, 25mm thick, shall be provided at the edges of all benchings and platforms.

Backfilling around completed Manholes shall be with suitable material deposited equally all round and compacted in layers not exceeding 300 mm.

712 MANHOLE COVERS AND FRAMES

Covers and frames shall be the type, size and weight shown on the drawings. They shall be fabricated from cast iron or steel frames of recessed type which shall be filled on site with concrete, to the levels indicated on the Drawings or as directed by the Engineer. Level differences shall be made up by not more than three courses of brickwork between the frame and the roof of the manhole.

Generally, the strength standard shall be to Class A (BS 497) or Class D 400 (European standard EN124) and may only be varied to Class B (BS 497) or Class B 125 (EN 124) where shown on the drawings and only in areas where vehicular access is impossible. Such relaxation shall only be made on express instructions of the Engineer.

Care shall be taken to see that frames do not suffer any distortion and that the cover will seat without any rocking.

All manhole covers shall be lock able to their frames, having a special lock and key or spanner, made in such a way that only authorised persons can access the manhole.

Where manholes are situated in the roadway, their frames shall be carefully bedded and levelled such that when closed the cover lies flush with the roadway.

713 BLOCKWORK WALLS

Blockwork walls shall have the outside joints pointed flush and the inside joints shall be raked out as work proceeds to receive rendering.

Unless otherwise specified, blockwork wall thickness shall be as follows:-

Walls up to 3 metres below ground level	200	mm
Between - 3 and 6 metres below ground level	400	mm

Walls of more than 7 metres below ground level should be of precast elements to BS 5911 or cast in situ of concrete of specified class.

Relieving arches of concrete shall be arranged in blockwork walls over large sized pipes.

Pipes passing walls shall generally be cast in or built in monolithically in one operation flush with the inside face of the wall.

Pipes for future connections shall also be placed as work proceeds and the external end sealed off with completely watertight temporary stoppers.

The pipes passing walls shall be as short as practicable and when jointed in and outgoing pipes no strain shall occur in rigid joints. The distance from the inside wall face to external joint may not exceed 600 mm for walls up to 400 mm thick.

Where boxing out for pipes passing walls has been allowed, jointing to outside pipelines shall be made before concreting into walls is finally carried out.

714 STONE FOR RIP-RAP

The stone used for rip-rap shall be obtained from approved quarries. It shall be free from impurities, overburden, mudstone, cracks, sandholes, veins, lamination or other imperfections. The stone shall be left irregular, when stone pitching is done, for dissipating the water energy in open channels or water courses. It will be laid in mortar 1:2 or dry without mortar as shown on the Drawings.

715 IRON PIPES AND FITTINGS

Cast iron pipes and fittings shall be of the class and have joint ends as shown on the Drawings and mentioned in the Bills of Quantities and Specifications, and otherwise comply in all respects with B.S. No. 78, except that flanged pipes and flanged fittings shall comply with B.S. No. 2035.

716 CEMENT MORTAR

Cement mortar for jointing pipes, masonry, slabs and plastering shall consist of cement and clean sharp fine sand all as specified and mixed in the required proportion by volume.

Mortar for use in connection with foul water shall be made with sulphate-resisting cement while that for use in connection with surface water drainage shall be made with Ordinary Portland cement. All mortar shall be conveyed fresh to the work as required for use. No mortar after setting shall be re-used or remixed for use.

717 INFILTRATION TESTING OF SEWERS

Sewers shall be tested for infiltration after backfilling. All inlets to the pipeline to be tested shall be effectively closed and the residual flow regarded as infiltration.

Limits of infiltration not to be exceeded are for sewers not exceeding 750 mm nominal internal diameter.

$$Q = 0.08 \times L \times D$$

Where Q = Limit of infiltration in litres during 1 hour

L = Number of 100 metre lengths of tested sewer

D = Nominal diameter of sewer tested in mm.

718 MANHOLE WATER TIGHTNESS TESTS

Where so required, manholes shall be tested for water tightness by filling with water. The Engineer will then decide whether the tightness is acceptable or not.

719 OPEN CHANNELS

Open channels shall be constructed of precast components - invert block drains or half round concrete channel and side slabs - as specified and shown on the Drawings.

The precast components shall be manufactured of specified concrete class and according to applicable specifications in relevant clause. Cube test certificate shall be submitted to the Engineer if so required.

Excavation to receive precast components shall be true to line and gradient and allow for bedding material as specified on the Drawings. Earth sides shall be given a slope of 1:1 or as otherwise specified or directed by the Engineer. The formation of the excavation shall give a firm base for the channel components.

Where required, sight rails shall be used to bone in channel with traveller.

Invert blocks, channels and side slabs shall be neatly jointed in cement sand mortar 1:3. Ends to be jointed shall be thoroughly soaked with water before jointing. Jointing shall be carried out as the work proceeds, all joints being trowelled to a smooth finish. Joints shall be protected from sun, wind and rain by approved covering kept constantly damp for a period of at least 3 days after forming.

720 ACCESS ROADS

(a) Preparation of the Formation

The formation of access roads shall be compacted as defined in these Specifications, the drawings and Bills of Quantities. The preparation of the formation shall only take place after all subgrade drainage, pipes, ducts and services, below the formation have been laid. No work above formation level shall take place until the formation has been approved by the Engineer.

(b) Lateritic Material for Sub-Base

b.1 Material Requirements

All Materials:

CBR at 95% MDD (Modified AASHTO) Min. 30 and 4 days soak

Clayey and Silty Sands:

- Passing 2 mm sieve (%) Max. 95

- Passing 0.075 mm sieve (%) Min. 10 - Max. 30

- Uniformity Coefficient Min. 5

- Plasticity Index

 In dry areas: Min. 5 - Max. 20

 In wet areas: Min. 5 - Max. 12

- Plasticity Modulus: Max. 250

b.2 Construction Procedures

Minimum thickness of compacted layer: 100mm

LAYING: by grader

COMPACTION:

- Use of grid roller or equivalent may be required to break down coarse particles.

- Minimum dry density: 95% MDD (Modified AASHTO)

- Compaction moisture content: between 80 and 105% OMC (Modified AASHTO)
- Maximum thickness compacted in one layer: 200mm

(c) Lime Improved Material for Base

c.1 Material requirements

Material before treatment

- Silty sands and clayey sands:

Maximum size 1 - 10 mm

Passing 0.075 mm sieve Max. 40%

Uniformity Coefficient Min. 5

- Plasticity Index: Max. 25

- Plasticity Modulus: Max. 2,000

- Organic matter Max. 1%

- Extra requirements for lime treatment:

Passing 0.425 mm sieve Min. 15%

Plasticity Index Min. 10

Lime

Hydrated calcium lime to B.S.890, Class B

Amount usually required: 4 - 6%

Treated Material

CBR of Lab. mix at 95% MDD (Modified AASHTO) and 7 days cure + 7 days soak: Min. 160

Plasticity Index: Max 15

c.2 Construction procedures

Minimum thickness of compacted layer: 125 mm

LAYING: by grader

MIXING: in place (pulvimixer or travel plant)

COMPACTION:

- Minimum dry density: 95% MDD (Modified AASHTO)

- Compaction moisture content: between OMC-2 and OMC (Modified AASHTO)

- Maximum thickness compacted in one layer: 200mm

- Time allowed to complete compaction and finishing: 2 hrs (cement), 12 hrs (lime)

PROTECTION AND CURING:

- Time allowed to place protection: 4 hrs (cement), 24 hrs (lime)

- No traffic permitted for first 7 days

c.3 Finishing

After compaction, the finished surface of the base shall be tested for smoothness to grade and cross-section profile. If tests on compaction and/or smoothness fail, the Contractor has to make this good at his own expense.

(d) Bituminous Surfacing - General

The grades and spraying temperatures for approved bitumens used for surfacing shall be:-

Prime coat : Cutback M.C.30 - 20 to 60 C

Seal coats : Straight run - 120 to 150 C

- 80 - 100 penetration

Heaters used for bitumen shall conform to BS1676 and the heated bitumen shall be applied by self propelled pressure distributors with spray bars complying with BS1707 or BS3136. Where different grades of bitumen are used, heaters and distributors shall be thoroughly cleaned before the grade of bitumen is changed. Flushings from heaters and distributors shall be drained to disposal pits and not discharged into drains, ditches or watercourses. Any bitumen heated above the maximum specified temperate shall be removed from the Site and replaced at the Contractor's expense. Hand spraying shall only be used if approved by the Engineer.

Where spraying is commenced or stopped, metal sheets or building paper shall be spread across the width of area to be sprayed to produce a clean sharp edge to the area. The sheets shall be cleaned daily and the building paper destroyed after use. During spraying, all kerbs, headwalls and other road furniture shall be protected from bitumen splashing. Any such features accidentally marred shall be cleaned immediately.

Equipment to be provided by the Contractor shall also include approved self propelled mechanical chip spreaders, power brooms and self-propelled pneumatic-tyred rollers weighing not less than five tonnes.

During the course of the work only essential construction equipment shall be allowed into the area and not allowed to stand on completed work. The road shall not be opened to general traffic until directed by the Engineer.

(e) Bituminous Prime Coat

Immediately before applying the bituminous material, the surfaces to be treated shall have all loose dirt and other objectionable material removed by power brooms. If so ordered by the Engineer, a light application of water shall be made just before the bitumen is sprayed.

MC-30 grade cutback bitumen shall then be applied to the surface at the rate of 1.0 l/m² or as otherwise directed by the Engineer.

(f) Bituminous Surface Dressings

Binder for surface dressing shall only be applied upon completion of the priming as specified in paragraph (e) of this Clause and when any defects to the primed surfaces have been repaired. No binder shall be applied until the primed surfaces have been approved by the Engineer.

Aggregate shall be spread, by mechanical chip spreaders, immediately following the spraying of the binder and no work is to commence until sufficient supplies of aggregate are to hand. Manual spreading of aggregate shall only be permitted when approved by the Engineer. After applications of aggregate, the surface shall be lightly broomed to give a uniform coverage with no areas having an excess or deficiency of aggregate. Within twenty minutes of application and brooming of the aggregate, the surface shall be rolled with a self-propelled pneumatic-tyred roller, weighing not less than five tons, until a smooth, well compacted surface is obtained. Upon completion, all loose aggregates shall be removed from the surface to disposal off the Site.

Bitumen binder shall be straight run 80/100 penetration grade bitumen and the first seal coat shall consist of bitumen sprayed at the rate of 1.2 l/m² of surface area and 19mm aggregate spread at the rate of 70m²/m³ of aggregate. The second seal coat shall consist

of bitumen sprayed at the rate of 1.2 l/m² of surface area and 12mm aggregate spread at the rate of 100m²/m³ of aggregate.

The aggregate grading should be as follows:-

	SIEVE (mm)							
	20	14	10	6.3	5	3	2	0.5
First seal	100	85-100	0-30	0-7	-	-	0-2	-
Second seal	-	100	85-100	0-30	0-10	-	0-2	-

and should have the following aggregate requirements:

LAA max.	35
ACV max.	26
SSS max.	12
FI max.	25

721 BLOCK PAVING -GENERAL

Block paving may be used for all roads, footways, cycleways, pedestrian areas, access lay-bys and adoptable parking areas. The design of pavements constructed with **block paving** shall in general conform to BS 7533. **Block paving** shall be laid only by an approved Contractor.

722 MATERIALS

Paving blocks shall comply with BS 6717 Part 1 and BS 6677 having a work size thickness of 65mm where used in non-vehicle trafficked areas and 80mm where used in carriageways, lay-bys and parking areas and having chamfered wearing surfaces. The tensile splitting strength of the blocks shall be 3.5 N/mm.

723 SUB-BASE

The sub-base material shall be Type 1 granular material. The finished surface level of the sub-base shall not deviate from the design levels by more than ± 10 mm. The finished surface shall be free of any soft patches and shall be close knit so that the laying course material cannot penetrate downwards. Where any soft patches are removed they shall be replaced with Type 1 granular material. Under no circumstances may laying course material be used to replace soft patches or for levelling the surface of the sub-base.

724 ROAD BASE

Where the pavement construction is not completed before building construction commences a **road** base shall be laid consisting of either dense bitumen **road** base or cement bound base. The finished surface level of the **road** base shall not deviate from the design levels by more than ± 10 mm. Prior to laying the laying course the road base shall be punctured on a 1m grid with holes of diameter < 50 mm.

725 LAYING COURSE

The laying course sand shall be in accordance with Table D2 of BS 7533: Part 3: 1997 (Annex D). The sand shall be pre-compacted with a plate vibrator and then levelled by screeding. The surface level of the bedding/laying course shall be treated with an approved active pre

and post emergence residual weed killer, at the rate of spread recommended by the manufacturer for total control. Special care must be taken near shrubs and trees, and arboricultural advice sought. The moisture content of the bedding sand needs to be a uniform 6-7%, it is therefore essential that the sand should be stored in an area which is well drained and that it be kept covered during periods of hot, dry weather or wet weather.

In some locations where a degree of rigidity is considered essential in the pavement surface, e.g. adjacent to drainage furniture, the incorporation of 5.6% by weight OPC may be permitted.

Only sufficient material for one day's work shall be prepared and in any case such that the position of this boundary shall not be more than one metre from the laying face at the end of the working period. Disturbance of the prepared laying course by pedestrian or wheeled traffic prior to placing of the blocks shall be avoided.

The course shall have a minimum sand thickness of 30mm for a bound **road** base and 50mm for a type 1 **road** base. The screeding of sand is very important and a surcharge of sand is required from the start.

726 EDGE RESTRAINTS

Edge restraint shall be provided at the perimeter of all paved areas and shall be adequate to support traffic loads and prevent the escape of laying course material from beneath the paved surface. Edge restraints shall consist of pre-cast concrete kerbs and channels or approved made blocks. Where the **block** pavement abuts an existing structure, the Engineer's approval shall be obtained before laying commences so that any necessary strengthening or damp proofing precautions which the Engineer may require, can be carried out prior to laying the **block** pavement.

727 IRONWORK

Frames and covers for gullies and manholes in **block paving** areas shall be properly bedded on mortar before laying commences. Frames and covers for gullies and manholes in **block paving** areas shall comply with the requirements of relevant clause and shall be without flanges, and shall be set 5mm lower than the finished **block** level. There shall be a minimum of one course of stretcher bond adjacent to all ironwork with the aim to have flush. A 300mm to 500mm wide piece of a suitable filter geotextile shall be laid under the laying sand and up the face of any ironwork or cover slab to prevent the migration of the laying sand.

728 BOND

The blocks shall be laid hand-tight working from an existing face or edge restraint and shall be laid to a herringbone pattern in carriageways. Stretcher bond shall only be used in footway and non-trafficked areas. **Block** shapes designed to assist with the formation of boundaries and with changes of direction may be incorporated as appropriate. Full blocks shall be laid first, closure units shall then be laid. Each area shall be completed as far as possible in full **block** units. Infilling to boundaries and obstructions shall proceed as the laying course proceeds and shall be completed before compaction commences. Alignment of the blocks shall be checked periodically and adjustments made where necessary to achieve straight joint lines.

729 ROAD BASE

In agreement with the Engineer the developers are permitted to omit laying the Blockwork until after building works are completed. In such cases the top 75mm of sub-base shall be replaced with dense bitumen macadam binder course. Prior to laying of the blockwork the base shall be cleaned, if the surface is in a poor condition the base course shall be removed and replaced with MOT Type 1 granular material to the correct level. If the DBM binder course remains it shall be punctured.

730 TRIMMING

Block shall be trimmed to shape and size in order to form boundaries and to work around obstructions. Where trimming is required it shall be carried out using an approved **block** splitting device or a powered concrete saw. No part of a **block** of less than one half of a whole **block** in size shall be used. Where it is unavoidable to fit the blocks neatly up to an obstruction with the Engineer's approval an in-situ granolithic concrete fillet may be formed.

The granolithic concrete shall consist of one part OPC, one part of fine aggregate and 2 parts of 10mm granite chippings measured by volume. Wherever in-situ concrete is used, careful selection of fine aggregate and colour pigment is required to achieve a colour match with the blocks. Such fillets are only acceptable with a minimum 120mm width and depth.

731 COMPACTION

The blockwork surface shall be compacted by a plate compactor to ensure the filling of the lower **block to block** joint by the laying course material and to produce an even surface finish. The plate compactor used shall have a plan area of not less than 0.25m² and shall transmit an effective force of 75-100kN per square metre of plate area. The frequency of vibration shall be within the range 75-100Hz.

Compaction shall follow completion of laying as soon as possible after each day's work and shall be compacted to within one metre of the laying face. No other area shall be left uncompacted at the completion of each day's work.

732 JOINT FILLING

After compaction of the blockwork surface jointing sand, free flowing silica sand complying with Table D3 of BS7533: Part 3: 1997 Annex D shall be brushed into the joints and using a plate vibrator compacted to refusal. The finished level of the sand shall be 5mm below the top of the blocks. The sand shall contain no deleterious salts or other contaminants and shall not stain the surface of the blocks.

Joint filling and final compaction shall be completed as soon as practicable after laying and at the completion of each days work. No traffic shall be permitted on the **block** surface until final compaction has been satisfactorily completed.

Note: A neoprene coated sole plate may be required on special surfaces

733 SEALER

Finally, an elastomeric prepolymer sealer shall be applied in accordance with the manufacturer's instructions to the surface of the small element **paving** immediately after the jointing sand has been brushed/vibrated in making sure it is evenly spread over the surface of the **paving** and allowing it to completely fill the joints before being absorbed into the jointing sand. Generally rate of spread varies between 2-3m²/litre. No sealant shall be left to "pond" on the surface of the slabs. Approved sealants are Nufins Blockseal, A.C.M. Paveseal or Resiblock Ltd's Resiblock Superior.

734 EARLY TRAFFICKING

Where during the period of early trafficking any movement of the surface course occurs the blocks shall be removed as directed by the Engineer and the cause established. After remedial work has been carried out to the Engineer's satisfaction, the disturbed area shall be immediately re-laid and re-compacted in accordance with the requirements of the foregoing clauses.

735 CONSTRUCTION IN INCLEMENT WEATHER

No laying of concrete blocks or laying course shall take place on frozen material in the lower layer. No frozen material or material containing ice shall be used.

736 LAYING OF CONCRETE BLOCK PAVING

The acceptable tolerance for the laid surface of blocks shall be ± 6 mm with a maximum relative difference between adjacent blocks of 2mm. The acceptable tolerances for capping layer, sub-base and base shall be as relevant Clause.

All block cutting shall be done using a purpose made block splitter or saw and the minimum size of laid block shall be 33% of a full block. The bond shall be broken as necessary to accommodate the minimum cut block size.

Full edge restraint must be provided prior to the laying of the blocks. The edge restraint should present a vertical face down to the level of the underside of the laying course.

Where block paving abuts a macadam surface an approved form of channel edge support shall be provided set flush into the surface of the block paving. Where the block paving adjoins manhole frames, gully frames etc the blocks shall be neatly cut and may require to be set in coloured cement mortar. The use of in-situ concrete infill is not acceptable.

On completion of paving the surface course should be fully compacted using a plate compactor to achieve the required compaction of the laying course. Joints between blocks shall be fully filled with dried free-flowing silica sand conforming to BS7533: 3. Joints should be refilled as necessary and the paving re-vibrated with two or more passes.

737 WATERPROOF UNDERLAY

Waterproof underlay shall be approved 125µm impermeable plastic sheeting. Overlapping of plastic sheeting shall be at a minimum of 300mm.

738 PRECAST CONCRETE KERBS AND CHANNELS

All kerbs and channels irrespective of type shall be laid, bedded and backed in accordance with relevant Clauses and be laid to a flowing alignment to the satisfaction of the Engineer.

Longitudinal falls less than 1 in 100 will not normally be acceptable. The Engineer should be consulted at an early stage in the design if the Contractor intends to use gradients less than 1 in 100.

Precast concrete kerbs shall be 125 mm x 255 mm half battered and shall comply with BS7263 Part 1, and shall be hydraulically pressed. Precast concrete radius kerbs shall be used on radii not exceeding 12.0 m.

Precast concrete dropped vehicular crossing kerbs shall be 125mm x 178mm and shall comply with BS 7263 Part 1 except dimensionally and shall be hydraulically pressed. Transition kerbs shall comply with the British Standard.

Precast concrete channels shall be 150 mm x 150 mm and shall be hydraulically pressed and manufactured in accordance with BS 7263 Part 1 except dimensionally. Precast concrete channels shall be used where the carriageway falls towards the kerb and may be used where the carriageway falls away from the kerb.

Precast concrete channels laid to a radius not exceeding 12m shall not exceed 450 mm long.

Precast units conforming to BS 5328 Part 1 should not be cut to a length of less than 300 mm

739 BLOCK PAVING CHANNELS

Where approved by the Engineer, approved concrete paving blocks may be used as channels only where a block paving surface is being used. They shall be laid in stretcher bond on bedding sand as specified. The channel shall be laid to a level 5mm below the finished edge of carriageway level. Block channels will not be approved for longitudinal gradients less than 1 in 80.

740 KERB AND CHANNEL LAYING

Typical sections giving full details of the foundation and backing are shown in Standard Details.

Where units are to be set on a race of fresh concrete, a foundation of ST2 concrete should be deposited along the line of units, onto which the units are laid directly on fresh mixed concrete and set to line and level. The backing concrete should be laid monolithically with a race of fresh concrete, dowel bars should be fixed into the base and extended into the backing haunching.

Where units are to be bedded onto a concrete edge beam, the concrete foundation shall be formed on the compacted sub-base to a minimum thickness of 150mm and wide enough to accommodate the units and backing concrete. Soundly fixed formwork or shuttering shall be used and the Class ST2 concrete to BS 5328 shall be compacted to produce a dense foundation free from honeycombing. The minimum period between concreting and the removal of the formwork or shuttering shall be 24 hours.

Kerb and channel units on the concrete foundation shall be laid butt jointed on a maximum 25 mm thick bed of semi-dry 3:1 cement mortar. Any surplus bedding material shall be thoroughly cleaned off and the foundation wetted if necessary prior to the placing of the backing concrete. The backing of ST2 concrete to BS 5328 shall be placed in a soundly fixed road form or shutter and thoroughly compacted to produce a concrete dense and free from honeycombing to the section as shown on Standard Details.

Kerb and channel units shall be laid true to line and level in a flowing alignment and shall not be backed until they have been inspected and approved by the Engineer.

Channels shall be laid in a broken joint bond with the kerbs.

741 TEMPORARY TRAFFIC SIGNS

Any design required for temporary traffic signs shall be carried out by the Contractor and submitted to the Engineer for approval.

742 PERMANENT WHITE ROAD MARKINGS

White road marking shall be in accordance with the latest National Traffic Signs Regulations and General Directions.

The material type shall be thermoplastic material complying with BS 3262 Part 1 Class A and BS EN 1436 and shall be either sprayed, extruded or screed applied.

All markings shall be reflectorised.

Road marking shall be laid in accordance with BS 3262 Part 3.

743 SEWER REPLACEMENTS

In order to carry out sewer replacement works, it will be necessary for the Contractor to make arrangements to deal with existing flows by over-pumping or other appropriate method approved by the Engineer. All arrangements for dealing with flows shall be approved by the Engineer prior to any diversion of flows. No flow shall be permitted to pass to any natural watercourse or surface water drainage system and the Contractor shall take steps to minimise smell and noise nuisance arising from any diversion works.

744 MANHOLE AND CHAMBERS

Manholes and chambers, including pumping stations, for sewage shall be constructed with sulphate-resisting cement. Sulphate-resisting cement is required for benching, bases and top slabs and covers of manholes and chambers. Precast concrete rings (components) for precast concrete manholes shall be cast with sulphate-resisting cement.

Whenever the Bill of Quantities mentions ordinary Portland cement, this shall be deemed to include also the cost of sulphate-resisting cement.

745 MANHOLE COVER LIFTING AND REFITTING

The Contractor shall be responsible for the lifting and refitting of all manhole covers and for provision of temporary protection in the event that a manhole cover and frame is damaged whilst being lifted or temporarily set aside during flushing, cleaning survey and repair operations.

746 RODDING, FLUSHING AND CLEANING OF SEWERS

The Contractor is to clean all accumulated silt and debris from the sewerage systems as directed by the Engineer. At the end of the operation every sewer length shall be free from all deposits and shall be flowing freely.

The Contractor shall make arrangements satisfactory to the Engineer for dealing with all flows into the sewer length to be cleansed, and shall adequately ventilate the length to eliminate all toxic gases before commencing cleansing.

After cleansing the Contractor shall inspect each length for indications of structural damage and inform the Engineer accordingly.

The techniques to be adopted for sewer cleansing are specified as rodding but the Contractor is required to select the most appropriate technique for each situation.

In some cases the sewers are surcharged due to blockage or damage and the Contractor will be required to eliminate this condition.

Where the Contractor wishes to employ jetting or flushing techniques he shall make all the necessary arrangements for locating a source of water, which must be approved by the Engineer; and shall include in his rates for all associated costs and charges.

Solid matter dislodged from the sewers shall be collected and carted from site. It shall not be pumped to waste with the sewage flow or flushing water.

The Contractor shall submit a method statement giving comprehensive details, including safety measures, of his proposals for sewer cleansing, flow control and the intended sequence of operations.

The Contractor shall keep accurate records of the progress of the sewer cleansing works, identifying the techniques adopted and the size of pipe work to which each technique has been applied, and shall submit this information to the engineer.

The cost of providing all water for flushing shall be included in the Contractor's rates.

747 SAFETY DURING SEWER CLEANSING

Cleansing of the gravity main shall require the establishment of safe working procedures in order to protect operatives and other staff from hazards which can occur in this type of work.

The main objectives are to establish a safe working environment whereby:-

- a) Traffic is diverted around the operational areas;
- b) Pedestrians are denied access to working areas;
- c) A safe physical working environment is created for operatives;
- d) A safe atmosphere is established and monitored in the gravity main;
- e) An effective and adequate rescue equipment is immediately to hand;
- f) An effective communication system is maintained with the operational headquarters.

748 REHABILITATION OF EXISTING MANHOLE COVERS

The existing manholes which are damaged shall be rehabilitated where directed by the Engineer. The Contractor shall remove the existing damaged chamber cover slabs and replace them with the appropriate type approved for the project. The Contractor shall exercise extreme caution not to cause further damage to the existing manholes to be reused. Where instructed, the Contractor shall replace the manhole covers with the approved type for the project.

749 CONNECTING SULLAGE TO SEWERS

In some cases, sullage i.e. wastewater from kitchens, bathrooms and laundry is not discharged to the sewers but to the open storm water drains. This sullage or 'grey water' shall be connected to sewers.

750 MAINTENANCE OF FLOWS

Where existing live sewers and laterals (house connections) are to be replaced or temporarily cut the Contractor shall make arrangements for sewage flows to be maintained by

use of temporary by-pass pipes, over-pumping or other methods. The Contractor shall submit details of his proposed method to the Engineer for approval prior to commencing the relevant section of the Works.

In addition to sewage flows all other flows of water through existing pipes, ditches, drains, ducts, culverts and the like shall be maintained. In some locations these flows may be seasonal or tidal and the Contractor shall ensure that adequate diversions are maintained in places where such variable flows are known to pass.

751 GRANULAR BEDDING AND SURROUND TO GRAVITY PIPES

All sewer or stormwater pipes laid in rock or on mass concrete infill and all PVC/HDPE pipes shall be laid on granular bedding or as otherwise detailed on the drawings.

Granular bedding material shall consist of non flaky broken stone or gravel, graded 20 mm to 5 mm size and shall have a Compaction Fraction not greater than 0.3 as ascertained by the test method described at the end of this clause.

Sand bedding material shall consist of approved local sand which material shall have a Compaction Fraction ascertained by the test method described below of not greater than 0.3. The Contractor shall provide all necessary testing apparatus for the use of the Engineer on site. Frequency of tests shall be at the discretion of the Engineer.

Before placing pipe bedding material the trench bottom shall be prepared and all loose stones, lumps of clay, rock projections, boulders and other hard spots removed. The approved bedding material shall then be laid over the full width of the trench to such depth that after the pipes have been laid to line and level, the thickness of bed beneath the barrel of the pipes is not less than 200 mm or as otherwise stated in the Bill of Quantities or on the drawings. The bedding material shall be evenly spread and carefully compacted and where the bedding beneath the pipe exceeds 200 mm in thickness it shall be placed in two separate equal layers. Any clay, large stones and other unsuitable material falling onto or into the bed from the trench sides or from any other source shall be immediately removed.

Should hand ramming fail to produce even compaction the Engineer may require mechanical compaction to be used, and the Contractor shall not be entitled to claim any extra payment on such account.

Timbering or any other form of trench support should be withdrawn, whenever possible, as the bedding material is placed so as to avoid disturbance of the bedding by later removal.

Pipes shall be laid and jointed as specified elsewhere. Any adjustments to line and level must be made by adding or removing bedding material under the body of the pipe and not by wedging and blocking. All hard objects or timber shall be removed before laying the pipes.

After the pipes have been laid correctly to line and level the bedding material shall be brought up to half diameter of the pipe and compacted as before and so as to prevent any voids under the pipe barrel and give uniform support all round. Care shall be taken not to disturb the pipeline from its approved position at this stage and as the subsequent backfilling of the trench proceeds as specified elsewhere.

For HDPE non-pressure pipe and where sand or granular surround is billed, the pipe shall then be covered with bedding material compacted as before to a depth of 150 mm above the top of the pipe barrel, or as otherwise shown on the drawings.

Where ground water conditions are such that the bedding material would be likely to act as a carrier for ground water from higher to lower ground, the Engineer may instruct flow barriers of suitable selected soil to be inserted in lieu of bedding material. Such barriers to be erected at reasonable intervals close to flexible joints in the pipe, without alteration of the rate for bedding etc.

752 TESTING OF GRAVITY PIPELINES

All new sewers and gravity pipelines shall be water tested, before the pipes are backfilled, for leakage out of the pipeline in the presence of the Engineer under a minimum head of 1.2 m above the pipe soffit or, if higher, the ground water level at the upstream end and a maximum head not exceeding 6.0 m at the lowest point of the pipeline under test. The water loss from within the pipeline shall not exceed 10 ml per cm of diameter per kilometre per hour.

After temporary reinstatement of the trench and before the final reinstatement all new sewers shall be tested in the presence of the Engineer for the infiltration of ground water into the pipeline. The water flow into the pipeline shall not exceed 10 ml per cm. of diameter per kilometre per hour.

In every case the water for testing the pipes shall be left in the pipes until they are covered with earth or other trench filling materials to a depth of at least 1.25 m or to ground level if this is less, over the top of the pipes and until permission is given by the Engineer for the water to be released. If after the Engineer has approved the sewer and has given permission for the trenches to be refilled the pipes become damaged and lose water from any cause and/or admit subsoil water the Contractor shall have the pipes uncovered and the defect made good and the pipes retested as before to the satisfaction of the Engineer and all at the Contractor's expense.

The Engineer may, exceptionally, permit the use of air or smoke tests in which case air or smoke shall be pumped into the test length until a pressure equivalent to 100 mm of water is indicated on a 'U' tube gauge. The pressure shall not fall below 75 mm at the end of the five minutes.

The Contractor shall provide all labour, water, plugs, caps, bends, pumps, gauges and other needful appliances for conducting the tests and no pipes or other work shall be covered up until they have been seen and passed by the Engineer as being absolutely watertight.

753 WATER-TIGHTNESS AND CLEANLINESS GENERALLY

The manholes, chambers, etc., shall be substantially watertight, with no identifiable flow of water penetrating the permanent Works, and shall be clean throughout and may be tested as requested by and in the presence of the Engineer. The Contractor shall provide all labour, water, drain-stoppers, bends, pumps, gauges and other needful appliances for conducting the tests and shall remedy any leaks or other defects.

The Contractor shall remedy any defective or leaky pipes, etc. and remove all dirt, silt or other obstructions from them or failing the Contractor doing this the Engineer may arrange to do so and deduct the cost of the same from any monies due to the Contractor. Such action shall not relieve the Contractor from any damages for which he may be liable in the event of the Works not being completed in the Contract time.

The Contractor shall include in his rates and prices for all water-tightness tests.

754 PIPES KEPT CLEAN

All pipes must be kept thoroughly clean and no water will be allowed to flow in laid pipes during the construction of the Works unless by special written permission of the Engineer. The Contractor shall make all necessary provision for the temporary conveyance by means of troughs or other approved methods of any drainage water during the execution of the Works and he shall be entirely responsible for the cleansing of any ditches, channels, drains, etc. into which he may discharge such water.

A wooden ball or similar approved 25 mm less in diameter than the diameter of the pipes under inspection shall be passed through each length of sewer when so ordered by the Engineer and any obstruction found shall be removed by the Contractor.

All pipelines shall be subjected to inspection for cleanliness before the issue of the certificate of Completion.

755 SLOPE PROTECTION SLABS IN PROPOSED SLUDGE DISPOSAL WASTE STABILISATION PONDS

The Contractor shall construct a concrete beam at the bottom of the proposed embankment slabs to hold them in position in all the ponds. The Contractor shall undertake all the works related to the construction of the new reinforced concrete sedimentation and stabilisation ponds. The Contractor shall submit a method statement giving comprehensive details of his proposal for implementation of the slope protection slabs, flow control and the intended sequence of operations

756 FILLING OF POND EMBANKMENTS

Material for filling of embankments shall be placed and compacted in layers not exceeding 150 mm compacted thickness to the profiles shown on the Drawings. The filling shall be built up and compacted thoroughly and evenly and shall be maintained at all times with a sufficient cross fall to enable surface water to drain freely from it. Surplus excavated material shall be used wherever possible subject to the approval of the Engineer.

Suitable imported natural material for filling shall consist of uniform readily compactible material free from roots, vegetable matter, building debris, clay lumps retained on a 75 mm sieve and stones larger than 25 mm.

Granular fill shall consist of material having the following characteristics: 100% by weight passing a 40mm sieve, not more than 12% by weight passing a 12 mm sieve and Compaction fraction not exceeding 0.2.

Filled surfaces of embankments which are to be the final surface shall be trimmed and regulated to form an even surface free from slurry, loose material or debris and compacted as specified.

Rock fill, if required, shall consist of rock, broken stone, concrete or other hard inert material of a suitable size.

757 COMPACTION OF FILL IN EMBANKMENTS AND POND BASES

Each layer of fill shall be thoroughly and evenly compacted by means of an approved vibratory roller to the satisfaction of the Engineer. The fill shall be compacted to an average of at least 95% of the maximum dry density.

Where water has to be added to achieve the optimum moisture content it shall be applied in an even manner. The rate of application shall be such that no transverse or longitudinal flow occurs. The previously compacted surface shall be prevented from drying out by watering prior to placing of the next layer.

Where the finished levels of the pond bases or banks are below existing ground levels, the base or banks shall be compacted to an average of at least 95% of the maximum dry density for a depth of 150 mm below the finished levels.

758 SECURITY AND MANOEUVRABILITY AT THE POND SITE

The Contractor shall ensure that the site of the works shall be adequately protected by temporary or permanent fencing and gates to inhibit the access of members of the Public, and also livestock and wildlife, from entering the site and being exposed to danger. The Contractor shall ensure that the secure site can accommodate sufficient operating space for heavy-duty sludge disposal trucks.

759 EARTHWORK, PERMEABILITY TEST AND CLAY LINING FOR PONDS

All fill shall be carried out in layers not exceeding 150mm and will be compacted to 95% maximum dry density (MDD) at optimum moisture content (OMC). All finished cut surfaces shall be scarified and compacted to 95% MDD at OMC.

Upon completion of the earthworks the Contractor, shall carry out, at his cost, permeability tests to identify 'K' coefficient of permeability. Each test should cover an area not exceeding 200sqm of the pond bottom surface. Where 'K' is $\leq 10^{-6}$ m/s, the Contractor shall scarify and compact the surface in this area. Permeability test will be repeated in this area.

Clay lining, shall consist of imported CL (clayey silt) classification and will be spread to a thickness of 100 mm and compacted to 98% MDD at OMC.

760 DISPOSAL OF SURPLUS EXCAVATED MATERIAL

All surplus excavated material shall be disposed off the site. The Contractor shall be deemed to have allowed for haulage in his tender rate. Overhaul shall not be carried out until approval has been given by the Engineer.

761 COMMISSIONING OF PONDS

The Contractor may not commission the ponds until such time when he notifies the Engineer of his intent to do so and receives written approval from the Engineer to proceed.

The Contractor shall ensure that all flow controls are correctly set before commencing commissioning.

The Contractor shall take appropriate care when filling the ponds, to prevent erosion of the pond base at the point of impact of the initial inlet flows upon the pond base and side slopes. The commissioning of the ponds will involve filling up all the ponds with liquid to a minimum depth of 1 m to avoid growth of any grass and to permit the gradual development of the algal and bacterial populations. The Contractor may propose certain herbicides to prevent such growth of grass between the period of completion of the works and commissioning of the ponds.

762 WEEPHOLES

Where shown on the Drawings or directed by the Engineer, the Contractor shall cast weepholes into concrete walls. The Contractor shall provide and place plastic pipes of the diameter shown on the Drawings to form weepholes which will be firmly held in position during the placing of the concrete. A 500 mm x 500 mm square of approved filter fabric shall be placed, central on the weephole between the concrete wall and backfill material.

763 DEBRIS SCREENS

Where shown on the Drawings, the Contractor shall fabricate and install debris screens across the full width of the drain channel cross-section. The screens shall be fabricated using galvanised mild steel complying with BS 729. They shall be mounted on R.C. supports and incorporate a safe access platform to facilitate manual clearing of debris as shown on the Drawings.

CHAPTER 8

ELECTRO - MECHANICAL WORKS
(GENERAL SPECIFICATIONS)

CHAPTER 8a - GENERAL SPECIFICATIONS

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CHAPTER 8 – GENERAL ELECTRICAL AND MECHANICAL WORKS

GENERAL

801 DEFINITIONS

In the Specification (as hereinafter defined) the following words and expressions shall have the meanings hereby assigned to them:

- (a) **“Specification”** means this Specification together with the technical details given in the Bill of Quantities and, subject to the Engineer’s approval, the Contractor’s Drawings, Specifications and technical details.
- (b) **“Supply”** and its derivatives means the complete design, manufacture, delivery to site, inclusive of such ancillary services as inspection and witnessed testing at the places of manufacture and shipment, workshop painting and of all such other services as are noted in the Specification or reasonably necessary for the safe, reliable and efficient completion of the Contract.
- (c) **“Install”** and its derivatives means complete installation, on site painting and adjustments, testing and commissioning of the works and of all such other services as are noted in the Specification or reasonably for the safe, reliable and efficient completion of the Contract.
- (d) **“Replacement”** and its derivatives means exchange of equipment, parts or similar with the latest model of the installed equipment or technically equivalent one of another manufacturer, inclusive of dismantling and removal of the existing equipment to the employer’s central store or off site as directed and all such other services as are noted in the Specification or reasonably necessary for the safe, reliable and efficient completion of the Contract.
- (e) **“Overhaul”** and its derivatives where not detailed for specific items of plant, means dismantling, checking and testing to identify defective components, replacement of defective components, reassembly, commissioning and testing. Overhaul shall include the item covered under “servicing”.
- (f) **“Repair”** and its derivatives where not detailed for specific items of plant, means, in addition to an overhaul, additional works such as diagnosis, machining, welding, etc.
- (g) **“Service”** and its derivatives where not detailed for specific items of plant, means the cleaning with high pressure air, water and or steam; oiling and greasing; the adjustments of gaps, injectors, torques to ensure efficient operation of the machine; and the replacement of normally wearing items such as bearings, bushes, seals, gland packings, gaskets, voltmeters, ammeters, drive belts, etc.
- (h) **“Spares”** and its derivatives where not detailed for specific items of plant, mean replaceable wearing parts and lubricants as required for normal maintenance of the plant.
- (i) **“Rehabilitation”** and its derivatives where not detailed for specific items of plant means the reinstatement of plant by overhaul, repair and service to put the plant in its original working state.
- (j) **“Quantities”** the quantities required for each item specified herein shall be as stipulated in the relevant BOQ.
- (k) **“Painting”** and its derivatives means the surface treatment with wire brush or sand blasting and application of the primer and finishing coats as per the specifications.

802 MANUFACTURER'S DEALERSHIPS

There shall be established manufacturer's dealers in Kenya for the proposed pumps and other equipment. The dealership shall have facilities for workshops and stores with sizeable inventories of commonly required spare parts. For pump suppliers in particular, it will be deemed mandatory for the dealer to have such a facility in Kenya. Bids shall contain official evidence of such a facility. Bids offering pumps from manufacturers which do not have the abovementioned dealership shall be rejected.

The Local Agent shall be expected to either have in his stores spare parts for the equipment or be in a position to expeditiously acquire the required parts.

Details (name, physical and postal address, telephone number, and email address of the Local Agent shall be provided by the Bidder in his bid.

803 CENTRAL STORES

All existing and surplus equipment and material which is removed from the WTP's and from the intakes shall be transported and delivered to the Client's stores, situated at the water treatment plant. The prices for removal shall include the costs for lifting by crane, handling, transport and documentation thereof.

804 PLANT OUTAGES

The works on the existing water supply system shall be planned in such a way so as to avoid a complete shutdown of the supply from other existing water treatment plants. The normal supply of water from the other plants shall not be interrupted.

805 THIRD PARTY INSPECTION

In the event that the Contractor did not provide, with his bid

- (a) A list of those who shall manufacture, erect, test and commission the Plant under the Contract; and
- (b) A certified copy of the certificate of listing of all of these firms under ISO 9001, ISO 9002 or ISO 9003 as appropriate for the works or services that these firms are to provide,

Then third party inspection shall be required as hereinafter provided. The costs of such inspection shall be deemed to be included in the Contractor's rates and prices.

The Third Party Inspectorate shall in general be required to certify that the Plant, and the completed work in respect of the Plant, is in complete accordance with the applicable national and international standards, and the Specification.

The Third Party Inspectorate shall be required to be present and to witness the fabrication of the principal components of the Plant, the assembly of the Plant and its works testing, the packaging of the Plant for shipment, offloading into temporary storage on site, erection, commissioning and the performance of all tests at any stage of the execution of the Works.

The Third Party Inspectorate shall be present at all times that the work being inspected is in progress and shall certify that its certificates are based on its own observations, without recourse to extrinsic evidence, or the observations or statements of others.

The inspection services shall be carried out wholly by the approved Third Party Inspectorate and its staff, and the Inspectorate shall not be permitted to appoint or utilise representatives from outside its employees, or to sub-contract any of the inspection services, save for tests carried out on the Inspectorate's behalf by independent laboratories approved by the Engineer, or tests carried out by others on behalf of the Inspectorate but witnessed by a qualified employee of the Inspectorate.

Prior to the commencement of the manufacture of any of the Plant, the Contractor shall propose to the Engineer and obtain approval for:

- (i) The firm which will carry out Third Party Inspection services, and
- (ii) Details of the precise services that the Inspectorate will provide, and the tests that the Inspectorate proposes to carry out.

The Engineer shall not be bound to accept the Contractor's nominated firm of inspectors, and shall not be bound to give any reasons for rejecting the Contractor's nomination. In the event of rejection of the firm nominated by the Contractor, the Engineer shall nominate three alternative firms, from which the Contractor shall choose one.

The Third Party Inspectorate shall provide the Engineer and the Engineer's Representative Certificates that the Plant conforms to the relevant standards and Specification at the following stages:

- (i) Receipt of all components and materials at the manufacturer's works
- (ii) Completion of manufacture and works testing
- (iii) Completion of erection on site
- (iv) On-site commissioning and testing.

The information contained in the certificates and the form of certification shall be to the requirements of the Engineer.

Only Plant which is manufactured, erected and tested by firms which had been proven at the time of bid to be listed under the ISO standards hereinabove provided for, or alternatively, Plant which has been certified as acceptable subsequent to Third Party Inspection as herein provided, shall be accepted as conforming to the Contract. Any other Plant shall be rejected at the Contractor's risk, cost and responsibility.

806 AUDIT OF QUALITY ASSURANCE

An audit of the applicable Quality Assurance Procedures shall be carried out by an independent inspectorate prior to the commencement of any work, which is to be executed by a firm for which exemption from third party exemption in accordance with Clause 9.1.6 is applicable. Such an Audit shall consist of the examination of the implementation of the applicable standard within the premises of the firm concerned, including the examination of relevant quality manuals, procedures, instruction sheets, records and the like, and interviews with relevant management and work staff. The Audit shall be carried out without prior notification.

The Audit inspectorate shall be chosen by the Contract from a list of three inspectorates proposed by the Engineer. The inspection and reporting shall be done directly by the personnel of the chosen inspectorate, and the inspectorate shall not be permitted to subcontract any of the services save for the employment of specialist consultants with the approval of the Engineer.

The report of the inspectorate shall be made available to the Employer, Engineer, and the Contractor within 42 days of the acceptance of the Bid. Such a report shall state whether, in opinion of the inspectorate, the firm or firms concerned have in place Quality Assurance Procedures that comply with the relevant standard. The costs of the inspectorate in executing this Audit shall be born by the Contractor. Where the Audit inspectorate does not find the Quality Assurance Procedures to be in accordance with the relevant standards, then the inspectorate shall provide in its report clear and concise requirements for the improvements, changes or modifications necessary for conformity to be achieved.

The Contractor shall be responsible for ensuring that the inspectorate's recommendations are implemented and shall thereafter arrange for a re-Audit of the concerned procedures, and a report on the re-audit. The costs of such re-Audit and the new reporting shall be borne by the Contractor.

No work in the manufacture, erection, testing and commissioning of Plant shall commence prior to the receipt by the Engineer of a report by the approved inspectorate of satisfaction with the Quality Assurance Procedures in use by the relevant firm.

The Contractor shall have full responsibility in ensuring the compliance by the manufacturers of Plant and his Sub-Contractors with the requirements of this clause.

Failure:

- (i) To provide the Audit inspectorate with access for inspection as required, or
- (ii) To implement any requirements of the Audit inspectorate,

shall result in the rejection of any Plant manufactured or works carried out by the relevant firm. In this regard, the provisions of Conditions of Contract Clauses 37, 39 and 63 will be applied.

807

CONTRACTOR'S RESPONSIBILITY FOR DESIGN

Subject to the requirements of the Specifications, the Contractor shall be responsible for the general and detailed design of electro-mechanical works to be carried out under the Contract and for all plant and equipment provided.

The Contractor shall be responsible for checking all technical information provided in the Drawings, Specification and Bill of Quantities and for confirming the suitability and output of his proposed plant and equipment for the duty required.

The drawings provided with the bidding documents are only for use by the Contractor in computing his bid and are not to be taken as record drawings.

The electrical schematics provided are guidelines to enable the Contractor to design practical circuits with reference to commercially available relays and other components. In this respect, the Contractor shall provide the manufacturer's name and technical details of all the components.

Scales shown on title blocks do not apply to the reduced scale drawings provided.

The Contractor shall be responsible for making all necessary site measurements and establishing all relevant data regarding conditions on site, required for the design, manufacture, installation and commissioning of the equipment.

The Contractor's design shall include any necessary modifications to existing installations

to suit the characteristics of replacement plant proposed.

The Engineer's approval of the Contractor's designs shall not relieve the Contractor of his responsibilities under the Contract.

808 DRAWINGS, OPERATION AND MAINTENANCE MANUAL

The bid drawings for this Contract are in the Book of Drawings.

At the time of the bid, the Bidder shall submit details of Plant and materials and drawings of the completed installation such as will demonstrate that the bid is based upon anticipated works, which it is expected would fulfil the intended purposes. These Bid Drawings shall also serve to illustrate the Bidder's intentions if the Bid is accepted. The acceptance of the Bid shall not be deemed to be acceptance of the Bid Drawings.

Within 45 days of the Contract becoming effective through the Letter of Acceptance the Contractor shall inspect the Site and shall submit for the Engineer's approval four paper copies of full and detailed designs of the Works (Principle Contractor's Drawings) including but not limited to:

- (i) Calculations, design criteria, design assumptions and the like to support the sizes, ratings, and essential components of the Works;
- (ii) Detailed drawings showing the location arrangement, dimensions, layout etc. of all of the Works, including circuit diagrams, dimensioned drawings of Plant, and fixing details to associated civil works;
- (iii) The quantities of materials which the Contractor intends to procure such as to enable completion of the Works;
- (iv) The requirements, specifications, sizes and other information required for the completion of foundations, supports, access works and other civil works associated with the Works;
- (v) Specifications and manufacturer's information regarding the Plant and materials to be provided; and
- (vi) Procedure for switching on the starters
- (vii) Fault finding
- (viii) Logic diagram for mechanical checks before starting pumps
- (ix) Logic diagrams for electrical checks before starting pumps (x)
Normal starting and shutdown procedures
- (xi) Over current and earth fault settings
- (xii) Dosing procedures: solution strengths and adjustments;
- (xiii) Such samples and models as shall be necessary to amplify upon the information provided as above.

The Engineer shall provide his approval or otherwise within 28 days of submission of the Principle Contractor's Drawings. Any Contractor's drawings, which the Engineer disapproves, shall be modified and resubmitted within 14 days of the Engineer's notice of disapproval. Upon approval, the Contractor shall resubmit the approved drawings in one transparency copy to the Engineer within 14 days of approval and he may utilise these Drawings as the basis of ordering Plant and materials for the Works.

Subsequently and from time to time for the duration of the Contract, the Contractor shall submit further drawings to amplify or modify the Drawings as shall be required by the Engineer or shall be considered by the Contractor as necessary or desirable.

The Contractor shall provide three draft copies of the Operation and Maintenance manuals and the drawings of the Works as built at the time of submitting the notice of readiness to make the Tests on Completion.

The Contractor shall give to the Engineer 21 day's notice of the date after which he will be ready to make the Tests on Completion for the Plant. The Tests shall then take place within 14 days after the said date.

Upon approval of the manuals, three copies shall be submitted. Of the approved drawings, three transparency and three paper copies shall be provided.

The satisfactory completion and submission of the Operation and Maintenance manuals and as-built drawings shall be one of the conditions, which the Contractor shall fulfil before the Hand-Over certificate is released.

809 STANDARD SPECIFICATIONS REFERENCE NUMBERS (SSRN)

The Standard Specifications reference Numbers (SSRN) is a list compiled to provide cross-reference of international standards. In these specifications, the standards required are given by an SSRN, which indicates all the known standards for the particular item of equipment, etc. An SSRN list is provided at the end of these specifications.

810 SCHEDULES OF PARTICULARS

Schedules of Particulars for mechanical and electrical equipment are provided at the end of these specifications.

The Bidder shall complete these schedules with full details of the equipment and materials proposed and submit them in his bid.

Bids which do not contain the above duly completed schedules will be ruled as non-response and will be rejected.

811 TESTS OF PLANT AND WORKS

Tests During Manufacture

During manufacture, the Contractor or his supplier shall carry out all tests on the Plant and materials which are specified in the relevant Standard Specification and shall forward to the Engineer duly certified copies of the test results and a certificate stating that the Plant and materials comply with the relevant Standards Specification.

Each pump shall be tested individually at the manufacturer's works in accordance with SSRN 016 and 017.

All pumps shall be tested complete with all the shaft bearings, thrust bearings and directly driven auxiliaries.

Pump casings pipe-work and all other parts of the installations subjected to high pressures shall be hydraulically tested at the Manufacturer's works to at least 1.5 times the maximum permissible working pressure.

Commissioning and Site Performance Trials and Tests

After complete erection of the Plant at the site, the Contractor shall commission the Plant

and operate each pump for a period of not less than 150 hours, (of which at least 36 hours shall be continuous) during which time he shall carry out any adjustments or modifications he may deem necessary to achieve the best possible efficiencies. The pumps may be run singly or in any combination to achieve these running hours, subject to availability of and demand for water and at the discretion of the Engineer.

The Operation and Maintenance manuals shall be completed before the commencement of Performance Trials. During the trials, the Employer's staff shall be trained on all the operation, maintenance and safety aspects of the pumping and treatment plant.

After all the pumps have been so operated, Site performance Trials shall be carried out on the Plant under the joint supervision of the Employer, the Engineer and the Contractor in accordance with Tests on Completion clause in the Contract to ascertain whether the Plant is capable of properly performing the specified duties and to determine the efficiencies of the pumping sets.

For the purpose of these trials, the head against which the pump sets are expected to work shall be checked by the pressure gauges installed by the Contractor. The head value shall be adjusted if necessary by throttling using line valves at the discretion of the Engineer, to be within 3% of the 'Assessment Heads' specified in the relevant Penalty Clause.

Reading of the pressure and cumulative discharge meter readings shall be taken simultaneously at such intervals as the Engineer may determine during the period of each trial.

The power credited to each pump shall be equal to $(Q \times H \times 9.80 \times 10^{-3}) \div \rho$ in kilowatts, where Q is the rate of flow in litres per second determined volumetrically as determined above and H is the pumping head in metres credited to each pump as the difference in gauge readings across the pump. ρ is the combined efficiency of the pump set.

The input power to each motor shall be computed in kilowatts as the sum of the readings of two portable Standard Class 1 Wattmeter connected for the measurement of balanced three-phase power. The wattmeters, which shall be made available for the tests by the Contractor, shall be initially calibrated together with their instrument transformers and connecting leads by KPLC or any other accredited agency, at the Contractor's responsibility.

The Contractor shall provide an accredited representative and except as otherwise indicated all measuring instruments and all other apparatus, oils and consumables necessary for the Performance Trials, as well as portable radio transceivers for use in communicating during the trials.

The Take Over Certificate will not be issued until all the completion tests have been performed and satisfactory results given to the Engineer or until any resultant modifications; repairs and re-testing are, in the Engineer's opinion, satisfactorily completed.

The tests shall include electrical installation tests as required under the IEE Regulations for Electrical Installations 16th Edition.

Running-in Period after Commissioning

After the site performance trials, the Works shall be operated under the supervision of the

Contractor's representative. The Contractor's representative shall further instruct the Employer's operators in all the operations of the Plant. All final adjustments shall be completed during this period. A period of at least five days of running-in will be expected at each plant.

Operation of Plant After Running in Period and Training of Staff

After the running-in period, the Contractor's representative shall operate the plant for a further period until the Employer's staff are fully conversant with all aspects of the plant and the plant operation is fully functional and the required production throughput is attained.

Hand-over certificates for completion of the plant shall only be provided to the Contractor after a satisfactory operation of the plant at this stage.

The Contractor shall perform On-the-job training in the following areas wherever applicable;

- Installation of mechanical and electrical plant
- Operation and maintenance of pumping plant
- Operation and maintenance of water treatment plant
- Leakage repairs
- Operation and maintenance of workshop equipment
- Operation and maintenance of vehicles
- Operation and maintenance of laboratory equipment
- Operation and maintenance of plant utility (works) equipment such as electric generators, water collection, treatment, distribution and supply systems.
- Operation and maintenance of process equipment such as piping, pumps, filters, compressors, motors, stills and instruments
- Operation and maintenance of safety equipment such as pressure-relief valves, breathing and emergency relief equipment and fire extinguishers
- Operation and maintenance of auxiliary equipment such as pipelines, drains, gauges and measuring instruments.

ELECTRICAL WORKS**812 ELECTRICAL DISTRIBUTION SYSTEMS****813 REGULATIONS AND STANDARDS**

The electrical installation shall comply with all relevant statutory regulations and standards current at date of tender, unless otherwise indicated within this Specification. In general the following shall apply:

- a) The IEE Regulations for Electrical Installations, 17th Edition
- b) The Health and Safety at Work Act, etc.
- c) Factories Act (UK)
- d) British Standards (BS) and International Standards stipulated in SSRN (Standard Specifications Reference Numbers)
- e) British Standards Codes of Practice (CP)
- f) International Electrotechnical Commission (IEC)
- g) Regulations under the Electricity Acts

If no standard is specified, the relevant British Standard or, in the absence of such standard, International standard shall apply.

Note: A list of the Standard Specifications Reference Numbers (SSRN) is provided at the end of these Electrical and Mechanical specifications.

814 ABBREVIATIONS OF ELECTRICAL ITEMS

R	-	red phase
Y	-	yellow phase
B	-	blue phase
N	-	neutral
AC	-	alternative current
DC	-	direct current
A	-	amp
mA	-	milliamp
V	-	volt
kW	-	kilowatt
kWH	-	kilowatt hour
kVAr	-	kilovar
MVA	-	megavolt amp
Hz	-	hertz (cycles per second)

SP	-	single pole
SPN	-	single pole and neutral
DP	-	double pole
TP	-	triple pole
TPN	-	triple pole and neutral
SPSwN	-	single pole and switched neutral
TPSwN	-	triple pole and switched neutral
MCB	-	miniature circuit breaker
MCCB	-	moulded case circuit breaker
RCD	-	residual current device
MCC	-	motor control centre

815 POLARITY

The polarity of all electrical apparatus used for the Works specified shall be arranged as follows:

for two pole apparatus the phase of 'live' pole at the top (or left hand side) and the neutral or 'earthed' pole at the bottom (or right hand side),

for three or four pole apparatus the phases in order of red, yellow, blue and neutral reading from top to bottom or left to right in the case of vertical and horizontal layouts respectively and as viewed from the front.

All non flexible cables shall be so connected between main switchboards, distribution boards, plant and accessories so that the correct sequence or phase colours are preserved throughout the system.

All non flexible cable cores shall be identified with phase colours for three and four wire circuits. Single phase circuits shall be red and black.

816 VOLTAGES AND FREQUENCIES

Unless otherwise indicated, all apparatus and wiring shall be suitable for use with a 3 phase, 4 wire, 400/230 volt, 50Hz earthed neutral supply. The supply waveform shall be a sine wave.

Supplies for control, tripping, alarm and indication circuits shall be 24 V DC. Circuit breaker spring charging motors shall also operate at 24 V DC.

Control voltage within motor starters shall be 110 V AC. Extension of 110 V circuits outside the starter shall not be permitted except for the circuit to the emergency stop button, where fitted.

Tap changer motors and electrical panel heating and lighting shall operate at 230 V, single phase. All equipment operating at 230 V shall be fully shrouded and clearly labelled.

Where 230 V lighting and heating is used within a panel which otherwise contains equipment with a nominal operating voltage of 24 V, the 230 V equipment shall be insulated, sheathed and protected in accordance with standard practice for installing such equipment in buildings. No live terminals shall be accessible without the use of tools, no single-insulated wires shall be used, and no 230 V cables shall share cable trays or other routes with 24 V circuits.

All references to voltages shall relate to the nominal, or rated value of the supply.

817 UNITS OF MEASUREMENT

All information shall be in SI units. Where plant design exist in imperial units, the dimensions and tolerances of layouts and terminal points shall be presented in SI units to a degree of accuracy which permits the precise matching of existing components.

818 ELECTRICITY SUPPLIES

The Contractor shall arrange with the KPLC to undertake any testing and inspection necessary for the electricity supplies to be connected when required. On completion of the tests and inspections, not less than two weeks prior to the power supply being required, the Contractor shall supply to the Engineer a copy of his Electrical Installation Completion Certificate and of the KPLC test certificates.

The Contractor shall ascertain the system earth arrangements which are normally classified as TT, TN-S, TN-C-S, TN-C and IT.

The Contractor shall also make enquiries from the Supply Authority on the declared Prospective Fault Current at the origin of the installation and take the value in to consideration for the proposed electrical installation design.

819 ELECTRICAL SAFETY

The Contractor shall be responsible for the electrical safety of all equipment supplied and installed. Whilst any equipment is being installed or tested, the Contractor shall ensure that all necessary precautions are taken to safeguard personnel working on site. If necessary, this shall include erecting warning notices and fencing off areas which are considered to pose a risk.

The Contractor shall be responsible for ensuring that the electrical installation is carried out by competent personnel and that the work is carried out in accordance with standard procedures and test requirements. Before any piece of apparatus is energised it shall be thoroughly examined for the presence of dirt, water or other foreign bodies.

820 ELECTRICAL MOTORS**(a) General**

Motors shall be three phase squirrel cage induction type and comply with SSRN 010, SSRN 011, SSRN 025 AND SSRN 033 as appropriate for the application specified. They shall be capable of withstanding without damage an overload equivalent to 150% of full load torque for 15 seconds.

The motor rating shall be not less than 120% of the maximum power demand of the driven plant when operating in its normal range. For motors above 15 kW, the input power factor over the normal operating range shall not fall below 0.85 lagging.

The motor terminal box shall allow adequate clearance for an air termination of the specified cable, cable lugs and glands.

Motors of 15 kW and above shall be fitted with anti-condensation heaters. The heaters shall be separately fused and energised when the main circuit contactor is open.

A motor rating plate shall be fitted to every motor giving the following information;
manufacturer's name

- a) motor type and serial number
- b) power rating

- c) current, voltage and winding connection
- d) supply frequency

- e) duty power factor
- f) duty speed
- g) class of insulation
- h) IP rating
- i) maximum number of starts per hour.

Unless otherwise specified the motors shall be capable of starting at least 5 times, equally disposed in any one hour at maximum ambient temperature.

Motor insulation shall be rated to thermal class F and temperature rise shall not exceed the limits of class B (SSRN 024).

The degree of protection of the motor enclosure as described by SSRN 025 shall be as follows:

- a) outside in desert applications IPW 55
- b) outside in temperature climates IPW 55
- c) subjected to powerful water jets: IP 65
- d) Submersible motors: IP 68
- e) Protection against water splashes: IP 44
- f) inside in controlled environment: IP 22

All motors shall be provided with a frame earth terminal of sufficient size to take full fault current. An earth conductor shall be connected in accordance with SSRN 030.

Unless otherwise specified, all motors operated on an HV supply, and all motors rated at 15 kW or greater shall incorporate winding temperature protection in the form of six thermistor (or thermocouple) temperature detectors embedded in the stator windings. The temperature detectors shall be wired to a connection box mounted on the motor frame. The box shall be dedicated to the connection of the temperature devices and shall not be used for any other purpose. The box shall incorporate over-voltage protection devices.

All motor rotating parts together with their couplings shall either be enclosed within the motor frame or be fitted with guards, removable only by the use of tools, to prevent accidental contact.

(b) Main Parameters

A summary of the main motor parameters is provided below:

Rated Output:	At least 1.20 x Highest defined pump duty point kW
Medium Voltage:	3,300 V +/- 6%;
Low Voltage	400 V +/- 6%;
Frequency:	50 Hz
Nominal Speed:	1500 RPM (preferable)/3000 RPM
Anti-Condensate Heater:	100 W/ 240 V (operational with motor off)

Winding Thermistors:	2 No. per winding
Winding Insulation Class:	F
Temperature Rise	Not to exceed limits of Class B

(c) Motor Efficiencies

The minimum motor efficiencies shall be as shown in the table below.

MOTOR RATED OUTPUT kW	MINIMUM EFFICIENCY AT RATED OUTPUT (%)
250 and above	96
132 up to 249	95
55 up to 131	94
Below 55	92

(d) Motor Starting Torque Performance

The motor locked rotor torque shall be adequate to meet the requirements of the driven load. For cage induction motors, the locked rotor torque shall not be less than the values given in BS 4999, Part 112

The motor starting (run-up) torque characteristics shall:

- Be adequate for starting the driven load under the most arduous operating conditions between 65% and 85% rated voltage;
- Provide at 65% - 85% rated voltage, an accelerating torque at any speed between zero and that at which breakdown occurs not less than 10% of motor rated full-load torque

In any event, the motor starting torque at rated voltage shall not be less than 1.4 times the torque obtained from a curve varying as the square of the speed and equal to the rated torque at the rated speed.

821 SWITCHBOARD CONSTRUCTION

(a) General

This section shall apply to the construction of all panels housing electrical apparatus, including but not limited to the following:

- switchboards
- motor control centres
- circuit breakers
- control panels
- monitoring or supervising panels
- distribution boards – control panels
- marshalling panels

- h) interface panels
- i) local control panels

(b) Safety

Access to any enclosure of compartment shall be possible only;

- a) when the circuit switch-disconnector is open and connections within the compartment are isolated or;
- b) when connections within the compartmental including any on the door or access cover, are fully shrouded to prevent accidental contact or;
- c) when connections within the compartment operate at a voltage not greater than 55 volts.

Where a test facility is provided for use with the door or cover open the provisions of (b) shall apply. Connections which may be live with the door or cover open shall be suitably labelled.

Bolted covers on compartments incorporating live connections shall bear a suitable warning label.

Labelled isolators, fuses or links shall be provided so that relays, controls and instruments may be isolated but keep other essential circuits energised.

(c) General Construction Standard

The switchboard and all components shall be constructed to withstand fault currents as specified or required under the relevant standards and regulations.

Switchboards, cubicles and enclosures for electrical equipment shall be constructed in sheet steel not less than 2.0 mm thick and suitably braced to form a rigid structure. Exterior edges and corners shall be rounded and the use of externally visible assembly bolts or similar shall be avoided.

The design shall provide protection against dust, damp and entry of vermin. Gaskets shall be fitted to doors and removable panels. Ventilation and cooling shall be by natural air circulation under the ambient conditions specified or to be expected.

Unless specified otherwise, switchboards, cubicles and enclosures shall be floor-standing with lockable hinged front doors and bolted removable rear panels for access to live equipment such as busbars and terminals.

The switchboard shall fit in the space as stated or indicated on the drawings. If there is any reason will not fit into the space, the attention of the Engineer shall be drawn in good time to enable alternate arrangements to be made either to the board or to its fixing position. It shall be the responsibility of the electrical contractor to verify the suitability of the space provided before commencement of installation.

Each section shall be separately accessible without disturbance to other sections for maintenance and inspection. Live parts with voltages greater than 55 V to earth within the section shall either be isolated automatically when the section door is opened, or be fitted with insulating barriers to prevent accidental contact by personnel. Parts still live when the unit is isolated shall be labelled "Danger Live". Where integral fuse or MCB distribution boards are incorporated, access to fuse carriers and MCB's shall be possible without isolating the fuse or MCB distribution board. With the operator's door open and with fuses and MCB's in place, the degree of protection of such distribution boards shall be not less than IP20.

A clear access of not less than 1000 mm, and preferably 1500 mm, shall be given at the rear and both ends of the panel.

Controls and switches mounted on any control panel section of a switchboard shall be installed in the height range 750 mm to 2000 mm; indicating instruments 900 mm to 1800 mm; recorders 900 mm to 1400 mm. This requirement shall not be applied to starters or feeder sections.

Switchboards shall be equipped with a power transformer and 2 No. 15 A, 110 Vac ($\pm 5\%$) RCCB protected sockets, suitable for use with electric hand tools. Switchboards shall additionally have 2 No. 13 A, 240 Vac RCCB protected sockets.

Each section of cubicle of the board shall be clearly labelled with circuit name and number, and the reference number of the section. The panel shall have a name plate carrying the manufacturer's name, address, reference and year of construction of the panel.

Cubicles and enclosures shall be earthed. Where a number of cubicles are bolted together, earthing shall be provided via a continuous high conductivity copper bar of minimum cross section 25 mm x 6 mm running the length of the panel. Terminals shall be provided for the connection of earthing from the metal cladding or armouring of incoming and outgoing cables. Holes shall be left at each end of the bar for connection to the main station earth and future extension. The bar shall be fault rated at not less than that of the associated equipment. Warning labels and instructions for earthing and isolating shall be fitted in each switch compartment. Front access doors shall open not less than 120° and shall be fitted with a locking handle and non-ferrous lift-off hinges which shall be captive when the door is closed. Locking combinations requiring different keys shall be approved before manufacture. The door shall be secured by captive screws or locking handles of sufficient number to ensure firm pressure on the door seal around the whole periphery. The door shall be mechanically prevented from opening before isolation of the live parts within. All doors shall be separately earthed to the main frame. Earthing via the door hinge will not be accepted.

Cables shall enter through 3 mm thick undrilled removable steel or brass (for single core cables) gland plates mounted at least 250 mm above switchboard base level. Access to both sides of gland plates for gland tightening shall be readily available. Gland plate knockouts will only be accepted for individually mounted starters and small power distribution boards.

Lifting eyeholes shall be provided at each top corner at each section of the switchboard and shall be removed and replaced with blanking bolts after installation.

Cubicles and enclosures for outdoor locations shall be fitted with lockable outside doors and a housing so designed that all controls, instruments and such like are fully enclosed and the whole assembly is weatherproof and vandal proof. The doors shall be fitted with stays to prevent overstraining of the hinge fixing, and allow fixing of the doors in the open position. Switchboards inside cubicles shall also be weatherproof to allow operation of the controls when the outside cubicle doors are open during inclement weather.

When specified, a double skin roof shall be fitted over the whole assembly to give added protection against direct sunlight.

LV enclosures shall be constructed to comply with SSRN 038 and have IP ratings of at least the following;

- for outdoor installation IP 65
- for indoor installation IP 54

Switchboard, cubicle and enclosure construction shall be capable of withstanding without damage the fault current of the system. HV enclosures shall be constructed to standards under SSRN 061 with IP ratings equal to those for LV enclosures.

Protective coatings shall be applied at the place of manufacture and before installation of its internal electrical fittings.

(d) Switchboard Small Wiring

Switchboard wiring shall be carried out in 600/1000 V PVC insulated cable to comply with SSRN 041. The conductors shall be stranded or flexible (where applicable); solid cores will not be accepted. The conductor size shall be not less than 1.5 mm² for control and indication circuits and not less than 2.5 mm² for CT secondary circuits.

Wiring within the switchboard shall be marked with ferrules at each end for identification. The letters and numbers used shall correspond with the switchboard wiring diagram.

The wiring colour code shall be as follows:

Phases	-	red, yellow, blue
Neutral	-	black
Control	-	grey/black
Earth	-	green/yellow

The wiring shall be neatly laced and cleated to the switchboard structure or contained within purpose designed plastic trunking and arranged so that access to equipment is not impeded. Where trunking is used the ratio of effective cross sectional area of the cables shall be not greater than 40% of the trunking area. Where wiring passes through metalwork the access hole shall be fitted with a suitable grommet.

Every wire shall be identified by indelibly marked circular ferrules at each end. Slip-on, 'u' type ferrules will not be accepted. Identification shall correspond with the wiring diagram.

Wiring between cubicles or panel sections shall be terminated on terminal blocks at each end.

Wiring onto hinged doors or plates which is subject to movement shall be run in flexible circular section trunking and shall be supported securely at both ends of the moving section. Adhesive fixings of the ends of the trunking will not be accepted.

Crimped flat blades shall be applied to all wire ends to ensure sound connection to terminal blocks and all circuit components.

Small wiring used for control, extra low voltage and instrument signals which are likely to be affected by interference shall be screened and/or spaced from each other and power cables to ensure no distortion or mal-operation.

(e) Switchboards Busbars and Primary Connections

All busbars and primary connections shall be of high conductivity copper to comply with SSRN 020 and SSRN 069. The mechanical and dielectric strengths of busbars and connection supports shall be able to withstand without damage the worst conditions of electrical surge which can occur on the installation. The busbars shall be capable of carrying full rated current continuously without exceeding temperature rise limits indicated in the above SSRNs.

The busbars, assemblies and connections of equipment shall be of a type which does not rely solely on air for insulation purposes. The covering material shall be non-deteriorating at the rated short-time maximum temperature of the busbars and shall have such thickness as is required to withstand rated line to line voltage between busbar and a conducting object on the exterior of the covering material for a period of not less than 60 seconds.

Where independent certification of busbar withstand and continuous rating is not available the Contractor shall include tests to demonstrate the suitability of the equipment.

Busbars and primary connections shall be housed in an air insulated enclosure segregated by barriers. Direct access to live bars shall not be possible. Access to

busbars and connections shall be only by removal of bolted covers. Suitable warning labels shall be provided externally on covers and internally on shutters. Busbars shall be identified by coloured bands opened at not more than 1,000 mm and in each compartment.

Baffles shall be provided to prevent the accidental entry of tools, etc. whilst maintenance work is being carried out in the vicinity of the chambers.

Busbars systems shall have a short time rating not less than that of the associated switchgear.

Busbars shall be extensive at both ends.

The conductors shall be separated and supported with the appropriate clearances in air or shall be otherwise adequately insulated or encapsulated.

822 SWITCHBOARD COMPONENTS

(a) General

This section shall apply to components used in all panels housing electrical apparatus, including but not limited to the following:

- ☐ switchboards
- ☐ motor control centres
- ☐ circuit breakers
- ☐ control panels
- ☐ monitoring or supervisory panels
- ☐ distribution boards
- ☐ marshalling panels
- ☐ interface panels
- ☐ local control panels

(b) Indicating Instruments and Meters

All instruments and meters shall be flush mounted, 96 mm x 96 mm minimum size and of the same pattern and appearance throughout. They shall be back connected and be similarly protected to maintain the environmental protection standard of the equipment enclosure on which they are mounted. Those which perform similar duties shall be of uniform type and manufacture.

Indicating instruments shall have black marking on a white background, a full scale deflection of 270° and be fitted with an externally accessible zero adjuster.

They shall have no parallax error and their normal maximum reading shall be approximately 60% full scale deflection.

Ammeters in motor starter circuits shall be capable of withstanding the starting current and shall have a compressed overload scale. The scale shall be clearly marked with a red line indicating normal full load current.

Indicating instruments shall comply with SSRN 070 and shall be of industrial grade accuracy, ($\pm 5\%$) unless otherwise specified.

Kilowatt-hour meters: shall comply with SSRN 014 and SSRN 070 and shall have an accuracy of $\pm 1\%$ unless otherwise specified.

The meter element shall be suitable for operation on single phase or three phase as specified, 50 Hertz AC system and shall be of indicator type, capable of continuously carrying the rated current.

The registering mechanism shall be of the cyclometer type giving a reading of six figures, the lowest indicating tenths of a unit.

Voltmeters: Voltmeters shall be of the moving iron flush mounting type, rectangular or circular and size as specified. They shall be suitable for vertical switchboard mounting and studs shall be provided for back connection. The voltmeters shall be suitable for operation on a 50 Hertz system, and be calibrated as required. The voltmeters shall be manufactured in accordance with BS 89 to industrial grade accuracy as specified therein.

The voltmeters shall be protected by high rupturing capacity cartridge fuses to SABS 172: housed in suitable insulated fuse carriers with a panel-mounting base. Voltmeter selector switches shall be incorporated.

Ammeters: Ammeters shall be and of the moving iron flush mounting type, in accordance with the clause above where applicable, and of the pattern, size and scale range as specified. Ammeters for use in motor circuits shall have a suitably compressed overload range.

Ammeters selector switches shall be installed if specified. Selected switches having spring located contacts running over copper segments are not acceptable.

Combined maximum demand and indicating ammeters: The instruments shall be flush panel mounting, rectangular in shape, the dial size being approximately 125 x 125 mm or 80 x 80 mm as specified. The ammeters shall comply with BS 89.

The instrument shall comprise a moving iron ammeter showing the instantaneous current value, combined with a maximum ammeter employing a bimetallic spiral device which will indicate the mean current value on the basis of a 15 or 30 minute period as noted, and which is fitted with a residual pointer to indicate the maximum mean current reached during any period between manual resetting.

All three indications shall be registered on concentric scales, and instruments having small moving iron ammeters with window cut-outs scales are not acceptable. The bimetallic system shall incorporate ambient temperature compensation.

The instrument shall be used with a current transformer having a 5 ampere secondary winding. 6 Ampere or 8 ampere instruments may be offered, scaled to the full load primary current of the current transformer, with an additional overload scale in the case of 6 amp instruments.

Power Factor Indicators: Instruments shall be housed in pressed steel cases. Shadowless scale plates shall be fitted. Instruments shall comply with BS 89. Indicators shall be suitable for flush mounting in switchboards. Current rating shall be 0.5 to 5 A continuous at the rated voltage. Power factor range shall be from 0.5 PF lead to 0.5 PF lag, and size shall be as specified.

Elapsed time meters: Time meters shall be of the flush mounting type, square phenolic frame, suitable for switchboard mounting. Registers shall be calibrated in hours and tenths of hours. Cyclometer details to be as noted. Voltage range shall be 200 – 250 V 50 Hz unless otherwise noted. Motors shall be self-starting, synchronous, non-reversing and shall be energised from the same supply as the apparatus being metered.

Transducers: Transducers shall be suitable for use in remote indication systems for alternating current and voltage using lightweight telephone type pilot wires. Outputs shall be suitable for operating moving coil instruments and recorders.

Outputs and inputs shall be as specified.

Output currents shall be independent of the load resistance over the stipulated range of load resistance.

Ambient temperature range – 10°C + 50°C.

Accuracies and linearity shall be according to the application as specified.

Open circuit. DC output voltages shall not rise above 18 volts when the load is removed or open circuited. Open circuiting of the output shall not result in damage to the transducer.

Short circuit. DC outputs shall be protected against a short circuit of the output terminals by a current limiting device.

Voltage, kW and kVA transducers shall be suitable for 3 wire unbalanced loads or as otherwise specified. Amplifiers shall be utilised where transducer outputs do not meet the required output range for the system.

Where portable instruments are specified they shall be of sub-standard accuracy ($\pm 1\%$)

Instruments shall be positioned between 1800 mm and 750 mm above finished floor level.

(c) Indicator Lights

Indicator lights shall be of uniform type as far as possible, to minimise spares requirements. Glasses and bulbs shall be easily removable without the use of a tool.

Indicator lights shall be not less than 20 mm diameter and shall be of the projecting type so they can be seen from the front and side of the switchboard. They shall be visible under bright sunlight conditions.

The lights shall be under-run to give long life either by use of a resistor to limit voltage to 90% of normal value, or by using higher voltage lamps.

Alternatively the lights shall be transformer operated or battery operated where a battery is available.

Colours of indicator lights shall generally comply with SSRN 071. The diffuser glasses shall be coloured and the bulbs shall be clear.

LED indicator lights shall not be used except where they form part of proprietary equipment.

All components, doors and removable covers shall be labelled. Fuse carriers shall also have labels which state the fuse rating to be fitted. Each cubicle door shall bear an identification label (minimum letter size 8 mm) and each switchboard and enclosure shall bear an overall identification label (minimum letter size 12 mm).

(d) Labels

All designating labels shall be of traffolyte or similar finished white with engraved letters and numbers filled with black and fixed by non-rusting screws.

Danger and warning labels shall be of similar material finished in yellow with red letters and numbers. Edges of labels shall be bevelled and lettering shall be at least 4 mm high.

(e) Pushbuttons

Colours of pushbuttons shall generally comply with SSRN 071 and in particular shall be as follows:

Red	-	stop, off or emergency buttons
Green	-	start or on buttons

Emergency stop push buttons shall have enforced contact separation. They shall be connected in the control circuits so they trip the circuit under all conditions. They shall have mushroom-heads of the stay-put pattern.

(f) Terminal Blocks

Terminal blocks shall be of non brittle material, screw-clamp or stud type barrier pattern. Pinch screw type blocks shall not be used.

At least 20% spare terminals shall be provided at all blocks.

Every terminal block shall have a clear plastic clip-on cover running the full length of the block to prevent accidental contact with live terminals.

Removable DIN rain terminals shall be provided for all wiring, mounted at an angle to provide ease of access, positioned not less than 150 mm from gland plates, doors or covers.

Power, control, earth and end stop terminals shall be provided and terminals shall be grouped and separated by barriers according to their voltage level and function.

No more than two conductors may be connected to one side of a terminal. Outgoing cables shall be wired so that outgoing wiring is connected to one side only.

Terminal blocks shall be mounted vertically at the side of the enclosure and set obliquely towards the rear doors.

Every terminal block shall have a clear plastic clip-on cover running the full length of the block to prevent accidental contact with live terminals.

Blocks at different voltages or phases shall be grouped and labelled accordingly.

(g) Test Terminal Blocks

Test terminal blocks shall be provided for secondary injection and testing of relays.

A metering block shall be provided for the connection of portable sub-standard instruments for plant testing.

Test terminal blocks shall be provided with shorting links or be of a type suitable for use with portable test plug-in equipment.

(h) Control, Auxiliary, and Selector Switches

Control and Selector Switches shall conform to SSRN 007.

Control Switches shall be of the three position type with a string return action to a central neutral position. They shall be labelled.

Electrically operated circuit-breakers shall be fitted with a control switch labelled Open/N/Close. These shall be of the pistol grip type with a spring return to the neutral position. The switch shall be lockable in the neutral position.

Selector switches shall make before break and shall remain in the position selected and be lockable in that position. They shall have spade shaped handles and each position shall be labelled.

Contacts of all switches shall be shrouded.

A minimum of four spare auxiliary switches, two normally open and two normally closed shall be provided for each circuit breaker and contactor.

(i) Switchboard Ancillary Equipment

The following ancillary articles shall be supplied with each switchboard.

- ☐ 2 pairs rubber gloves to SSRN 077 according to rated voltage of switchboard.

- ☐ 1 No. "treatment for electric shock" metal enamel instruction plate suitable for screen attachment.
- ☐ Operating handles, tools, spares and lubricants as specified elsewhere.

(j) Voltage Transformers

Voltage transformers shall comply with SSRN 003. The secondary winding shall produce an output line voltage of 110 V, three phase. The accuracy class and VA rating shall be as specified or shall match the requirements of all connected instruments and relays.

The primary circuit shall be protected by HRC fuses having a short-circuit rating of not less than that of the switchgear. The connections between the fuses and the switchgear primary conductors shall be of sufficient cross section and be supported to withstand the short-circuit rating of the switchgear.

The secondary circuit shall be protected by HRC fuses mounted as close as possible to the secondary terminals. Fuses shall be accessible without the need for isolating the switchgear.

Isolatable voltage transformers shall have the facility for padlocking in the service position. Safety shutters shall automatically cover the busbar spouts when the transformer is withdrawn. Shutters shall have the facility for padlocking in the closed position.

(k) Current Transformers

Current transformers shall comply with SSRN 002 and shall be of the wound-primary or bar-primary type according to ratio required. All current transformers shall have a short-time current rating of not less than that of the switch panel in which they are incorporated. For bar-primary current transformers this rating shall be for a period of 3 seconds. For wound-primary patterns the rating shall preferably be for a period of 3 seconds but may be reduced to not less than 0.5 seconds subject to the Engineer's approval.

Identification labels shall be fitted giving type, ratio, rating, output and serial numbers. Current transformers shall be of Class 1 accuracy for use with measuring instruments and Class 10P for use with protective relays.

Class 5P shall be used for combined overcurrent and earth fault protection of the inverse time overcurrent type.

The secondary windings of each set of star-connected three phase current transformers shall be earthed at one point only, via a bolted link.

Separate sets of CTs shall be used for metering and protection.

Shorting links shall be provided at test blocks.

(l) Control Transformers

Unless otherwise specified all contactor control circuit supplies shall be obtained from the 110 v secondary winding of a single phase integral control transformer.

Transformers shall be of the double wound pattern in accordance with SSRN 051 and shall have an earth screen between primary and secondary windings. One leg of the secondary winding shall be earthed. The primary winding shall be protected by carriage fuses, and the secondary winding shall be protected by a fuse and link.

A spare control transformer shall be provided with each new switchboard.

(m) Anti-Condensation Heaters

Anti-condensation heaters shall be fitted to:

- ☐ Wall mounted enclosures

- ☐ Individual floor mounted enclosures
- ☐ Each vertical section of single tier switchgear to control gear
- ☐ Each tier of multi-tier enclosures

Each heater shall be controlled by its own thermostat, ON/OFF switch and fuses or MCB. Heaters in exposed positions shall be fitted with a safety guard.

Each section of the panel shall contain an anti-condensation heater, rotary isolating switch, and HRC fuse or appropriate protective device. A bus-wired single phase supply controlled by a calibrated adjustable thermostat shall energise all panel heaters.

823 **PROTECTIVE RELAYS**

(a) General

Protective relays shall be mounted on the front of the switchgear or relay panel in such a position that operation and maintenance can be conveniently carried out. Auxiliary relays may be mounted inside a cubicle provided that they are readily accessible.

Each relay shall be contained in a dust proof case with a clear front cover. All metal bases and frames shall be earthed except where there are technical reasons where this is impracticable.

All relay contacts shall be capable of making the maximum current which can occur in the circuit without causing damage to the contacts.

Relays shall have position for testing the operation and calibration without disconnecting the permanent wiring.

Flush, draw out type relays are preferred. Each relay shall have an indicator device to show when the relay has operated and if necessary, which phase element. Each indicator shall be hand resettable. Resetting devices shall not require the removal or opening of the relay. It shall not be possible to operate the relay without opening the case.

Where solid state relays are specified, these shall be of the module type comprising a number of plug in elements allowing interchange of functions. Each of the protection elements shall have adjustable controls for current and time settings as required. Solid state relays of a particular type shall have interchangeable protective elements with other similar relays supplied under this Contract.

All relays shall be provided with a name plate giving manufacturer, type, serial number, year of manufacture, ratings and connection diagram.

All relays using a DC auxiliary supply shall operate down to 60% of the nominal voltage and up to boost charge voltage of the battery.

Protection relays shall comply with SSRN 019 where appropriate and shall conform to the following provisions:

(b) Generator or Transformer Biased Differential Protection

The protective relay system shall be suitable for generators or two or three winding transformers. The relay shall not operate due to magnetising or line switching current surges or tap change ratio changes provided on the transformer, nor for thorough fault currents.

(c) Transformers Restricted Earth Fault Protection

These relays shall be instantaneous in operation, consistent with normal operating due to transient switching currents. Each relay shall be capable of being set to operate under service conditions with primary currents likely to occur on site by means of relay adjustment.

(d) Over-current and Earth Fault Protection

Relays shall be of the attracted armature or rotating disc type having instantaneous, inverse or very inverse definite minimum time, directional or non-directional characteristics as specified.

(e) Under Frequency Relays

The settings range shall be variable between –10% and +2% from the rated frequency. Two different settings shall be provided to give alarm and trip facilities. A low pass filter unit shall be fitted where the harmonic distortion exceed 5% of the fundamental.

(f) Under and Over-voltage Relays

Variable settings shall be provided as required together with a 0 to 5 second time delay.

(g) DC Trip Relays

Relays shall be suitable for operating with the voltage reduced to 60% of normal.

(h) Motor Thermal Relays

Relays for motor protection shall give protection against overload, stalling, current unbalance, and single phasing. The relay shall have variable current settings and overload tripping time.

(i) Voltage Asymmetry, Phase Sequence and Failure Relay

Voltage asymmetry, phase sequence and phase failure shall be self-powered and monitor sine wave form. Asymmetry adjustment shall be between 5 - 15% and tripping delay from 0.1 - 10s.

824 MOTOR STARTER – LOW VOLTAGE

Motor starters shall be of the “direct on line” (DOL) or assisted start type as specified. Where the size of motor or the power supply arrangements require the use of assisted starting, this shall be of the auto-transformer type in preference to other methods.

Unless otherwise specified, the type of motor starters shall be dependent on the rated power of the motor as indicated below:

- ☐ Below 10 kW: Direct on line
- ☐ 11 kW to 75 kW: Star delta or Soft Starter
- ☐ Above 75 kW: Autotransformer or Soft Starter

All starters shall comply with SSRN 008 and SSRN 013.

Utilization category	AC3
Co-ordination type	C
Intermittent duty class	0.3

Mechanical endurance 3 million

The starter shall have motor circuit HRC fuses of motor circuit protector type moulded case circuit breakers to protect each contactor and overload unit against short circuit conditions. The contactor shall not be used for short circuit protection.

The starter shall incorporate the following features:

- (a) Fault rated, door interlocked, fused switch or MCCB with mechanical operating handle, ON/OFF indication and padlockable OFF facility. The fused switch or MCCB with thermo/magnetic releases shall be fitted with not less than one "make" and one "break" spare auxiliary contacts in addition to those used within the starter circuitry.
- (b) Thermal overload device with inherent temperature compensation and single phasing protection, time lagging to cover the starting period, and overload setting adjustment. Operation of the device shall open the main contactor circuit and this shall be locked out until reset via a door mounted hand operated reset pushbutton.
- (c) For motors up to 30 kW direct connected thermal overload devices integral with the motor contactor with the accepted. For motors rated at over 30kW the overload devices shall be separately mounted. For motor of 100 kW and above the starters shall be equipped with motor protection relays which provided thermal imaging type overload detection, earth leakage protection, instantaneous over-current protection, and phase current unbalance protection.
- (d) Local/remote and/or manual/auto (or manual/off/auto) control selector switch as required by the application.
- (e) Triple-pole air break contactor complying with SSRN 008 and with inherent undervoltage release.
- (f) Fault reset pushbutton.
- (g) HRC cartridge fuses(s) and wiring via main contactor N/C auxiliary contacts to supply the motor anti-condensation heaters.
- (h) HRC cartridge fuses for control and indication circuit protection.
- (i) Ammeter and single CT (normally fitted to yellow phase) for 3 phase motors of 2.5 kW and above. Where power factor correction capacitors are fitted, the ammeter shall read uncorrected current.
- (j) Push buttons and pilot indicator lights (mounted in front):

Push Buttons:

(i)	Start	Green
(ii)	Stop	Red
(iii)	Emergency Stop	Red, mushroom head type
(iv)	Trip reset	Black

Pilot Lights

(i)	Phases	White
(ii)	Starting	White
(iii)	Running	Green

(iv)	Trip	Red
(v)	Dry-run	Red
(vi)	Pressure stop	Amber

Individual alarm lights shall be provided for each fault condition. They shall remain in the alarm condition until the protective device is manually reset.

* Motors 250 kW and over only

- (k) Hours run counter.
- (l) Start push button, operable in local or manual modes only.
- (m) Stop pushbutton of the latching, mushroom-headed type, coloured red and latching in the stop position. The pushbutton shall be of the twist to reset type. The stop pushbutton shall be operational in all control modes.
- (n) The starter circuitry shall also provide connections for an emergency stop pushbutton located at the plant. This shall be connected in series with the starter mounted stop button to directly break the main contactor control supply.
- (o) Power factor correction capacitors shall be supplied when necessary, to correct the power factor of the motor to a minimum of 0.95 lagging.
- (p) Where the motor rating is 100 kW or greater, the capacitors shall be separately switched. In this case the capacitors shall be fitted with discharge devices.
- (q) For motors of rating 250 kW or greater, winding temperature detector relay to SSRN 031 arranged to continuously monitor three temperature detectors.
- (r) Lamp test pushbutton
- (s) Panel anti-condensation heater, fuses and thermostat.
- (t) Control relays as required.
- (u) Flow failed protection relay.
- (v) All necessary links, wiring, terminals, terminations, and insulated barriers.
- (w) Power factor correction capacitors shall comply with BS 1650 and be suitable for operation over the temperature range 0°C/+45°C. Each capacitor bank shall be fitted with discharge resistors and striker pin fuse protection, all to be enclosed within a sheet steel housing having a terminal box with separate bolted access cover and an external earthing terminal. Means shall be provided for monitoring fuse failure visually. For HV applications, the fuse pins shall be arranged to also operate a trip bar which shall initiate a warning light on the motor starter. The power factor shall not be lower than 0.95 lagging.

825 **MOTOR STARTERS – HIGH VOLTAGE**

High voltage motor starters at 3.3, 6.6 or 11 kV shall comply with SSRN 009 and incorporate features specified under LV motor starters except as modified below.

Contactors shall be operated by 110 v DC (full-wave rectified AC) derived from a transformer-rectifier in each starter. Contactors shall be vacuum or air as specified.

Operation of vacuum contactors shall be such that current is broken at, or very near to zero current to minimise current chopping.

Contactors shall comply with SSRN 062 and shall have utilization category AC-3 and duty of Class 0.03 unless otherwise specified. Each starter shall have low voltage and high voltage apparatus segregated with access to the low voltage control compartment by a separate door.

All HV starters shall be equipped with motor protection relays which provide thermal imaging type overload detection, earth leakage protection, instantaneous overcurrent protection, and phase current unbalance protection.

826 HIGH VOLTAGE CIRCUIT BREAKERS

Circuit breakers shall be vacuum or SF6 type as specified. The equipment shall comply with SSRN 004 as appropriate and be fully rated for the ambient conditions specified.

Circuit breakers shall be capable of clearing any fault condition which may occur on the system without damage to equipment or personnel.

Circuit breakers of the same pattern and rating shall be interchangeable.

Vacuum circuit breakers shall comprise separate vacuum interrupters designed to prevent welding of contacts and sharp current chopping during fault interruption or switching or motor loads.

- independent manual spring
- hand charged spring with electrical or manual release
- motor charged spring with electrical release
- DC solenoid

All operating mechanisms shall have mechanical 'ON' and 'OFF' indicators and a manual trip device fitted with means for locking. Hand charged and motor charged spring mechanisms shall have mechanical indicators to show 'SPRINGS CHARGED' and 'SPRINGS DISCHARGED'.

The operating mechanisms of hand charged and motor charged spring types shall be arranged so that release of the springs to close the circuit breaker can only be achieved by a deliberate action. It shall not be possible for vibration or mechanical shocks to release the charged springs. Motor charged spring mechanisms shall be arranged so that charging is initiated automatically following a discharge. The necessary limit stops and switches for the automatic control of the charging shall form an integral part of the mechanism. The facility shall be provided to hand charge a motor charged spring mechanism.

Spring operated mechanisms shall be provided with volt-free contacts to give indication that the springs are charged.

Solenoid closing mechanisms shall be suitable for operation down to 80% of the nominal control voltage. They shall not mal-operate or cause excessive vibration when energised either from the voltage of the closing battery with the charging rate set at maximum, or from the voltage of a full wave rectified source designed for multiple simultaneous operation. Unless otherwise specified, this higher voltage shall be not less than 120% of the nominal control voltage.

To facilitate maintenance and the adjustment of contacts, it shall be possible to 'slow-close' the circuit breaker but this operation shall only be possible in the fully withdrawn position. Any operating handle or lever necessary shall be supplied.

All circuit breakers shall be provided with interlocks to ensure that:

- (a) the circuit breaker cannot be racked into or out of the service or earth position whilst it is closed. Attempts to rack out a closed circuit breaker shall not cause it to trip.
- (b) the circuit breaker can only be closed when fully engaged in the service, earth, or fully isolated positions
- (c) the circuit breaker cannot be closed in the service position without completing the auxiliary circuits between the fixed and moving portions.
- (d) The circuit breaker cannot be 'slow-closed' except in the fully isolated position.
- (e) with hand charged or motor charged spring mechanisms, the springs cannot be discharged until they have been fully charged or until the means for charging has been fully removed and disconnected.
- (f) when the circuit breaker is closed in the earth position, tripping can be effected only by the manual device in the operating mechanism.

Where mechanical key interlocking is employed, tripping of a closed circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism.

Circuit and/or busbar earthing shall be by the transfer circuit-breaker method without the requirements of any loose attachments. The earthing operation shall be completed by the closing of the circuit breaker by its normal operating means using local control. Selection of either circuit or busbar earthing shall be possible only after the circuit breaker has been fully isolated. Mechanical key interlocks shall remain operative when the circuit breaker is in either earthing position.

Facilities shall be provided on all incoming and feeder circuit breakers for earthing the circuit side. On at least one circuit breaker panel in any section of busbars, facilities shall be provided for busbar earthing.

A set of safety shutters shall be provided to cover each three phase group of stationary isolating contacts. The shutters shall be opened automatically by a positive drive from the circuit breaker moving portion and when closed shall prevent access to the stationary isolating contacts. When the circuit breaker is withdrawn each set shall be capable of being individually operated and of being padlocked in the closed position.

To facilitate high voltage and current injection testing via the isolating contacts, a device shall be provided for fixing (not locking) the shutters in the open position and for releasing them into the closed position. The device shall be arranged to be cancelled by the moving portion to ensure the restoration of the automatic feature of the shutters.

Busbar shutter shall be coloured red, and labelled 'BUSBARS' in large white letters. Circuit shutters shall be coloured yellow.

Shutters in bus-section units shall be coloured red and shall be labelled with a large white arrow pointing in the direction of the section of busbars to which the contacts are connected.

Circuit breaker moving portions shall be fitted with positive guides to ensure correct alignment of the isolating contacts in both the service and the earth positions.

LOW VOLTAGE CIRCUIT BREAKERS

All 400 V circuit breakers for incoming circuits, and bus section circuits on 400 V switchboards and interconnector circuits shall be of the air break metal clad type complying with the requirements of SSRN 020 and SSRN 040.

Circuit breakers shall switch three phase poles. The neutral pole shall either be switched or established through a bolted link. Access to the link shall not be possible when the equipment is in the "Service Position".

Provision shall be made for easy access to the circuit breaker contacts for maintenance purposes.

Arc chutes shall be so arranged that the emission of hot glasses shall not damage any part of the equipment.

828 FUSED-SWITCHES AND DISCONNECTOR COMBINATION DEVICES

(a) General

Fused switch disconnectors, switch-disconnectors and disconnectors, shall be rated at 500 V and shall be to the standards in SSRN 007.

Fuse switch disconnectors shall be of the air break triple pole or single pole and neutral type. They shall have not more than one fuse in any one pole. The neutral shall be either switched or taken through a removable link. If a switched neutral is required, the neutral shall be arranged to make first and break. A separate brass earth terminal shall be provided.

Operating mechanisms shall be of the independent spring type and fitted with mechanical ON and OFF indicators. Operating handles shall be of semi-flush or telescopic pattern to reduce front projection to a minimum.

Disconnectors shall be identical for fuse-switches but the fuse links shall be replaced by hard drawn high conductivity copper links.

Facilities for locking the operating handles by padlock shall be provided.

All switch-disconnectors shall be rated to make the full short circuit current of the system. Units used on distribution circuits shall be rated to break full load current and units used in motor starters shall be rated to break stalled motor current.

(b) Fuse and Links

Fuses shall comply with SSRN 058 (LV) or SSRN 060 (HV) as appropriate.

Fuses and links shall be provided to enable any circuit to be isolated as necessary for maintenance and test purposes without isolating the whole panel. All fuses shall be of the cartridge type. Fuse carriers and solid link carriers and bases shall be made of plastic moulded insulating materials; ceramic materials will not be accepted. Accessible live connections shall be effectively shrouded and it shall be possible to change fuses and remove links with the circuit alive without danger of contact with live metal. The fuses shall be rated to give maximum protection to the apparatus in circuit and the rating shall be inscribed on the fuse label.

Earthing and neutral links in main supply circuits shall be solid copper and bolted pattern.

Fuses and links functionally associated with the same circuit shall be mounted side by side.

829 MOULDED CASE CIRCUIT BREAKERS

Moulded case circuit breakers (MCCBs) shall be manufactured to SSRN 040.

MCCBs shall have thermal overload and adjustable magnetic short circuit tripping devices with a trip-free mechanism to ensure that the contacts cannot be held closed against a fault. Contacts shall be silver tungsten tipped and shall operate with a wiping, arc resisting material and incorporate arc chutes based on the de-ionising principle.

MCCBs shall have a factory calibrated and sealed trip unit, interchangeable with similar units for varying the rating of the circuit breaker.

Where dust and damp proof enclosures are to be used, then the circuit breakers shall be fully enclosed in a case with a gasketed door. Circuit breakers mounted in a composite control panel shall be segregated from other equipment and have a matching purpose-

made cover plate. Where possible, circuit breakers shall be mounted vertically and be arranged so that one breaker can be removed without interfering with other circuit breakers. The switch dolly and protruding face shall be engraved with the circuit rating and the ON and OFF positions.

Tripping due to overload or short-circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual ON and OFF positions. To reset from the 'tripped' position, the dolly shall first pass through the OFF position. All phase poles shall operate simultaneously.

MCCB's used for short circuit protection (only) in motor starters shall provide instantaneous short circuit protection by means of an adjustable magnetic element on each pole. The adjustment knob(s) shall have the end and mid-setting points marked and adjustment shall follow a linear scale so that each point has a significant value with calibration tolerances. MCCB's shall not be used to provide thermal protection or switching of motors.

MCCB's shall be ambient temperature compensated. Compensation shall allow the breaker to carry rated current between 25°C and 50°C with tripping characteristics that are approximately the same throughout this temperature range.

830 MINIATURE CIRCUIT BREAKERS

Miniature circuit breakers (MCBs) shall be manufactured and tested to SSRN 052 .

MCBs shall have a short circuit rating of at least M4 and shall be Type 2 unless otherwise specified.

The fault capacity of the MCB shall be not less than that of the switchboard. If this is not the case, back up HRC fuses shall be fitted.

831 EARTH LEAKAGE CIRCUIT BREAKERS

Earth leakage circuit breakers (ELCBs) shall be of the current operated type complete with current balance transformer, test push button, trip coil and thermal overloads. They shall be double pole for single phase and four pole for three phases and neutral circuits. ELCBs shall comply with the requirements of SSRN 006.

The out of balance current shall not exceed 30 mA for circuit breakers up to 60 amp rating and 500 mA for above this rating.

Current operated ELCBs shall not be used where the product of the operating current and the earth loop impedance exceeds 40.

832 POWER FACTOR CORRECTION EQUIPMENT

General

This specification covers the supply, delivery, installation, testing and commissioning of power factor correction equipment which shall be fully automatic and shall include all the cabling, control and indication.

All the equipment and workmanship shall be in strict accordance with the latest requirements of the relevant standards.

All equipment shall be installed indoors and shall be suitable for either wall or floor mounting as specified. Equipment shall be suitable for working under temperature and humidity conditions as stated.

All the equipment shall be suitable for working at the declared voltage. All the switches, contactors, fuses and breakers supplied shall have the necessary rating to ensure safe and efficient working at all times.

Main Requirements

Capacitor banks supplying the reactive load as specified;

A rack or frame in which the capacitors shall be mounted, suitable for wall or floor mounting;

Power factor correction panel/s as specified.

All the necessary internal interconnecting wiring for the complete operation of all the equipment.

Operating instructions and parts lists for all the equipment supplied.

The current ratios, rating and characteristics of the current transformers needed for the operation of the relay/s and power factor meter. The current transformers shall comply with SSRN 002.

Wiring diagrams of the system.

A connection diagram of the equipment

Drawings or clear sketches showing the dimensions of the panel/s and the rack or frame holding the capacitors.

Clear markings in the form of plastic ferrules on all terminals.

Commissioning and testing the equipment after installation by the Electrical Contractor.

An alarm bell and/or light as specified to warn of any failure of the PF correction equipment.

A set of spare fuses for each fuse bank in the equipment.

Construction of PF Correction Panel(s)

The power factor correction panel/s shall consist of a galvanised angle or channel iron chassis covered with minimum 1,6 galvanised sheet metal panels, and shall be vermin and dust-proof.

The equipment shall be mounted on an angle iron frame work within the panels to give a flush front panel.

The front and back panels shall be removable for access to wiring and equipments, shall be held in position by chromium plated captive coin slot screws and shall be well ventilated.

Capacitor banks and power factor correction panels shall be designed to permit extensions as specified. Equipment shall be rated to handle the extra load supplied by these extensions.

Equipment in the PF Correction Panels

- ☐ The following equipment shall be fitted on the power factor correction panel (s):
- ☐ An isolator switch as specified in the technical schedule
- ☐ A selector switch for selecting manual/off/automatic operation

- ☐ Multi-stage relay/s as specified in the technical schedule.
- ☐ Contactors as specified in the technical schedule.
- ☐ Pilot lights for each step.
- ☐ High rupturing capacity fuses as specified in the technical schedule.

Busbars and interconnecting cabling.

Cables to PF Correction Panel

The main cables feeding the power factor correction equipment shall be of the size as indicated on the drawings. All cables feeding capacitors shall have a current carrying capacity of 1.43 times the normal current required by those capacitors.

Capacitor Banks

The capacitors which shall comply with SSRN 093 shall be capable of automatically healing burn-outs caused by over-voltage or ageing.

Protection against thermal overload and internal over voltage shall be provided. This protection device shall be insensitive to harmonics and incorporate a time-delay attachment to prevent unnecessary operation due to transient closing over-currents.

Each bank of capacitors shall be connected through a set of high rupturing capacity fuses. The rating of these fuses shall be 1.8 times the normal current drawn by the capacitors.

The capacitors shall not contain any Polychlorinated Bipheyls (PCB's).

Relay for Capacitor Banks

The relay shall sense reactive power and shall be of the multi-stage type with the number of stages as indicated.

Method of Switching Capacitor Banks

Unless otherwise required the capacitors shall be connected to the circuit in progressive increments in approximately equal steps.

Discharge Devices for Capacitors

Capacitors shall be fitted with discharge devices of such a nature that the capacitors will be discharged in the time between switching operations to such a level that the rating of the protective devices will never be exceeded when the capacitors are connected to the circuit.

If discharge devices other than high ohmic resistors are used, the discharge device shall be disconnected when the capacitors are switched into the circuit.

Protection Devices for Capacitor Banks

The protection equipment on the distribution board to which the power factor correction equipment is connected, shall be as follows:-

- ☐ of such a make and type that uniformity of the board is maintained.
- ☐ have the necessary rupturing capacity to safely break the maximum fault current that could exist at that point of the circuit,
- ☐ be of a fault current limiting type that will limit the fault current to such a level that the fault level capacity of the other protection devices on the board will not be exceeded under any fault condition,
- ☐ have the necessary rating to carry at least 1.43 times the current required by the power factor correction equipment under normal conditions.

Isolator Switch for Capacitor Banks

The isolator switch shall be of the triple pole, hand operated panel mounting air break type, unless otherwise stated, having a continuous current rating high enough to carry 1.43 times the current that might be required by the power factor correction equipment under normal conditions. It shall be suitable for operation at the specified voltage. The contacts shall be of silver alloy and the switch mechanism shall be of the quick make- break type. The switch is required to open and close a circuit carrying a current up to the full current rating of the switch, and shall be fitted with arc chutes.

The switch shall be housed in a moulded plastic case suitable for back panel mounting.

Contactors for Capacitor Banks

The contactors shall be of the open or totally enclosed triple pole, air break, magnetically operated type, suitable for working at the indicated voltage.

The contactors shall be fitted with silver or silver alloy contacts, and shall be fully in accordance with SSRN 062.

The current ratings of the contactors shall be such that they can connect and disconnect 1.43 times the load current supplied by the capacitor banks and shall be valid for duty classification AC4 defined in IEC 158-1. Contactors shall operate without vibration.

833 CONNECTIONS TO MOTORS**General**

The Electrical Contractor shall:-

- a) Supply angle iron framework and channels as required.
- b) Erect starters on angle iron framework at motors, on walls, motor control centres or floor channels as indicated on the drawings.
- c) Provide wiring from the main LV switchboard to all sub-distribution boards, motor control centres, switches, socket outlets, junction boxes, motor starters and actuating devices.
- d) Ascertain exact locations of motor starters, motor control centres and control devices prior to installing and wiring up.
- e) Provide all control and interlock-field wiring.
- f) Provide isolators, lockout pushbuttons, etc as noted.
- g) All the equipment shall be suitable for working at the rated voltage.

Installation: Connection to Motors

The Electrical Contractor shall supply and install PVC insulated conductors in heavy gauge conduit or PVC, SWA & PVC, XLPE and Tough Rubber Sheath cables as specified on perforated cable trays, with claw type cleats, in ducts and trenches, or MIMS cable as specified.

Final connections to motors shall be made as follows:-

- a) Flexible conduit soldered or brazed into brass glands shall be used with an earth wire run through the conduit between the distribution board and the motor terminal box. Where motors are exposed to the weather or are mounted in moist environments e.g. sump pumps, the flexible conduit shall be of weatherproof quality and PVC taped overall, including the glands.

- b) Mineral insulated copper sheathed, PVC or aluminium sheathed cable installations shall terminate at the entry to the terminal box with a loop of cable, to enable the motor to be removed without damage to the cable, and also to eliminate cable fractures resulting from motor vibration.
- c) Where terminal box entries are restricted the conduit may be terminated with a conduit box and the final connection to the motor made by using flexible cable. In these cases one extra core shall be provided in the flexible cable for earthing purposes.
- d) All motors more than two metres from a distribution board shall be fitted with an isolating switch of the correctly rated capacity, adjacent to the motor, supplied and installed by the Electrical Contractor. When this is exposed to the weather the isolator shall be weatherproof. In the case of interlocked systems i.e. air conditioning, the isolator shall be lockable to prevent unauthorised switching.
- e) Earth wires shall be run in conduit feeding motors, and control gear.

Motor Disconnecting Devices

Motor disconnecting devices shall be installed at motor locations where indicated and as required by the "standard regulations". Devices shall not be grouped at central location, except as indicated.

Disconnecting devices shall be provided either by means of a lock-out push button to interrupt the motor control circuit or by means of an isolating switch of ampere rating as noted on the drawings.

The Electrical Contractor shall allow sufficient clearance for removal of the motor(s)

Earthing: Connection to Motors

All non-current carrying metal parts of the equipment shall be effectively earthed.

Tests: Connection to Motors

All the power factor correction equipment shall be set correctly by the Electrical Contractor to the approval of the Engineer before any circuit is energised and tests carried out. The Electrical Contractor shall provide all the material and instruments required for testing and bear all the expenses incurred.

Local Control Stations

Local control stations or motor control centres (MCC) shall be of heavy duty construction and where appropriate, constructed in accordance with safety and general construction equipment with the Clause entitled 'Switchboard Cubicle and Enclosure Construction'. Local control stations shall be mounted directly onto the plant to be controlled, or be provided with a floor mounting tubular pedestal with provisions to accommodate the incoming cables.

Small covers shall be secured by screws or bolts and be totally removable. In larger sizes and where instruments are to be fitted, the covers shall be provided with heavy duty hinges.

The bottom face shall be arranged to accept, with adequate space for the use of spanners, gland terminations for the number of cables required.

Terminals shall be provided for interconnections arranged vertically at the side for easy access, and marked with identification numbers/letters corresponding with the associated diagrams.

Pendant type local control stations for cranes, hoists, etc. shall be of moulded neoprene or equivalent heavy, flexible, high impact strength materials. The materials shall be

connected by a long moulded-in cable strengthening sleeve, to minimise the possibility of cable fracture at the bending point. The enclosure shall be self coloured in safety yellow.

834 **MARSHALLING BOXES**

Marshalling boxes shall be constructed of sheet steel with ample space for routing and terminating cables and cores.

Enclosure protection shall be the same as that for switchboards.

Outdoor	IP65
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Indoor	IP54
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Every marshalling box shall be provided with the following:

- undrilled gland plate arranged for bottom entry

- anti-condensation heater with thermostat and fuse

- padlocking facility and padlock

- earthing bar with terminal holes

- door-switch operated internal light with fuse

- labels for front door, fuses, terminal blocks, and terminals

- transparent plastic covers on terminal blocks operating at greater than 24 V

835 **POWER TRANSFORMERS**

(a) **General**

Power transformers 25 kVA and above shall be of the outdoor, oil immersed, naturally cooled typed, classified ONAN. They shall be manufactured and tested to SSRN 051.

Transformers shall be sized for continuous operation at the maximum rating at the ambient conditions specified. Unless otherwise specified the rating shall allow for unshaded conditions.

The transformer load factor shall be taken as 80% for normal operation.

The core construction shall be built up of on-aging, low loss and high permeability, cold rolled, grain oriented silicon steel. Lifting eyes or lugs shall be provided for removal of the core assembly.

The cores shall be earthed at one point only with a readily accessible removable connection which may be conveniently opened to check the core insulation.

The windings shall be double wound connection Dy 11.

Transformers shall be supplied complete with oil level indicator with drain cock, sample cock, oil change valves, jacking pads, pulling lugs, Buchholz relay, thermometer pocket with thermometer, and earthing terminal.

Transformers rated above 150 kVA shall be fitted with separate oil and winding temperature gauges.

Transformers rated above 250 kVA shall be provided with offload tap changers manually operated by a lockable wheel or handle. The tapplings shall be provided on the HV windings at $\pm 2\frac{1}{2}\%$ and 5% of the no load primary voltage.

Cable boxes with wiping or screwed glands shall be provided for the cables specified. A non-magnetic gland plate shall be fitted for single core cables and insulated glands

provided for 400 sq mm cables and above. It shall be possible to remove the cable boxes without breaking the cable seal or draining the oil. Disconnecting link boxes shall be fitted on the high and low voltage sides of the transformer for cable pressure testing.

A summary of the required transformer specifications is provided below:

Number of phases	3
Voltage Variation	+/- 2.5%
Frequency Variation	+/- 2.5%
Frequency (Hz)	50
Primary Voltage (kV)	33/11 – as specified (on load) - Delta
Secondary Voltage (kV)	0.400/3.3/6.6 as specified (on load) – Star
Capacity (kVA)	(As specified)
Tapping range of nominal voltage (%)	+3x1.66%(Total 5%) - 5x1.66% (Total 5%)
Tap Changeover Type	Off load
Impedance Voltage (approx)	4.7% at nominal tap position
Vector Group	Dyn11
Insulation Class	36
Cooling Type	ONAN
Max. Winding Temperature (°C)	65
Max. Oil Temperature (°C)	60
Max. noise level (dB)	55

(b) Insulator and Bushings

Porcelain insulators and bushings shall comply with the requirements of SSRN 053 and SSRN 072 as appropriate.

Porcelain for insulating purposes shall comply with the relevant requirements of SSRN 072. Each porcelain insulator shall bear the manufacturer's mark and batch identification, which shall be applied before firing. The clamping surfaces of all porcelain insulators shall be accurately ground and shall be free of glaze.

(c) Insulating Oil

Insulating oil shall comply with the requirements of SSRN 054. Insulating oil shall be provided by the Contractor for all oil-filled apparatus and 10% excess shall be provided for topping up purposes in sealed drums.

If equipment is to be filled with oil at Site, the Contractor shall provide oil for filtration equipment of suitable capacity.

The Contractor shall supply a schedule of insulating oils and greases which the Contractor recommends for use with his equipment.

836 EARTHING

(a) Submissions by the Contractor

Submissions which the Contractor is required to make in relation to earthing installations shall include, where relevant, the following;

(a) Drawings

Diagrams detailing the complete earthing installation, including connections to all items of electrical plant and extraneous metalwork.

Earthing conductor route and layout giving:

Location of all test links

Location of all earth electrodes and connecting chambers

(b) Data

Manufacturers catalogues, data sheets and specifications for all fittings and materials.

(c) Calculations

Calculations for:

Earth resistance

Potential rise

Step and touch potentials

(d) Test Certificates

Certificates for tests carried out at site including:

Earth electrode resistance

Continuity of protective and equipotential bonding conductors

Earth loop impedance

(b) General

Earthing systems shall comply with SSRN 065 (a) and IEE Wiring Regulations (16th Edition) as stipulated under SSRN 065 (b).

For general earthing the KPLC terminal shall be used. The Contractor shall be responsible for obtaining and complying with KPLC earthing requirements.

The Contractor shall obtain Earthing Declaration forms where required by KPLC and shall be responsible for its completion and submission to KPLC when the installation is complete and ready for bonding to the earth terminal. A copy of this form or any other documents pertaining to earthing shall be sent to the Engineer.

In view of the hazards associated with earth leakage current, particular attention is to be directed to careful bonding and earthing of all electrical apparatus. In general the following principles which apply to all surface plant and items shall be adopted.

The metalwork of all items of electrical plant, electrical system neutral points, power and control cable armouring and screens, and extraneous metalwork, including structural steelwork, pipework, fences and gates, shall be connected to the earthing installation.

Earth continuity in non-electrical plant shall normally be achieved via metal to metal faces, pipe flanges, metal hinges, and metal fixings. Earth straps to bond pipework sections shall be supplied where earth resistance is high or there is risk of corrosion or similar which could in the future increase resistance and affect earth continuity.

Perimeter fences shall be either bonded to the earthing system. Metal gates shall be bonded to the fence using flexible connections.

(c) Installation

The earthing installation shall comprise an earth terminal, earth busbars, circuit earthing conductors, equipotential bonding conductors, main earthing conductor and earth electrodes. The circuit earthing and equipotential bonding conductors shall be of the radial, grid or ring form as dictated by the plant layout.

The earthing installation shall be protected from mechanical damage and corrosion.

Joints in tape conductors shall be riveted and soldered, brazed, clamped, bolted or exothermically welded. Non-corrosive flux shall be used for soldered joints. Clamped and bolted type joints shall be tinned and shall only be used above ground.

The interconnection of conductors below ground shall be by means of exothermic welding or brazing. Compression type lugs shall be provided for the termination of cables.

Earthing conductors shall be buried directly in the ground or secured to building structures, cable racks and trays using proprietary fixings.

Where the soil is aggressive to copper, buried earthing conductors and joints shall be protected by an approved serving.

An equipotential bond shall be provided to all buried metal pipework at the point of entry into a building or chamber where electrical apparatus is installed. Electrical continuity across all pipe joints within the structure shall be ensured. Normally the connection of the pipe flanges will suffice, but where pipework incorporates a compression coupling (e.g. Viking-Johnson coupling), a bond shall be provided to any otherwise isolated section.

Cable armouring and screens shall be bonded to earth at both ends unless otherwise specified. Cable armour shall not be used as the sole earth protective conductor.

(d) Substation Earthing

Two 240 mm x 16 mm earth electrodes shall be driven in to the ground in the immediate vicinity of the substation at least 3m apart with their tops below ground level (and accessible via an earth manhole). The electrodes shall be interconnected with a 70 mm² bare copper conductor buried 600mm below ground level. A 70mm² earth conductor shall be taken from each of the two electrodes, one to the transformer neutral terminal and the other to the main earthing bar in the transformer room.

The earthing point in the transformer room shall be connected to the substation main earth bar (50 x 6 mm) by a minimum of 2 x 70 mm² insulated copper conductors. Details of the main earth bar are provided under (F) below. All earth wires shall be secured to the earth bar by means of M10 brass bolts. Locknuts shall be provided for all the terminals. The point of origin of each earth conductor must be clearly indicated by means of a metal strip tag attached to the conductor in such a way that the conductors can be easily identified.

The HV switchboard, transformer earthing terminal and cable supports shall be bonded to the main earth bar by means of 70 mm² earth conductors. The neutral busbar and the earth bar in the main LV switchboard shall be bonded to the main earth bar with an earth conductor having a cross-sectional area of not less than half the size of the phase conductor between the transformer and the main LV switchboard. A bolted test link shall be provided between the bar and the connection to the earth mat or rods.

(e) Ring Main Earth System

A 70 mm² bare stranded copper conductor is to be run as a ring main system throughout the plant and must be connected to all substation earth bars and distribution pillar earth bars.

Individual items of apparatus are to be bonded to this ring by bare copper conductors as detailed below:

For any apparatus, by a bare stranded conductor having a conductor cross-sectional area of not less than half of the phase conductor except that:

it need not exceed 70 mm²;

it shall not be less than 2.5 mm² except for circuits with phase conductors below 2.5 mm² in which case, it shall be the size of the phase conductor;

the earth conductor shall be run as a separate cable or wire for the feeder cables;

for conduit installations, a separate PVC insulated earth conductor shall be run together with the phase conductors as sized above.

(f) Conductors: General

Circuit and main earthing and equipotential bonding conductors shall be high conductivity copper tape or 1000 V grade PVC insulated multi-stranded cable. PVC cable insulation shall be stripped green/yellow. Cable lengths shall be continuous and intermediate jointing is not permitted.

The main bonding conductor shall be not less than 16 mm² and supplementary bonding of non-electrical plant not less than 10 mm². All connections shall be made using compression type cable lugs, taped on completion to completely seal the lug and any bare copper from the atmosphere. Soldered lugs are not permitted. Earth conductor terminations and connections shall be as follows:

Copper Tape: rivetted and brazed, or thermite type weld;

Stranded Conductor: crimped lugs bolted to the equipment or earth bar;

Connections between Stranded Conductors: brazed, thermite type weld or crimped.

The surface to which earthing bonds are fixed shall be cleaned free from paint and other non-conducting material and coated with petroleum jelly.

(g) Conductors: System with Neutral Earthed Solidly

For systems where the neutral is solidly bonded to earth on the secondary side of the transformer as distinct from those earthed through an earthing transformer or resistor, where the earth fault current is limited, the fault level must be taken in to account when making the following connections:

System neutral to main earth bar: conductor to be insulated;

Transformer frame to main earth bar;

Main switchboard frame to main earth bar.

(h) Earthing of Cable Armouring

All cables provided with metal sheaths, screens and /or armour shall be terminated in approved glands.

Unless otherwise specified, the gland shall form a good electrical connection with the gland plate. The electrical continuity shall be assured if required by additional connections.

(i) Earth Electrodes

Earth electrodes where used shall be solid copper or copper clad high tensile steel rods with a copper plate thickness of not less than 0.25 mm. The outer diameter shall be not less than 16 mm. The rod shall penetrate a minimum of one metre below ground level. Where multiple rods are used they shall be separated by a distance of not less than the driven length.

Earth rods shall have hardened tips and caps and be extendable.

Where soil conditions make the use of rod type electrodes impracticable a grid configuration may be used comprising horizontally buried bare high conductivity copper tape of dimensions 15 mm x 4 mm minimum. Tape shall be buried at a minimum depth of 600 mm.

Each earth rod shall be provided with a clamp fabricated from non-ferrous metal for the connection of the earthing conductor. The connection shall be made in a concrete inspection chamber set flush with the finished ground level. The inspection chamber shall be permanently marked "ELECTRICAL EARTH".

Marker posts and plates shall be provided to mark the position of the electrodes and buried connections. The markers shall be similar to those provided for cable routes.

(j) Earth Resistance Measurements

The Electrical Contractor shall carry out earth resistance measurements on completion of the installation of the earthing system and the results shall be submitted to the Engineer

Should the earth resistance exceed the value given by the formula:-

$$\begin{aligned} Z &= A/B; \text{ where:-} \\ Z &= \text{Earth Impedance} \\ A &= \text{Protective Device System Phase to Neutral Voltage;} \\ B &= \text{Protective Device Maximum Rated Current} \times 2 \end{aligned}$$

the Engineer may request the Electrical Contractor to install additional earth electrodes or trench earths and/or separation of the neutral and/or installation of a earth leakage device.

Generally, the resistance to earth of each complete earthing network shall not exceed 1 ohm.

(k) Main Earth Bar

Where specified, a main earth bar shall be installed in a convenient location. This shall comprise a high conductivity copper bar of sectional area at least that of the main earthing conductor. The earth bar shall be wall mounted, supported on insulators. The earth bar shall be complete with disconnecting links for test purposes, and connection points for the outgoing and incoming earth cables and tapes.

Earth studs shall have a minimum size of M10.

(l) Earthing of Buildings

Earthing of all the electrical equipment, circuits and outlets shall be carried out in accordance with the requirements of the local supply authority and the relevant wiring regulations. All metal conduits and metal sheaths of cables shall be bonded to the metalwork of their termination gear. Each building shall have an associated terminal to which all metal bodies required to be earthed shall be connected. The earth terminal shall be connected by an earthing lead to an effective earth electrode situated as near the building as practicable (TT System); to the neutral conductor (TN-C-S/PME System); or to the PEN conductor (TN-C System).

The earth lead shall not be smaller than 25 mm² of stranded copper conductor.

The resistance from the earthed end of the earthing lead to any earth continuity conductor in a building installation shall not exceed 0.2 ohm.

All metal water pipes, drain pipes, down pipes, conduit and guttering shall be securely earthed, contact surface being thoroughly cleaned. Wire used shall be stranded copper of not less than 4 mm² or 12 x 0.8 mm perforated or solid strapping. The earthing conductor shall be fixed to the pipework with brass nuts and bolts; and against walls with brass screws at 300 mm centres. In all cases where metal water pipes, downpipes, flues etc are positioned within 1.6 m of switchboards, an earth connection shall be installed between the pipework and the board. In vertical building ducts accommodating both metal water pipes and electrical cables, all the pipes shall be earthed at each distribution board.

(m) Miniature Substation Earthing

The earthing of mini-substations is similar to the earthing requirements of substations described above except that a main earth bar is not required. The earthing bar in the LV compartment shall become the main earth bar. The HV switch, transformer earth terminal and neutral busbar shall be bonded to the earthing bar in the LV compartment described for substations.

(n) Switch Rooms

The earthing of switch rooms utilising earth electrodes is similar to the earthing requirements of substations described above. A main earth bar is required to which the earthing electrodes and the HV switchboard shall be bonded by means of 70 mm² earth wires.

(o) Outdoor Equipment

In cases where substation contain transformers or switchgear installed outdoors, the fence shall be earthed as follows if no other method is specified:

- a) A 70 mm² earth wire shall be installed 400 mm below ground level and 500 mm from the fence on the outside of the substation along the entire length of the fence. This earth conductor shall be earthed at each corner by means of a 2400 x 16 mm earth electrode. Both the electrode and the earth conductor bonded to the fence. The earth conductor shall also be bonded, at least at two points, to the main earthing system.
- b) A 70 mm² earth wire shall also be buried at a depth of 400 mm around each transformer and switch and bonded to the main earthing system.

837 NEUTRAL EARTHING RESISTORS (TRANSFORMERS AND GENERATORS)

The resistors where specified shall comply with the relevant parts of SSRN 065 and shall be formed from continuous grids or strips of chrome aluminium steel or equivalent material.

The material shall have a temperature coefficient of less than 1.2% increase in resistance per 100 deg C rise over the operating temperature range, a high resilience against breakage and be free from any flaw likely to cause local overheating. The resistors shall be assembled into standard units having an inherent inductance of less than 10 degrees phase shift between current and voltage when operating on a 50 Hz supply.

Interconnections between tiers shall be of plated copper connectors bolted to stainless steel terminals.

The resistance units shall be clamped securely in tiers by mica insulated bolts so as to prevent loops or grids coming into contact due to short-circuit forces. The resistance tiers shall be mounted in a box formation between pressed steel and frames, adequate allowance being made for any thermal expansion.

Terminals shall be provided for the connection of external cables and these shall support the cables or interconnecting copperwork firmly holding them well clear of other parts. Cables shall not be run above hot resistance material.

The resistance units shall be mounted in drip proof enclosures for protective classification of IP23. All protective and supporting steelwork shall be plated with zinc.

An air break isolator and a current transformer of suitable rating shall be provided for mounting in the same enclosure with each neutral earthing resistor.

A temperature switch shall be provided within the resistor enclosure to detect uncleared earth fault or faults within the resistor.

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LIGHTNING PROTECTION

Where buildings or sections of the plant are to be protected against lightning or static charges, an earthing system shall be provided. The installations shall be carried out in accordance with SSRN 073.

The down connectors shall be of hard conductivity copper of 25 mm x 3 mm section. One down conductor within a length of 30 m shall be provided. The tape shall be fixed to the outside of the structure by means of stand off saddles. Where indicated, connections shall be made to the concrete reinforcing. The route of the tapes and the fixings shall be approved by the Engineer before installation.

Where the framework of a building is constructed of structural steel columns, these may be used in place of down conductors provided that the separation distance between them does not exceed 30 m. The upper ends of the columns shall be bonded to the roof conductors and the lower ends to the earth system.

The reinforcing steel of a building may be used as a down conductor provided it is adequately bonded to the earthing system.

The reinforcing system of prefabricated buildings shall not be used unless special provision is made for bonding the various prefabricated sections together, or to the reinforcing steel of an in situ cast section of the building.

Where specified the conductors shall be PVC insulated to prevent corrosion and to blend with the building fabric.

A test link shall be installed in each down conductor adjacent to the earth rod at a height of 1200 mm above ground level. The overall resistance of the earth termination system to earth shall not exceed 10 ohms. If this requirement is not met the number of earth electrodes shall be increased or they shall be interconnected until a value of 10 Ω is attained. After this resistance value is obtained, the lightning protection system shall be bonded to the main earthing system.

Each earth termination shall comprise a tinned copper plate of size 900 x 900 x 3 mm, one of which shall be riveted and soldered to each down conductor. Alternately, copper weld earth spikes 10 x 2400 mm may be used, or a trench earth comprising 70 mm² diameter rods.

Earth plates shall be installed at a depth of 1800 mm below finished grade and at a minimum distance of 3 m from the building. The soil shall be reinstated in 250 mm layers and thoroughly mixed with rock salt.

Care shall be taken when bonding dissimilar metal to prevent electrolytic corrosion. All bi-metallic joints shall be sealed with an inert, tenacious, waterproof compound.

Air terminals shall be of medium/hard-drawn phosphor bronze rod of 12.5 mm diameter with single or multi point heads, with suitable means for connecting to the roof (horizontal) conductors. The minimum height shall be 900 mm.

Roof or horizontal conductors shall be of soft annealed copper strip having a cross-sectional area of 20 x 3 mm and shall run as directly as possible between the air terminal and the earthing system.

839 CABLES AND WIRES

(a) General

Cables and wires shall be supplied by an approved manufacturer and where possible the same manufacturer shall be used for all cables and wires. Each drum or coil of cable shall be accompanied by a certificate stating the manufacturer's name, rating of cable, result and date of tests. Cables manufactured more than 12 months before delivery will not be accepted.

All cables shall be delivered with cable ends effectively sealed. When a cable is cut from a drum both ends shall be immediately sealed to prevent ingress of moisture. Cables shall not be transported to site in loose coils but a number of short lengths of cable may be transported on the same drum. The Contractor shall be wholly responsible for the purchase and/or hire costs of all cable drums.

Cables and wires shall be adequately rated for current carrying capacity under normal and short time fault conditions at the specified voltage.

When assessing the rating and cross section of any cable or wire, the following factors shall be taken into account:

Maximum voltage drop permissible

Type and magnitude of load

Fault level and duration related to circuit protection relays and fuses

Over-current setting of relays

Route length and disposition of cables

Ambient temperature

Method of laying

The Contractor shall submit cable schedules for approval detailing ratings, sizes, lengths, method of installation and function of all individual cables.

(b) Cable Types

Cables complying with the relevant standards stipulated in the SSRN will be accepted provided that all cables which are supplied for a specific operating voltage are to the same national standard. Each cable shall be in accordance with a standard which relates to its application.

Standards specified in the following clauses indicate the type of cables which may be used in the design. If the Contractor wishes to use cables to an alternative standard then details of current carrying capacity, derating factors, etc. shall be submitted to the Engineer for approval.

a) High Voltage Power Cables

XLPE/SWA/PVC – semi-conducting conductor screen, cross linked polyethylene insulation, stranded copper conductors, core screen of semi-conducting compound, semi-conducting tape, and metallic layer, extruded PVC bedding, galvanised steel wire

armoured, flame retardant red PVC sheathed overall, suitable for use on an earthed system of the voltage specified. Cables shall comply with the relevant requirements of SSRN 074.

b) Medium/Low Voltage Power Cables

XLPE/SWA/PVC – cross linked low density, polyethylene insulated, stranded copper conductors, extruded PVC bedding, galvanised steel wire armoured, flame retardant black PVC sheathed overall, suitable for use on an earthed system at a rated voltage of 0.6/1kV or 1.9/3.3kV as specified. Conductor temperature shall not exceed 90°C for continuous operation and 250°C for short circuit.

PVC/SWA/PVC – PVC insulated, extruded PVC bedding, galvanised steel wire armoured, flame retardant black PVC sheathed overall, stranded copper conductors suitable for operation on a system at a rated voltage of 0.6/1 kV. Conductor temperature shall not exceed 70°C for continuous operation. Cables shall comply with SSRN 024.

PVC/PVC – PVC insulated extruded PVC bedding, flame retardant PVC sheathed overall, stranded copper conductors suitable for operation on a system at a rated voltage of 0.6/1 kV. Maximum conductor temperature shall not exceed 70°C. Cables shall comply with SSRN 024.

PVC – PVC insulated single core copper conductor rated at 450/750 V. Insulation shall be phase coloured. Conductor temperature shall not exceed 70°C for continuous operation. Cables shall comply with the appropriate specifications given in SSRN 074.

c) Submersible Borehole Pump

PVC/PVC – PVC insulated, tough rubber sheathed overall, stranded copper conductors suitable for operation on a system at a rated voltage of 0.6/1kV. The cables shall be four core, 3 phase and earth without any armouring wires or screen. The cable format shall either be circular or flat.

d) Flexible Cables and Cords

General purpose – PVC insulated stranded copper conductors white PVC sheathed overall, rated at 300/500 V in accordance with SSRN 075.

e) Instrumentation and Control Cables

f) Analogue Signal Cables

Cables shall be PVC or polyethylene insulated, twisted pair laid with individual or collective screen, tape bound with extruded PVC bedding, galvanised steel wire armouring and overall PVC sheath. Conductors shall be multistrand copper, 24/0.2 mm (0.75 mm²) or as specified. Solid cores shall not be permitted. The cables shall be rated at 300/500 V and shall comply with the relevant section of SSRN 074.

Cables with a collective screen only are permitted for use where the signal is a high level carrier (e.g. 4 - 20 mA dc) and the route length is not greater than 30 m. Where the route length exceeds 30 m or the signal is low level (e.g. from a strain gauge) cables shall have both individual and collective screens.

g) Digital Signal and Control Cables

Where the signal is based on a supply not greater than 24 V DC and the maximum ON-state loop current does not exceed 20 mA, then analogue type cables shall be used. Where the voltage and/or current exceeds these limits the cables shall comply with one of the following specifications.

PVC/SWA/PVC – PVC insulated, extruded PVC bedding, galvanised steel wire armoured, flame retardant black PVC sheathed overall, stranded copper conductors suitable for

operation on a system at a rated voltage of 0.6/1 kV. Conductor temperature shall not exceed 70°C for continuous operation. Cables shall comply with SSRN 024.

PVC/PVC – PVC insulated, extruded PVC bedding, flame retardant PVC sheathed overall, stranded copper conductors suitable for operation on a system at a rated voltage of 0.6/1 kV. Conductor temperature shall not exceed 70°C for continuous operation. Cables shall comply with SSRN 041.

(c) Cable Labelling

At each end of each cable, in a uniform and visible position a label shall be fixed on the cable to indicate that site cable number and route, and the number of size of conductors. Labels shall be made of brass, aluminium, lead or copper strip, engraved and retained by suitable non-rusting or non-corroding binding wire passing through two fixing holes, one at either end of the label. If the cable gland is not normally visible, then the label shall be fixed inside the panel by means of screws.

Three phase power cable cores shall be identified A, B, C or colour coded red, yellow, blue so that the correct three phase sequence is preserved throughout the system. Single phase power cable cores shall be colour coded red, black.

On rotating plant where, to achieve the required direction of rotation it is not possible to connect the phase cores to the appropriately identified terminals, additional core ferrules shall be fitted to identify each core with the terminal to which it is finally connected.

Control cables shall have individual cores identified by means of suitable permanent ferrules bearing the same number at both ends.

Core identification shall occur at every point of termination using an approved system of ferrule markers. The size of the ferrule markers shall be such as to match the overall diameter of conductor plus insulation. Numbering shall read from the termination outwards on all cores.

Each cable and core shall bear the same number at both ends of the cable and core respectively.

Terminals shall bear permanent identification as follows:

Power terminations - colour, number of letter

Control terminations - letter or number or both

CABLE INSTALLATION**(a) General**

Non-sheathed single insulated wire shall only be installed in galvanised steel conduit or trunking.

Cables with sheaths but without any form of armouring shall only be installed in protected indoor locations such as floor ducts, conduits, or covered cables trays and ladders.

Cables with underground quality PVC sheaths and steel wire armouring may be installed in all locations including being direct buried in the ground, pulled into underground ducts or clipped direct to a surface or uncovered cable tray.

Single core cables shall not be used unless absolutely necessary (e.g. feeder cables from transformers to switchboards). Where the installation method requires armouring this shall be of the non-magnetic type formed from hard drawn aluminium strip or wire. No single core cables shall be direct buried in the ground.

Where cables are run together in the same tray, trench or conduit they shall be suitably derated or spaced to maintain current rating. Crossovers shall be avoided where possible. Large power cables (e.g. those carrying in excess of 50 A), and signal cables shall be run separately to minimise interference.

Where a number of cables are terminated in equipment, they shall finally approach the equipment from a common direction. Top and bottom entry methods shall not be mixed in the same panel.

Cables shall be complete with all saddles, cleats, hangers, brackets, trays, ladders, ties, nuts, bolts, screws, washers, packing, ducts, sand, concrete covers, marker tape and route marker posts as may be necessary to complete the installation.

Marker tape shall be placed in the ground above cables laid underground either direct buried or in ducts. The tape shall be 150 mm wide, yellow with black printing "DANGER-ELECTRIC CABLES".

All cables of less than a complete drum length shall be installed without joints except where approved by the Engineer.

Unless unavoidable, cables shall not be installed in areas of direct sunlight. Where it is necessary, sunshields constructed to the approval of the Engineer shall be supplied and installed.

(b) Submissions by the Contractor

Submissions which the Contractor is required to make in relation to the cable installation shall include, where relevant, the following:

a) Drawings and Schedules

Block diagrams to show control cabling systems with each cable and terminal equipment being identified as in the cable schedules.

Cable route and layout drawings.

For those items which are underground these drawings shall include the following:

- ☐ Route plans for all cables, cable ducts and cable trenches.
- ☐ Sectional views of all cable ducts, trenches etc. for each different section throughout the route.
- ☐ The position of all marker posts, joints, drawpits etc.

Route plans and section views for all cable trays and cable runs.

Cable schedules, which shall detail the cable number, type, voltage, size, route, length, and number of cores. Control cable schedules shall detail the connected and spare core numbers, diagram numbers of connected equipment, core ferrule and terminal reference numbers.

b) Data and Calculations

Manufactures catalogues and data sheets for all cables and fittings.

Cable sizing calculations.

c) Test Certificates

Test certificates for all witnessed and routine tests carried out at the manufacturer's works and at site.

(c) Installation Direct in the Ground

A cable buried in the ground shall be of a construction incorporating an earthed armour or metal sheath or both or be of insulated concentric construction in accordance with the relevant section of SSRN 065.

Power cables of rated voltage up to 1000 V shall be buried at a depth of 500 mm to the cable centre. Power cables of rated voltage above 1000 V up to and including 12 kV shall be buried at a depth of 800 mm to the cable centre. The depth of laying shall only be varied due to the presence of other cables or services. The laying of cables at excessive depth will not be accepted. Unless avoidable, cables shall not be routed below pipes.

The bottom of excavated trenches shall be free of sharp stones and other obstacles and shall be covered with sand or fine sifted soil compacted to a depth of 50 mm.

Cables shall be unrolled from the drums in such a manner as to avoid loops and kinks, and care shall be taken when laying or pulling into ducts to avoid damage to the outer sheath by drawing over sharp obstacles, edges, or stones. Cables pulled in either by machine or by hand shall be pulled in using rollers to prevent contact between the cable and the ground.

Cables shall be snaked into the trenches to avoid tension in the cables during backfilling or from subsequent settlement. After laying, cables shall be covered to a minimum depth of 100 mm of compacted sand or sifted soil and shall have a layer of protective concrete cable tiles laid above. The tiles shall be overlaid with marker tape.

Where cables of different voltages are laid together at the same depth, vertical cable tiles shall be used to segregate the cables.

Control, instrumentation and communication cables shall be laid not closer than 1000 mm to high voltage cables.

(d) Installation in Underground Ducts

Underground ducts shall be constructed of impact resistant uPVC and shall be laid at a minimum depth of 500 mm (to the duct centre). The duct shall be surrounded by not less than 75 mm of sieved sand on all sides. At road crossings, uPVC ducts of minimum diameter 100 mm shall be laid at a minimum depth of 1000 mm (to the duct centre). The duct shall be surrounded by not less than 150 mm of concrete on all sides.

When installing cables in ducts the following measures shall be observed;

cables shall be pulled in a straight line

rollers shall be position at the ends of the ducts both at the drawing in and drawing out points over which the cables are to be drawn

uPVC ducts and cables sheaths shall be coated with an approved lubricant

the maximum distance between draw-pits shall be the guaranteed minimum length of cable on each drum, making allowance for jointing.

adequate space shall be allowed in each draw-pit for the installation and jointing of cables

the pulling rope shall be guided by rollers

only one large scale shall be drawn into each duct

where more than one small cable is to be pulled into the duct, all cables shall be pulled simultaneously.

Whenever a duct is laid in the ground, a draw wire or man-made fibre rope shall be pulled in and at least 1,000 mm excess length shall be left at each end.

(e) Sealing Cable Entries into Buildings

Where cables pass in or out of duct entries into or within buildings, these entries together with any spare ducts shall be effectively sealed against the ingress of moisture. The sealing method shall have a fire resistance of not less than 30 minutes.

(f) Marking of Underground Cables

The location of all underground cables shall be identified by:

engraved plates fixed to the exterior surface of the walls of buildings 300 mm above ground level, directly above the point where cables pass through the wall

marker posts on road verges, etc. at intervals of not more than 100 m and at all junctions and changes of direction along the route

marker posts at 10 m intervals within an enclosed site and at all junctions and changes of direction along the route

Marker posts shall be of concrete, not less than 200 mm high and shall have an enamelled metal plate affixed giving the details of the cable the below including the depth and voltage rating. A drawing or sample of a typical marker post shall be submitted to the Engineer for approval.

(g) Installation in Cable Trunking

Cable trunking shall be manufactured from hot dipped galvanised mild steel of thickness not less than 1.25 mm. The trunking shall have two return flanges for rigidity. Where necessary, additional strengthening straps shall be fitted internally. The cover shall overlap the trunking and be made of the same gauge steel. All bends, tees and intersections shall be of the gusset type and shall, where possible, be purpose made by the manufacturer and of a matching design to the main trunking. Retaining straps shall be fitted to hold cables within the trunking when the cover is removed. Barriers formed from continuous sheet steel with the bottom edge welded to the trunking shall be installed where it is necessary to segregate cables.

The size of the trunking shall be adequate for the number of cables to be installed together with 50% spare capacity. Trunking shall have minimum dimensions of 50 mm x 50 mm.

Internal connecting sleeves shall be fitted across joints in the trunking and earth continuity ensured by bonding each section of trunking to a continuous earth wire.

Non-flammable fire barriers shall be inserted where the trunking passes through walls or floors.

Conduit connections to trunking shall be made by flanged couplers and internal brass bushes.

Trunking shall be supported at intervals not greater than 2 m horizontally or 2.5 m vertically.

Crossings over expansion joints shall be made in flexible conduit.

Whenever trunking is cut or drilled the bared sections shall immediately be given a coat of zinc rich cold galvanising paint.

Cable and trunking runs shall be determined by the Contractor and agreed by the Engineer before any work is started. A clearance of not less than 150 mm shall be maintained between the trunking and plumbing or mechanical services.

Trunking systems erected outside a building shall be weatherproof.

(h) Installation in troughs and trenches

Where the building structure incorporates purpose built covered trench systems, power distribution cables may be laid on the floor of the trench. Control and instrumentation cables shall be segregated and installed on cable trays or ladders fixed to the walls of the trench.

Where the building structure incorporates general service trenches containing pipework, chemical lines and other services, all cabling shall be segregated from other services and run on cable tray or ladder fixed to the trench walls. Crossovers shall be kept to a minimum and cabling shall be taking above wet service pipework.

(i) Cable tray and ladder

Cable tray and ladder shall be of hot dip galvanised perforated steel of thickness not less than 1 mm for trays up to 100 mm width, not less than 1.25 mm for trays from 100 mm to 150 mm width, and not less than 1.5 mm for trays from 150mm to 300mm width. Cable tray and supports shall be manufactured in accordance with the relevant requirement of SSRN 076.

Cable tray and ladder supports shall be of ample strength to maintain rigid support to the fully laden cable tray along its entire length. All brackets and traywork shall be suitable for withstanding the normal weight of the cables fixed to it together with a temporary weight of 125 kg.

Wherever possible, cable tray shall be installed in full lengths without cutting. Where tray is cut or drilled the bared sections shall be dressed and immediately be given a coat of zinc rich cold galvanising paint. Similarly for PVC coated trays, the bared sections shall be immediately sprayed using a PVC aerosol.

(j) Installation in buildings

Cables to be run on walls, ceilings, or other structures shall be supported on tray or ladder racks, or enclosed in conduit or trunking.

All cables shall be neatly run vertically or horizontally parallel to adjacent walls, beams or other structural members.

Cable hangers, cleats, saddles, brackets and similar supporting devices shall be of an approved type and of adequate strength for the cables they are supporting. They shall be treated to withstand site conditions without corroding. Self locking plastic buckle clips and strapping shall not be used.

Hangers shall be spaced according to recommendations in the IEE Wiring Regulations. Allowance shall be made for expansion and contraction of the cables.

(k) Cable installation in conduit

a) General

Conduits shall be either galvanised heavy gauge steel screwed type or light-gauge steel non-screwed type, steel or PVC. Accessories shall either be malleable cast iron or pressed steel.

Conduits and fittings shall comply with the appropriate standards stipulated in SSRN 076 as appropriate.

A space factor of 40% shall not be exceeded, and in any case conduit of less than 20 mm diameter will not be permitted. The tubing is to be perfectly smooth inside and out and free from imperfections. Both ends of every length of tubing shall be reamed with all sharp edges removed before erection.

Where conduits converge, adaptor boxes shall be used. Conduits shall be connected by means of male brass bushes and couplings. Where conduits are greater than 25 mm, straight through joint boxes shall be of the trough type.

Where conduit or fittings are attached to equipment casings, the material of the casing shall be tapped for a depth of not less than 10 mm or male bushes and flanged couplings may be used.

Hexagonal lock nuts shall be used at running joints and shall seat firmly and evenly onto mating faces. Lock nuts shall not be used at non-running joints.

All junction boxes, draw-in boxes, and inspection fittings shall be placed so that the cables can be inspected, withdrawn and re-wired during the life of the installation.

Generally not more than two bends or offsets or one coupling will be permitted without a suitable inspection accessory. Fish wires shall not be left in conduits during erection. The whole of the installation shall be arranged for a loop-in type of system with joints being carried out at switches, isolators or appliance fittings.

Ends of conduits which are liable to be left open for any length of time during building operations shall be plugged to prevent the ingress of dirt and covers shall be fitted on all boxes.

Generally, conduits shall not cross expansion joints of buildings. Where they cannot be installed in any other manner, a galvanised flexible conduit shall be used across the expansion joint. A total of 150 mm movement shall be allowed.

In all spare (empty) unwired conduits and conduits for the services of others, such as telephones, aerial systems etc., the electrical contractor shall install suitable rust proof draw wires and leave ready for use by others. Empty conduit boxes, telephone boxes, etc. are to be provided with blank plates.

b) Surface installation

Surface conduits shall be secured and fixed by means of distance spacing saddles or clips which allow the conduits to be taken directly into accessories without sets or bends. Conduits shall be run in a square and symmetrical manner. Runs shall be properly ventilated and allow for drainage of condensation. All surface conduit runs shall be marked out for approval by the Engineer before the installation is carried out. Where large multiple parallel conduit runs occur, galvanised trunking may be used instead.

Conduits installed on structural steelwork shall be secured by girder clips, drilled and tapped to the metalwork. Power driven fixings shall be used only with the approval of the Engineer. Any drilling or access which is required through any structural member of the building shall be agreed with the Engineer before carrying out the work.

Exposed threads and plates where galvanising has been damaged shall be cleaned and then painted with two coats of an approved metallic zinc based paint. This treatment shall be applied as the work proceeds.

c) Concealed installation

Concealed conduits shall be securely fixed to prevent movement before laying of screed, floating of plaster, casting of columns or other building operations necessary after the conduit installation. Crampets or similar fixings shall be used for attaching the conduit to blockwork, etc. Building nails will not be accepted.

At least 15 mm shall be allowed for finishes over the conduit. Where this cover cannot be maintained then expanded metal shall be fitted over the conduit. Conduit cast into reinforced concrete floors shall be fixed to the steel reinforcing. Concrete shall be prevented from entering conduit boxes when being poured. Where possible, the conduit boxes shall be fixed to shuttering to give a flush finish.

Conduit installed in voids, false ceilings, and other concealed routes shall be installed as specified for surface conduits. Draw-in wires shall not be pulled into the conduits during erection. Wiring shall be carried out after the false ceiling or permanent ducts have been completed. Conduit installed in floors shall be sealed against ingress of moisture.

The conduit installation shall be inspected by the Engineer before the building operation conceals the work.

d) Flexible conduits

Flexible conduit shall be of the waterproof galvanised type of PVC wire-wound type with cadmium plated mild steel couplings. Lengths of flexible conduit shall be sufficient to permit withdrawal, adjustment or movement of the equipment to which it is attached and shall have a minimum length of 300 mm. Flexible conduit shall not be used as a means of providing earth continuity. A single earth conductor of adequate size shall be installed external to the conduit complete with earth terminations.

Where conversion from rigid conduit to flexible metallic conduit is to be made, the rigid conduit shall terminate in a trough type box. The flexible conduit shall extend from this box to the equipment, the earth continuity cable shall be secured to the box and to the piece of equipment. The use of lid facing screws, etc. will not be permitted. Adaptors shall incorporate a grub screw or a gland to prevent the flexible conduit becoming loose.

e) PVC conduit

Where galvanised conduit is liable to corrosion, PVC conduit shall be installed.

PVC conduit shall be of the oval or round high impact non-flame propagating type as specified and self extinguishing, to SSRN 082. Surface and concealed installations shall be generally as described for steel conduit.

PVC conduit fittings shall comply with SSRN 081. They shall all be white unless specified otherwise.

Jointing shall be carried out using a PVC solvent and socketed accessories. Expansion couplers shall be fitted in straight surface rings every 12 m. The free end shall be sealed with non-setting mastic to form a waterproof seal.

Purpose made bends may be used providing that the cable bending radius is maintained. Cracked or crinkled conduit will be rejected.

The conduit shall be suitable for use in ambient temperatures of between -5°C and 60°C and shall not be installed in areas that receive direct sunlight. A separate protective conductor (earth continuity conductor) shall be installed.

Adaptable boxes and accessories shall be made from heat resistant insulating material. The minimum wall thickness of boxes having a nominal internal depth of 16 mm or less

shall be 1.5 mm. For deeper boxes the minimum wall thickness shall be 1.5 mm. For deeper boxes the minimum wall thickness shall be 2 mm. All boxes which are intended to support luminaries or other heat sources shall have either external fixing lugs rivetted to the metal fixing inserts or utilise steel insert clips.

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CABLE TERMINATIONS AND JOINTS

(a) Power cable terminations

Power cables shall be terminated in suitable boxes arranged for bolting to switchgear, motor starters and motors. Each cable entry into a terminal box shall be made through a suitable gland.

Boxes shall be of adequate proportions to accommodate all cable fittings including stress cones or other means of insulation grading. Boxes shall be openable for inspection without disturbing the gland plate, cable or termination.

Where air insulated terminations are used, the cable crutch shall be protected by a heat-shrink trifurcating sleeve.

Cores shall have either crimped lugs or sleeves to match either post terminals or bolted clamp terminals.

Glands for armoured cables shall provide a positive armour clamp to the box or switchgear coating. This clamp shall completely support the cable weight so that no tension is applied to the termination. The clamp shall also provide earth continuity and be of adequate size to withstand the full fault current of the system for one second.

Where single core glands are required, these shall be non-magnetic. The gland plate shall also be of a non-magnetic material. Removable connections for bonding across the gland insulation shall be provided. The gland insulation shall withstand a test of 2 kV AC for one minute.

Glands shall comply with SSRN 078 as appropriate. They shall seal the inner and outer cable sheaths against ingress or dirt and moisture and provide mechanical support. All glands shall be provided with an earthing tag.

Where cable glands are exposed to the weather these shall be protected by heat shrink or purpose moulded sleeves covering the gland continuously from the cable sheath to the gland neck.

Where the apparatus enclosure classification requires sealed cable gland entries, sealing shall be achieved by using threaded cable gland holes and polytetrafluoroethylene (PTFE) tape.

(b) Multicore or Control Cable Terminations

A sufficient number of terminals shall be provided to terminate all cable cores. For control and auxiliary wiring an additional 20% of this number shall be provided as spares.

Terminal blocks for terminating up to and including 35 mm² cable shall securely clamp the conductor, without damage, between two plates by means of a captive screw; pinch screw type terminal blocks shall not be used.

For cables above 35 mm², stud or bolted terminals shall be used, each cable core being fitted with a suitable lug.

Not more than one core of internal or external wiring shall be connected on any one terminal. Where duplication of terminal blocks is necessary, purpose made solid links shall be incorporated in the design of the terminal blocks.

Terminals which remain energised when the main equipment is isolated shall be suitably screened and labelled.

Terminal blocks for different voltages or circuit type shall be segregated into groups and distinctively labelled.

Plant which has to be dismantled for maintenance shall have multicore cable terminations made of through glands onto an adaptable box. The box shall have terminal blocks, and connections shall be made to the equipment by single core wires and flexible waterproof plastic conduit. A separate earth core shall link the box to the equipment.

(c) Joints

Through joints shall only be allowed on long cable runs outside buildings. Where such joints are necessary in thermoplastic and elastomeric cables, the cables shall be jointed with epoxy or acrylic resin cold setting compound, which has been pre-measured and pre-packed ready for use. The boxes shall be of split, moulded plastic type with filling vents for compound. Bonding straps shall be fitted with armour clamps across the joint and inspected by the Engineer prior to filling the box with compound. Wrapped pressure type joints will not be accepted.

Conductor cores shall be jointed number to number or colour to colour.

842 SMALL POWER AND LIGHTING INSTALLATIONS

(a) Distribution Boards

Distribution boards shall be of folded sheet steel enclosed construction, braced to form a rigid structure. Doors shall be lockable, hinged and gasketed to give a damp and dustproof enclosure. The degree of protection shall be IP43 (indoors and IP55 (outdoors). The boards shall conform to SSRN 020.

The busbars shall be mounted on non-hygroscopic insulators, completely shrouded or PVC insulated, coloured to denote the appropriate phase. The current rating of the busbars shall be not less than the sum of the maximum current rating of all outgoing circuits. A neutral bar shall be provided with a separate terminal for each circuit.

A separate earth terminal block shall be provided with a separate terminal for each circuit. Distribution boards shall have a fault rating at least that of the system for one second. Removable top and bottom undrilled gland plates shall be provided with a brass earthing stud.

A switchfuse or isolator shall be connected on the incoming side of the board. The device shall be triple pole and neutral with over-current protection.

Each outgoing circuit including spare ways shall be protected by an HRC fuse or miniature circuit breaker (MCB). HRC fuse bases and carriers shall be of non-hygroscopic insulation.

Barriers shall be fitted over all live parts and spaces between phases. Each distribution board shall have a permanent circuit identification chart mounted on the inside of the front door.

Boards for use on DC systems shall be double pole types with fuses on the incomer.

(b) Bulk switching contactors

Bulk switching contactors (e.g. for large lighting or heating loads controlled from a single switch) shall be of the air break electromagnetic type and shall comply with SSRN 007 and SSRN 008. The contactors shall be continuously rated for the duty specified, shall have a utilisation category ACi, and an ~intermittent duty class 0.3 with the characteristic mechanical endurance of that class. The current ratings specified shall be eight hour rated duty.

Contactors shall be single or triple pole as required, each type with a neutral terminal. Contactors shall be fitted with a continuously rated operating coil having both terminals brought out.

Enclosures shall be similar to those of distribution boards and shall have a degree of protection not less than IP52 to SSRN 012.

(c) Socket outlets

Domestic and Industrial pattern socket outlets shall comply with SSRN 079 as appropriate.

In areas having plaster, tiled or other decorative finish, socket outlets shall be fitted flush with the finished area. In all other areas fittings shall, unless otherwise specified, be surface mounted.

Unless otherwise stated or indicated on the drawing, the mounting height of the bottom line of the outlet to:

the working surface shall be 250 mm;

the finished floor level in office areas shall be 400 mm;

the finished floor level in garages and vehicle storage area shall be 1,350 mm.

(d) Lighting switches

Internal lighting switches shall comply with SSRN 080 and the relevant section of SSRN 065 and installed in the positions shown on the drawings. They shall be supplied complete with box, cover plate and fixing screws. They shall be surface mounted metal clad type with aluminium or steel finished box.

At multi-switch positions, the switches shall be contained in multi-gang boxes.

External lighting switches shall be of the metal clad, galvanised and weatherproof pattern with rotary action. They shall be surface mounted.

Where operation of a lamp or group of lamps is required from two separate locations, two way switches shall be fitted.

(e) Internal lighting

Luminaires shall be complete with all supports, suspensions, flexible cables, pendants and plugs. They shall be connected to the main circuit wiring with heat resisting flexible cables of a minimum core size of 24/0.20 mm.

Protective classification shall be IP42.

The earthing of all luminaires shall be by a separate core in the connecting flex or cable, securely bonding the earth terminal on the fitting to that of the interconnecting cables.

Where adjacent luminaires are connected to different phases of the supply, a label shall be fitted internally, warning of the presence of the phase to phase voltage.

Luminaires shall not transmit load to suspended ceilings unless the ceiling and lighting is of integrated design with the appropriate supports.

Where high bay discharge luminaires are suspended from the structural ceiling, the connection between the fitting and fixed wiring shall be by plug and socket.

Lampholders for flexible pendants shall be of the all-insulated skirted pattern with cord grips.

The fixings, connection boxes and other parts of the luminaires shall be erected at times to suit the building programme. The glassware, diffusers, shades, lamps and tubes shall not be fitted until all building work is complete. Fittings shall be left clean inside and outside and ready for use.

(f) Types of luminaires

a) Fluorescent

Diffusers shall be of flame retardant extruded acrylic or GRP material. They shall be either opal or prismatic pattern as specified.

A gasket shall be fitted between the diffuser and the body to form an effective seal.

The luminaires shall comply with SSRN 081 as appropriate for ordinary, indoor normal atmospheres and for chemically corrosive atmospheres, where appropriate.

Fluorescent luminaires shall have two suspension or fixing points.

b) Incandescent luminaires

Recessed downlighter luminaires shall be constructed from an aluminium alloy reflector and housing with adequate top ventilation holes. An adjustable position, porcelain lampholder shall be incorporated, pre-wired with heat resistant cable. Re-lamping shall be from below only.

Surface incandescent luminaires shall be of the white opal glass type suitable for wall or ceiling mountings.

c) External lighting

All external luminaires shall be of the totally enclosed fully weatherproof pattern with vandal-proof polycarbonate diffusers having a minimum degree of protection IP65 to SSRN 038.

Security lighting systems shall be designed to be inaccessible to intruders.

Bulkhead luminaires shall have a cast aluminium alloy body, polycarbonate diffuser, gasket and porcelain lampholder.

d) Emergency lighting

Emergency lighting luminaires shall be of the self-contained or slave type as specified.

The luminaires shall be fully automatic in operation, providing instant illumination in the event of a mains failure. The battery capacity shall be sufficient to operate all luminaires connected to the emergency lighting system for a period of 3 hours.

(g) Lampsa) General

All lamp holders shall be fitted with a lamp of a type and size specified by the manufacturer or as stated on the drawings.

b) Fluorescent lamps (Designations MCFE/U and MCFAV/U)

Fluorescent lamps shall comply with the appropriate section of SSRN 081. Unless otherwise specified, lamps shall be coloured 'white' for industrial use

and 'warm white' for commercial and domestic lighting. Lamp caps shall be of the bi-pin type. The guaranteed minimum life shall be not less than 3000 hours.

Metal strip lamps (MCFE/U) shall be used in glass reinforced polyester luminaires or where the metalwork is not within 20 mm of the lamp.

c) Incandescent lamps

Incandescent lamps shall comply with the relevant standards in SSRN 081. General lighting service lamps shall have a coiled coil up to 150 W and single coil above this wattage. The lamps shall have standard bayonet cap and have an internally frosted glass envelope.

General lighting service lamps used for emergency lighting or lamps operating at a voltage different from the normal mains voltage, shall be fitted with an Edison screw cap. Lamps rated at 300 W and above shall have a Goliath Edison screw cap.

Guaranteed minimum life shall be not less than 2000 hours for lamps rated at 300 W and above and 1000 hours below 300 W.

d) Mercury Discharge Lamp Fittings

Mercury discharge lamp fittings shall have combined parabolic reflector and control gear unit. Control gear shall be complete with power factor correction capacitor, high temperature 30 A connection terminals and choke. Fittings shall be suitable for connection to conduit and shall have slots in the top of the reflector to allow a flow of air to pass over the lamp and reflecting surfaces.

e) High Pressure Sodium Lamp Fittings

High pressure sodium vapour lamp fittings shall have combined parabolic reflector and control gear unit. Control gear shall be complete with power factor correction capacitor, high temperature 30 A connection terminals and choke. Fittings shall be suitable for connection to conduit and shall have slots in the top of the reflector to allow a flow of air to pass over the lamp and reflecting surfaces.

(h) Low and Extra Low Voltage Supply Transformers

Low and extra low voltage supply transformers shall comply with SSRN 028 and shall, unless otherwise specified, be of the single phase type. Transformers shall be supplied complete with fixing bracket.

The rated output voltage and VA shall be as specified.

(i) Electric hand-lamps

Electric hand-lamps shall be suitable for 25 V operational and shall be complete with specified length of TRS flexible cable, lamp and galvanised wire guard. Electric hand lamps shall comply with relevant section of SSRN 081. The hand lamp cable shall, unless otherwise specified, be terminated in a plug complying with SSRN 079.

When used with a portable supply transformer, the cable may be permanently connected to the output terminals via a suitable compression gland.

The hand-lamp shall be complete with a reeling drum or wall brackets or both for the neat storage of the cable when not in use.

(j) Automatic earth proving supply points

Where supplies are taken to portable tools or machinery at 230/400 volts the supply point shall incorporate a device for continuously monitoring the effectiveness of the earth connections to the appliance. The apparatus shall comprise a metal cased totally enclosed damp and dust proof unit incorporating a double pole or triple pole hand operated circuit-breaker, relay, low voltage transformer and non-linear resistor together with a socket outlet facilitating the connection of a flexible cable having two separate earth cores in addition to the supply cores. In addition to the mains operated no-volt trip and relay, a current operated earth leakage trip shall be incorporated. The plug and socket arrangements for the outgoing lead shall be specially designed for the system of protection and shall not be interchangeable with other types.

Earth proving supply points shall be to SSRN 082.

(k) Time Switches

Time switches shall be of the synchronous motor wound clockwork type with a 30 hours spring reserve. The time switch shall incorporate a test ON/OFF switch which shall not interfere with the time clock and auto winding mechanism.

(l) Wiring

Internal wiring shall be carried out using single core pvc insulated cable installed in surface run L conduit or trunking and shall be fixed to walls of structured steelwork.

The copper conductor size shall be not less than 1.5 mm² for circuits feeding lighting or fixed apparatus or less than 2.5 mm² for socket outlet circuits.

No conduit serving a single phase socket outlet, lighting point or switch shall contain more than one supply phase.

843 BATTERIES AND CHARGERS

(a) General

Battery units shall comprise a floor standing or wall mounted front access type steel cabinet accommodating batteries, battery charger and distribution facilities.

(b) Batteries

Unless otherwise specified, batteries shall be of the high performance nickel-cadmium type having cells housed in translucent, high impact plastic containers. The containers shall be fitted with vented filler plugs. High and low electrolyte levels shall be permanently marked on the container.

Cell terminals shall be of the bolted type. The terminal polarity shall be permanently marked.

Battery cells shall be arranged so that each is accessible for test and inspection. Cells shall be located in the lower section of the cabinet and shall be not less than 300 mm above floor level.

Batteries shall be supplied complete with all necessary connections. The connections between tiers, and cells and disconnection links and fuses shall be of the multi-stranded plastic insulated type.

The nominal battery voltage shall be 24 V unless technical considerations otherwise dictate. The battery capacity shall be adequate to supply all connected loads for a minimum period of 8 hours.

At the end of the 8 hour period the battery shall have sufficient capacity to complete the operations listed below, at the end of which the battery voltage shall not have fallen below 90% nominal value with the standing loads connected.

Two closing operations on all automatic circuit breakers.

Two tripping operations on all circuit breakers.

Charging of one DC motor wound circuit breaker closing spring.

Detailed calculations and loading data used to determine the battery capacity shall be submitted to the Engineer at an early stage in the Contract.

(c) Battery charger

The battery charger shall be of the solid state design incorporating 'Float' and 'Boost' charging facilities. In the 'Float' charge mode, the charger shall automatically maintain the battery in a fully charged condition whilst supplying its rated current. In the 'Boost' charge mode the charger shall be capable of fully charging the battery from a fully discharged state in a period not exceeding 7 hours.

Boost mode is not required for standby batteries for fire detection, emergency lighting or intruder alarm systems.

The charger output voltage regulation shall not exceed $\pm 2\%$ for load variations of 0 to 100% with AC supply voltage variations of $\pm 6\%$.

The charging characteristics shall minimise battery water loss.

The charger shall be equipped with the following:

Incoming supply On/Off switch

Supply On indication

Output voltmeter

Output ammeter

Float/Boost charge selector switch

Charger Failed alarm relay

Charger Failed indication

The minimum requirement for the 'Charger Failed' alarm shall be the detection of AC supply or DC output failure. The alarm relay shall not operate under a transient AC supply failure condition.

An individual pair of volt-free contacts for 'Charger Failed' shall be provided. The contact shall be wired to terminals.

(d) Distribution

Double pole moulded case or miniature circuit breakers shall be provided as required.

GENERATING PLANT

844 DIESEL GENERATORS

General

Generator sets shall consist of diesel engines and alternators mounted together on common bed plates. The sets shall be suitable for indoor installation taking into account the climatic conditions prevailing in the country where it is being installed.

The generators shall be designed for long service life, high reliability, ease of maintenance and repair.

Generator sets shall conform with the requirements of the following clauses:

Engines

Engines shall be industrial four stroke, water cooled, direct injection machines and shall operate at not more than 1500 rpm. Standardisation of types is required so all machines of the same output shall be from the same manufacturer. Where the requirement is for machines of different sizes, every attempt shall be made to supply machines from the same manufacturer which share many components in common. (It is accepted that most manufacturers do not produce machines with a range of outputs as large as that required by the contract).

Turbo charged engines will be accepted, but units with intercooling will not be.

The site rating of the engine shall be calculated in accordance with SSRN 021 and shall have an inherent overload capacity of 10% for 1 hour in any 12 hours. The engine shall be capable of operating at full load for 500 hours without attention to filters or injectors, and for 10 000 hours between major overhauls.

An automatic speed governor complying with the appropriate Class covered under SSRN 021 shall be fitted. Where generators are required to operate in parallel, the governor shall give a drooping speed characteristic. Facilities shall be provided to manually trim the engine speed by $\pm 5\%$. An independently acting, shaft driven overspeed device shall be fitted to trip the set at 120% of the rated speed. The device shall require resetting by hand before the engine can be re-started.

Engines driving generators of 2 MVA or less shall be started and controlled using 12/24 V (as applicable) supply from heavy duty lead acid batteries. The engine starter motor shall be of the reselect type and the batteries sized to give six 30 second consecutive starts of the engine at an ambient temperature of 0°C. For small generators (up to 250 kW) the batteries may be set-mounted. For larger sets the batteries shall be separately mounted.

Engines driving generators with an output in excess of 2 MVA may alternatively use air injection starting. In this case each installation of generators shall be complete with the following items:

- electrically driven compressor
- compressor driven by hand—start diesel engine
- air receiver for each generator in the installation. The air capacity shall be sufficient for six consecutive starts
- all necessary air pipes, valves, gauges, fuels supplies, motor starters, cables etc. required for a complete installation.

The engine lubrication system shall be of the closed circuit wet-sump forced feed type supplied by an engine-driven pump. The pump shall be fitted with pressure regulating and

relief valves, sump suction filter and renewable micro-felt flow line filter. Large machines (e.g. over 2 MVA), may require the use of twin or multiple pumps and filters.

The engines cooling system shall be by means of a water jacket and a heavy duty air blast radiator, mounted on the generator bedplate, together with an engine driven fan and water circulating pump(s). A thermostatically operated by-pass valve shall be fitted in the cooling system to maintain an optimum operating temperature during starting and running conditions. The radiator cooling air shall be exhausted to atmosphere via a louvered opening and a bellows connection to the radiator. A further louvered opening shall be provided to supply cooling and charge air.

Cooling via an engine-mounted heat exchanger and pumped water is permitted if a suitable source of clean secondary cooling water is available. If such a system is proposed by the Contractor he shall provide a fully detailed specification and diagrams of the cooling water system.

A charge air intake filter (or filters) shall be fitted. This shall be of the heavy duty type to SSRN 083 and shall be suitable for operation in a dust laden atmosphere. Where the engine is turbo-charged, the filter shall be of the oil wetted type.

The engine shall be capable of operating with fuels complying with the appropriate section of SSRN 084. The fuel feed shall be via a fuel filter and a fuel agglomerater fitted before and in line with the fuel filter.

Cyclic irregularity of the engine/alternator combination shall not exceed that specified in SSRN 021.

Alternators

The alternator shall be of the salient pole, revolving field, brushless, self-regulating type and shall be three phase or single phase as specified. The unit shall be manufactured in accordance with SSRN 030 - SSRN 034 and shall be continuously rated and capable of withstanding a 10% overload for 1 hour in any 12 hour period. The unit shall additionally withstand a short circuit for not less than 3 seconds.

A three phase alternator shall be capable of supplying an unbalanced load where the current of the highest loaded phase exceeds that of the lowest loaded by 40%.

The winding insulation shall be to Class F but the machine shall be designed to limit conductor temperatures to Class B. The machine shall be designed to operate continuously in ambient temperatures up to 50°C.

The exciter shall be of the revolving armature type with the armature overhung on a shaft extension at the non-driving end. The output of the exciter shall be rectified by a rotating silicon diode rectifier bridge to supply the main generator field windings. The exciter field shall be controlled through automatic voltage regulation (AVR).

The machine shall be protected to IP22 with open circuit air cooling. The air ducts shall be designed to reject falling drops of water, and they shall be fitted with grilles to keep out vermin.

An anti-condensation heater shall be provided and this shall be energised automatically when the generator is out of operation.

Control Panel

The control panel shall be constructed to SSRN 020 and SSRN 021 with a rating of not less than IP 54. In the case of small generators (up to approximately 250 kW), the control panel may be mounted on the set itself, but for larger sets the control panel shall be separately mounted. Where the panel is separately mounted it may be necessary for some direct reading gauges to remain set-mounted. In this case the instruments shall be mounted together on a panel fixed to the set, but where they generate alarms or other electrical signals these shall be transmitted to the separately mounted control panel.

The control panel shall contain the following items:

- on/off switch for control circuitry
- engine stop/start push buttons
- emergency stop push button with twist reset
- tachometer
- oil pressure gauge
- water temperature gauge
- ammeter for each phase
- kW meter
- voltmeter and phase selection switch
- ammeter (battery starting/charging current)
- DC volt meter (battery volts)
- Indicator lamps
 - low oil pressure
 - high water temperature
 - overspeed
- hours run meter
- off/auto anti-condensation heater switch

In the case of a generator with electric starting, consideration shall be given, when selecting the relays and other electro-magnetic devices in the control system, to the voltage drop which occurs during operation of the starter motor.

All control panels shall be complete with a mains powered battery charger and battery. In the case of an electric starting generator the battery will be the starting battery and shall be rated accordingly. In the case of air starting generator the battery shall be rated in accordance with the requirements of the control circuitry only.

845 EXHAUST SYSTEMS FOR DIESEL ENGINES

The exhaust system shall incorporate silencers suitable for use in an industrial area and shall include all necessary supports and other items to make a complete installation. Exhaust tubing shall be heavy gauge mild steel to SSRN 085, and shall include a stainless steel bellows close to the engine to reduce vibration and permit engine movement.

The system shall be suspended from the walls and roof by suitable brackets and angle ties which shall include mountings to prevent the transmission of vibration and noise to the building.

The system shall be adequately lagged and fixed within the building. Where the roof is of combustible material and the walls of the building are of incombustible material, the exhaust shall be routed to atmosphere through the wall rather than the roof. Where both the walls and roof are of combustible material, special care shall be taken to protect the building from the exhaust piping and the hot gases discharged from it.

The exhaust system outlet section shall be horizontal and where possible it shall point in the direction of the prevailing wind.

846 DAILY SERVICE TANK

A daily service fuel tank holding sufficient fuel for 12 hours operation at full load shall be provided for each generator. In the case of a small generator (up to 250 kW) the tank may be set mounted, but for larger machines the tank shall be mounted on a frame. Fuel supply to the generator shall be by gravity.

The tank shall be constructed in mild steel and the fittings in materials other than:

- Yellow brass, including low grade alloys of copper and zinc
- Lead and zinc
- Galvanised metals
- Natural rubber

The tank shall be complete with the following fittings:

- Local indication of fuel level to be given at a position where it can be easily read during fuel delivery
- Drain pipe situated at lowest point in tank complete with isolating valve. The drain pipe shall be routed to the fuel dump tank
- Outlet pipe complete with water trap and isolation valve
- Filling point at the top of the tank with removable gauze filter
- Overflow pipe. This shall not have any valves and shall be routed back to the bulk storage tank.
- Vent pipe. This shall be routed to atmosphere with a continuous rise from the tank and shall be terminated with an inverted 'U' bend and vermin screen.

The tank shall have an extra volume above the normal maximum contents level of the tank of not less than 5% of the maximum volume of the tank.

The vent pipe shall be located not less than 50 mm above the highest possible fuel level.

847 BULK SERVICE TANK

Tanks and fittings etc. shall conform to SSRN 086. The tank shall be constructed in mild steel and the fittings in materials other than:

- Yellow brass, including low grade alloys of copper and zinc
- Lead and zinc
- Galvanised metals
- Natural rubber

The following fittings shall be included:

- 600 mm diameter manhole complete with portable cover situated in the top of the tank complete with ladder to the interior
- Dipstick, calibrated in litres with guide tube and striker plate
- Local indication of fuel level to be given at a position where it can easily read during fuel delivery
- Filling pipework and fittings complete with isolation valve and captive end cap. The

filling point shall be at the top of tank to prevent siphoning.

- Outlet pipe situated at the raised end of the tank not less than 150 mm above the tank bottom, complete with check valve, isolating valve, and end cap.
- Drain pipe situated at lowest point in tank complete with isolating valve and captive end cap
- Inlet fittings for the overflow pipe from the daily service tank or tanks
- Vent pipe situated at high level in the tank. The pipe shall rise continuously from the tank and terminate with an inverted 'U' bend and vermin screen
- External ladder for horizontal tanks more than 2 m diameter

The tank shall have an extra volume above maximum contents level of the tank of not less than 5% of the maximum volume of the tank.

The vent pipe shall be located not less than 100 mm above the highest possible fuel level.

The internal surface of the tank shall be cleaned and treated with temporary preservative before shipment. The preservative shall be soluble in fuel oil.

The bulk fuel tank shall be complete with two transfer pumps together with all necessary pipework and valves to make a complete installation. One of the transfer pumps shall be electrically driven and shall be complete with a locally mounted starter arranged for manual control. The other pump shall be hand-operated.

The fuel dump tank shall be constructed generally in accordance with the requirements for the bulk storage tank. It shall have a capacity not less than the total capacity of all the daily service tanks to which it is connected, and shall be mounted at such a level that the service tanks can be rapidly drained into it. Connections and pipes shall be provided to facilitate the draining of the dump tank.

Tests on Completion

On completion of the erection, the cubicles and panels shall be subjected to the following tests in the presence of the Engineer or his representative:

- (a) Wiring visual check to confirm conformity with wiring and schematic drawings
- (b) Wiring and motor insulation tests
- (c) MCCB current injection at the set values for Over current tripping
- (d) Measurement of panel earthing resistance
- (e) CT ratios
- (f) Instrument calibration
- (g) Equipment functional tests
- (h) Tripping functions

The Contractor shall provide the test instruments for the above tests and record all the test results in the Test Certificate which shall be signed by the Contractor and submitted to the Engineer prior to acceptance of the work as having been completed.

Cable and Wiring Tests

On completion of the installation, the cables shall, in the presence of the Engineer or his representative, be subjected to the following tests as laid down in the SSRN 018 (which includes IEE Regulations) and local KPLC requirements.

- (a) Insulation
- (b) Polarity
- (c) Earth continuity
- (d) Loop impedance

- (e) Impedance at the origin of the installation (Z_e)
- (f) Any other tests which may be required by the Engineer to ensure safe and satisfactory completion of the work and compliance with the Technical Specifications

Tests on New Transformers

The following tests shall be performed on all the new transformers at the manufacturers' works and during commissioning in accordance with SSRN 051:

Works Tests

Notwithstanding the provisions of the approved standards, the tests shall include the following routine tests:

The windings shall be checked for:

- Polarity
- Phase relationship
- Resistance
- Turns ratio

Appropriate measurements shall determine the following parameters:

- Losses on full load
- No-Load losses
- No-Load current
- Short-Circuit voltage

Measurement of high voltage di-electric strength

Oil insulation tests

The Contractor shall provide the Engineer with a test certificate issued by an approved testing institution, which shall include the tests carried out in accordance with the approved standards

Commissioning Tests

The following tests shall be carried out by the Contractor to the satisfaction of the Engineer prior to the commissioning of the transformers:

- Ratio test at all tap positions
- Vector group
- No load current
- Output phase rotation

The Contractor shall record these tests in a certificate which shall be provided to the Engineer prior to the commissioning of the transformers. The Contractor shall be responsible to provide testing instruments for the above tests.

GENERAL SPECIFICATIONS - MECHANICAL**MECHANICAL EQUIPMENT****848 PUMPS****849 PUMP SELECTION**

In selecting pumps the following factors shall be considered:

- quality of water (corrosivity, abrasiveness);
- suction head and draw-down (in boreholes);
- borehole casing diameters and positions of screens;
- power supply characteristics;
- hydraulic characteristics of the supply system;
- pump cost and operating costs;

850 HYDRAULIC EFFICIENCY

- availability of operation and maintenance services;
- standardisation of equipment

Large pumps in low lift stations shall preferably be of the vertical turbine type. Smaller low lift pumps may be either horizontal or vertical.

High lift pumps shall preferably be horizontal, for ease of maintenance and longer life. Wherever possible a single-stage pump shall be preferred to a multi-stage, and lower speed motors are preferable to high speed motors. It is not considered advisable to use multi-stage high speed pumps due to increased wear despite possible initial costs savings.

Every pump shall be provided with a non-return valve, gate valve, air release valve, pressure gauge and flow detection switch. Borehole pumps shall in addition be equipped with a level measurement instrument and an automatic low-level protection switch. Provision shall be made for metering the production of each system, and for flow- recording at larger stations.

851 GENERAL PUMP DESIGN

Pumps shall be arranged for priming by means of an adequate positive suction head in all possible operating conditions and be driven by electric motors, unless otherwise specified. The motor voltage may be low or medium voltage as specified.

Pump shafts shall be forged from a material compatible with the impellers. If the pumps are fitted with packed glands, the shafts shall be provided with replaceable sleeves where they pass through the gland.

Pumps may be fitted with mechanical seals in place of packed glands only if they have proved satisfactory over a long period when fitted to the design pump in question and with prior approval. They shall be designed for easy adjustment and seal removal.

Effective means shall be provided for the collection of gland leakage water and piping it to a suitable floor drain.

Intake pumps for surface water duty shall be designed for pumping raw water with a high silt content, to be capable of passing 75 mm diameter solids and to avoid possible choking by weeds or other tough sinuous material.

Lubrication arrangements shall be designed to avoid any contamination of the pumped fluid. Unless otherwise specified, all pump bearings shall have a design running life of not less than 100,000 hours.

Bearings shall be designed for loadings 20% in excess of calculated maximum loading and shall be suitable for reverse rotation at 150% rated speed or the maximum reverse speed the pump can reach in installed conditions when driven backwards by reverse flow, if this is greater.

Bearing cooling arrangements if used shall be designed on the closed-circuit principle. Open discharge of cooling water into the pumping station drainage system is not permissible.

The rotating assemblies shall be statically and dynamically balanced and designed so that the first critical speed of the pump and its drive is at least 50% higher than the maximum operating speed. Where the rotating assemblies are small and any out of balance forces are negligible this requirement will not be necessary. The manufacturer is required to state whether balancing has been completed.

The speed of any main pump shall not exceed 1500 rpm without approval of the Engineer. However, for a given pump duty, if the higher speed pump has a better BEP, then the latter should be proposed.

The head/quantity characteristic of any pump shall be stable at all rates of flow between close and open valve and shall be steep enough to permit satisfactory operation in parallel with other pumps under all conditions specified.

The pump efficiency shall be well maintained over the whole of the specified duty range, even if this necessitates the use of a larger motor to provide the peak power demand. For vertical spindle suspended pumps the pump efficiencies quoted shall take into account shaft and rising main losses up to and including pump discharge bend and pump coupling.

The NPSH requirements of the pumps, based on the 2% output drop criterion shall be at least 1 m less than the NPSH available at every working condition.

Water velocities in the suction or delivery branches of a pump shall not exceed 2.5 m/s when the pump is operating within its specified duty range and within this working range there shall be no discernible noise due to hydraulic turbulence or cavitation within either the pump or its associated pipe-work and valves.

Each pump shall be complete with all necessary ancillary equipment and fittings to render the unit complete and ready for service. This shall include isolating valves, non-return valves, air-valves, cooling water pipe-work, gland leakage pipe-work, air release pipe-work, pressure gauges, gauge pipe-work, holding down bolts, access platforms and other items as appropriate.

852 PUMP PERFORMANCE GUARANTEE

The pump performance guarantee shall relate to the flow rate, the total head and the efficiency of the pump when tested at the manufacturer's works.

The pump shall operate at its design point within the acceptance tolerances for flow rate and total head laid down in SSRN 016.

853 MATERIALS OF CONSTRUCTION

The pump impeller, shafting, sleeves, wear rings, casing, etc. shall be of suitable material to cope with the pumped medium and the Tenderer shall have satisfied himself that sufficient detail has been provided to make this assessment.

Typical materials of pump construction have been given in the following Clauses and are intended only as a general guide.

854 SURFACE MOUNTED PUMPS

Surface mounted pumps may be end-suction or side suction with front, side or top delivery as specified.

The pumps shall be of horizontal fixed speed centrifugal flow type operating at a preferable speed not exceeding 1500 RPM. Where low speed pumps have low efficiencies at a given duty, pumps with speeds not exceeding 3000 RPM may be offered. The pump, 400 V, 3,300 V or 6,600 V, 3 Phase motor, flexible coupling and guard shall all be mounted on a single base-frame.

Pumps shall be horizontally mounted complete with drive motor on a common base plate. The pump/drive coupling shall be of the spacer type to facilitate removal of the pump rotating element and bearing housing without dismantling the pump casing, adjoining pipe-work or drive motor.

Pump impellers for raw water may be of cast iron (GG 25) and for high lift duties, shall be of zinc free bronze. Impellers shall be cast in zinc free bronze, leaded gunmetal, stainless steel (or equivalent) of a composition chosen with regard to the specified pump duty.

The impellers shall be keyed to shafts of high tensile steel adequately protected against corrosion with renewable bronze sleeves. Alternatively shafts may be of stainless steel fitted with renewable sleeves where wear is likely to occur. The seal shall be gland packing in a stuffing box.

All revolving parts shall be correctly balanced both statically and dynamically.

Renewable bronze or stainless steel wear rings shall be provided, with adequate clearance for water to be pumped, at all points where wear may impair the efficiency of the pump.

Oil or grease lubrication of the bearings shall be such as to prevent leakage and contamination of the water.

Correctly designed tapers and joints for the suction and delivery pipework shall be provided. All modified pipework shall be to the PN rating of the pipework.

Provision shall be made of all necessary foundation bolts, ragbolts etc. required for the plant and these shall be complete with plates, nuts and bolts and made of stainless steel.

A coupling shall be provided between the motor and the drive shaft. The coupling shall be of non-rigid rubber bushed pin type and have easily removable coupling guards.

The acceptance tests for pump sets shall conform to the relevant sections of SSRN 016 and SSRN 017.

The pumps' suction and delivery connections shall be flanged. The pumps shall be equipped with suction and delivery pressure gauges as specified.

Each pump casing shall be of close-grain grey cast iron, modular cast iron or similar approved material. All working surfaces shall be accurately machined and where necessary, they shall be provided with a register of adequate depth to ensure accurate and true alignment.

Unless specified otherwise, the sealing for all the pumps shall be of gland packing type. The Contractor shall provide all bolts, nuts, plates, guards, etc. necessary for rendering the installation complete.

The dimensions of the pump shall be metric conforming to SSRN 088 or its equivalent. Flanges shall conform to SSRN 207. The bed-plate shall be of substantial fabricated steel construction with floor fixing bolt holes ready drilled. All holding down bolts, etc. shall be supplied with the units.

The velocity at the entrance to the pump impeller shall not exceed 2.5 m/s.

Impellers shall be provided with means to prevent abrasive matter reaching the glands and with fully shrouded impellers, to prevent the trapping of matter between the impeller vanes and the casing.

Glands may be fitted with suitable mechanical seals or conventional soft packing. The gland arrangement shall be designed for ease of adjustment or removal of the seal or packing material. Shafts shall be sleeved around the area of the gland when soft pack glands are used.

Flushing facilities shall be provided for mechanical seals or packed glands where pump fluid may be contaminated with abrasive material. Where soft packed glands are used, means shall be provided for collection of the gland leakage water which shall be piped into the drainage system through adequately sized ports.

Lubrication arrangements shall be so designed that there is no contamination of the pumped fluid.

The pumps and associated pipework shall be, wherever possible, arranged so that air can be completely expelled during priming. Where this is not possible, facilities shall be provided for the removal of the trapped air. Adequate facilities shall be provided for drainage of the pumps for inspection purposes.

Tappings shall be provided at both the suction and discharge flanges for pressure gauge equipment.

855 ELECTRO SUBMERSIBLE BOREHOLE PUMPS

Borehole pumps shall be of the totally submersible radial or mixed flow borehole type, having zinc free bronze casings and impellers and high tensile steel shafts and fittings. The pumping units shall be suitable for continuous operation.

The pump body shall have separate sections for each stage, which shall have matching faces machined and spigotted, to allow accurate location and alignment of the sections during assembly. The fixing nuts, bolts, washers and studs or bolts shall be manufactured in stainless steel material.

The pump shall be fitted with removable shaft bearing sleeves, bearing brushes, casing wear rings and impeller wear rings. Each impeller shall be located on the shaft by identifiable distance sleeves or similar, such that reassembly of the rotating element can be carried out without the necessity of accurate measurement. The rotating assembly shall be statically and dynamically balanced after which each part of the assembly shall be identified and marked to ensure identical reassembly after maintenance, etc.

Bearings shall be water lubricated and where rubber type bearings are used the bearing material shall be securely bonded to a metal housing. Rubber bearings shall only be used where there is sufficient pressure difference through the bearing to afford adequate lubrication and cooling of the bearing, and where the bearing is submerged under all operating and starting conditions. Natural rubber shall not be used under any circumstances.

Bearings shall be positively retained within the pump body to prevent the possibility of the bearing rotating; a press fit alone is not acceptable.

The pump shall be directly coupled to its drive motor and shall be fitted with a lifting disc type check valve. The check valve shall be designed for a minimum friction loss and shall have its disk drilled with a suitably sized hole, to allow the water column to fall on cessation of pumping, without excessive reverse rotation of the pump.

The pump shall be fitted with a suction case of a material suitable for the liquid being pumped and shall be provided with long bearings to stabilise the shaft and motor shaft and to avoid radial thrust on the motor bearing. A screen shall be incorporated having a minimum open area of 4 times the eye of the impeller.

The submersible motor shall be of the completely enclosed type for continuous duty under water operation on 400V, 50 Hz, 3 phase ac. The motor shall be equipped with an approved seal, located in the top of the motor where its shaft extends through the motor housing, to isolate the well water from the liquid filled motor. The liquid shall be either water or a high dielectric strength mineral oil and it shall be circulated throughout the motor for cooling the motor, stator winding and bearings. Motor performance shall be in accordance with the relevant section of SSRN 011 and SSRN 022.

Motor thrust bearing ratings must be ample to carry the thrust load imposed by the pump when operating under the maximum anticipated pumping head. Motor thrust bearings shall be capable of operating with rotation in either direction, and the thrust capacity when operating in reverse shall not be less than the rated capacity.

An expansion chamber or diaphragm shall be provided to relieve thermal expansion of internal motor fluid due to temperature and shall provide motor internal and external pressure balance under all conditions of temperature and pressure.

The drive shaft shall be a 13% chromium steel or equivalent corrosion resistant material. Outer shell shall not be less than 0.012 m thickness and shall be of material to resist corrosion.

The borehole pump column pipe shall be manufactured from steel pipe coated with an epoxy bituminous solution or similar approved.

The column pipe shall comprise a number of sections at the option of the Contractor such that for each well the total length may be adjusted by plus or minus 2 m. A maximum of three different lengths shall be supplied. Column pipes and fittings supplied in accordance with this requirement in excess of that installed shall become the property of the Purchaser which shall be in addition to those ordered as specified for spare parts.

The sections shall be connected by either welded neck flanges or screwed couplings. Welded neck flanges shall be suitably notched or similar to facilitate installation of the motor power cable and level sensing equipment. Where screwed couplings are used the couplings shall be coated with a PTFRE anti-galling compound.

The borehole pump surface plate assembly shall consist of a steel base plate of the required strength to carry the weight of the complete pumping unit. The surface plant shall be supplied with a flanged sleeve to fit over the well casing. The sleeve shall be fitted with a puddle flange for building in. The couplings shall be screwed on to the upper end of the column pipe and shall have a long radius flanged bend.

The plate shall be provided with suitable openings for the power cable, well vent and water level indicator, as required.

856 SPLIT CASING PUMPS

Pumps shall be horizontally or vertically mounted.

Pump casing shall be split along the axis of the shaft to permit the approval of the impeller/shaft assembly without dismantling the pipe-work. Top and bottom half casing shall be dowelled to ensure alignment. Jacking screws shall be provided on the casing flanges to facilitate dismantling.

The bedplate shall be a substantial fabricated steel construction with floor mixing bolts holes ready drilled. All holding down bolts, shall be supplied with the units.

Bearings shall be of the ball or roller type shall conform to the relevant section of SSRN 089 as appropriate, or shall alternatively comprise phosphor bronze or white metal bearings, complete with means of lubrication and seals. Bearings shall be mounted outboard.

Where shafts are susceptible to wear at bearings and glands, renewable sleeves shall be fitted. Wear rings and bushes shall be fitted to the casing and impeller at the points of running clearance.

Pumps shafts shall be steel-forged and the impellers shall be zinc-free bronze. Pump casings shall be fitted with an air release cock. Provision shall be made for periodic lubrication of bearings without removal of any parts.

Glands may be fitted with suitable mechanical seals or conventional soft packing. The gland arrangement shall be designed for ease of adjustment or removal of the seal or packing material.

Flushing facilities shall be provided for packed glands. Where soft packed glands are used, means shall be provided for collection of the gland leakage water which shall be piped into a separate drainage system through adequately sized ports.

857 VERTICAL SPINDLE SUSPENDED PUMPS

The pumps shall be vertical, shaft driven units having impeller stages of the mixed flow multistage type. The impellers and guide vanes shall be either surface coated cast iron or cast bronze. The impeller shaft shall be a corrosive resistive low alloy steel designed for low stress and long life at the duty speed.

The discharge head shall be a composite fabrication or casting and shall include the following:

- supporting flange with holding studs

- Bedplate ring with levelling screws and plates

- Lifting lugs for withdrawal

- Fixing for motor and coupling

- Provisions for insertion of cables and level recording equipment

- Provision for access to service the water seal

The discharge head seal shall be selected for long life with the minimum maintenance and may be of the mechanical or packed gland type. Packed glands shall have an intermediate lantern ring. The pressure limit of mechanical seals shall be at least 50% greater than the closed valve pressure. Provision shall be made to return to the sump any water leaking past the head seal.

The drive shaft and couplings shall be of ample strength to withstand the maximum accelerating torque of the pump with a factor of safety of at least two. The drive shaft couplings shall be designed to preserve true shaft alignment at all times and shall be located close to the bearings. The design of the couplings shall provide for accurate assembly and re-assembly within the limits of the permissible end-float of the shaft and spindle.

(a) Oil Lubricated Line Shaft Bearings

The drive shaft bearings shall be oil lubricated and spaced at a maximum distance of 1.5 m apart. The pump line shaft shall be AISI C – 1045 cold-drawn steel, stress relieved. The shaft sections shall be coupled with mild steel couplings and shall have machined left hand BSP threads the axis of the shaft.

Shafting shall have bronze bearings threaded on the outside to permit end connection of the shaft enclosing tube. The shaft enclosing tube shall be located with rubber centering spiders, or alternative approved methods.

(b) Water Lubricated Line Shaft Bearings

The transmission shaft shall be of ground steel. The shaft sections shall be coupled with mild steel couplings and shall have machined left hand BSP threads. Shaft sections shall

be in 1.5 m maximum lengths but the shaft section length adopted shall be the same as the guide bearing spacing. At least one shaft section, not the top section, shall be half the standard length. The butting faces of each section shall be machined square to the axis of the shaft. The guide bearings shall be of resilient rubber mounted in a spider bearing retainer assembly. The bearings shall be spaced at intervals necessary to ensure vibrationless running at the specified pump speeds.

Column pipes shall be of standard weight steel pipe furnished in interchangeable sections of a nominal length of not less than 1.5 m. The pipe sections shall be connected by steel flanges. All nuts, bolts, plates, etc., necessary for installation of the pumps and columns together with shafts, auxiliary piping and fittings required to render the pumping unit complete, shall be provided.

858 VERTICAL DRY WELL PUMPS

The pumps shall be of the vertical spindle, centrifugal volute type arranged for automatic priming by gravity from the intake and driven through vertical intermediate shafts from motors located above.

Pump casings shall be equipped with large hand holes in the casings to give ready access to the impellers and wear rings.

All parts exposed to wear shall be adequately protected by means of renewable sleeves, bushes, wear rings, etc., which shall be arranged for easy inspection, adjustment or replacement without removal of the pump casings, pipe-work, etc., or the need to disturb the draft shaft alignment.

The pump thrust shall be taken by a combined thrust and radial type bearing assembly capable of taking the weight of the moving parts and the hydraulic loads under all conditions of operation with a minimum life of 100 000 hours.

Each pump shall be fitted with an automatic air release valve and isolation valve, as necessary to ensure satisfactory priming.

The volute casing shall be in one piece, or split design capable of withstanding a test pressure of 1.5 times the maximum operating condition. Integral inlet and discharge flanges shall be provided. Integral lifting lugs shall be incorporated.

Each pump shall be provided with suction and discharge pressure gauges including isolating valves at the pressure tapping points on the casings.

A drain valve shall be fitted at the lowest point of the casing complete with a tundish or connecting drain to the sump.

Impellers shall be fully shrouded and secured to the shaft by a key. The impeller retaining nut shall be fitted with a locking device. Shafts shall be alloy steel forging compatible with the impellers.

The motors shall be connected to the pumps by means of drive shafts. The shafts shall be adequately sized to prevent whip or vibration when operating and shall be designed to accommodate small changes in alignment caused by foundation settlement, expansion, etc.

Universal joints shall be provided where necessary and the end couplings shall be designed to allow the pumps or motors to be removed without the need to dismantle the whole of the shafting.

All intermediate shafting between pumps and motors shall be provided with adequate guards.

859 SUBMERSIBLE PUMPS

Submersible pumps shall be of the totally submersible centrifugal or mixed flow type capable of operating below a 15 m head of water. The pumping unit shall be suitable for

continuous operation, designed to meet the desired performance and capable of handling the pumped medium without undue wear and tear.

A built-in cooling system must allow the motor to operate continuously at its rated output regardless of whether the electric motor is submerged or not.

The motor shall be direct coupled to its pump and rated for continuous full load operation above or under water.

The insulation rating of the motor shall be Class F rated to run at Class B and supply rated output at deviations of up to $\pm 5\%$ of the rated frequency and voltage. The motor shall be to IP68 in accordance with SSRN 038.

The cable termination shall be watertight and provided with a cable sleeve and strain relief.

The motor shall have ball type bearings permanently greased and maintenance free.

The pump and motor shall be separated by two mechanical face seals. The lower seal shall rotate in the water medium and the upper seal shall rotate in an oil bath medium.

The pump shall have a non-overloading performance characteristic and its efficiency shall be high at the duty point and remain at reasonably high level over the duty range of the pumping system.

The pump wear rings shall be easily replaceable.

860 PUMP AND MOTOR PROTECTION

Pressure Transducers or Switches

Pressure transducers (transmitters) where specified shall be provided for pressure control and or dry-run protection of pumps together with a timer relay.

- ☐ Pressure range: to conform to the respective pump application;
- ☐ Voltage 230 V AC or DC voltage: 24 VDC.

In addition to the provision of pressure transducers the contractor shall supply and install relays to enable the pump to:

- ☐ Stop on high pressure;
- ☐ Lamp to indicate stoppage on high pressure;
- ☐ Stop on low suction pressure;
- ☐ Lamp to indicate stoppage on low pressure;
- ☐ Manual re-start

861 FLOW TRANSDUCERS

Flow transducers (transmitters) or squing water level switches where specified shall be used for dry-run protection together with a timer relay. With this type of protection, the pumps trips when there is no flow after a pre-determined time delay.

Gems FS -550E or FS 600 or equivalent make

Main specifications:

- ☐ Stainless steel or brass construction
- ☐ Protection IP 65
- ☐ Size: 1" BSP;
- ☐ Electrical rating: 20 VA, 240 V, 1.5 A

862 THERMISTOR PROTECTION (PTC)

All new electric motors windings shall be provided with embedded PTC (Positive Temperature Co-efficient) thermistor probes. The thermistor probe shall be wired to a

relay in the starter panel to trip the motor when the motor temperature rise reaches the limit. In addition, the relay shall actuate an alarm and/or an indicator lamp.

863 PUMP DRY-RUN PROTECTION

(a) Level Electrodes

Level electrodes shall comprise of stainless steel tips with integral signal cable with neutral and low level cut-off probes. The cables shall terminate at a junction box.

Suspension clamps, permitting height adjustment, shall be installed at the top of the wells with suitable restraining devices to prevent entanglement of cables and shall be installed at a suitable distance above each well.

(b) Float Switches

Float switches shall comprise a pear shaped polypropylene case containing a single pole changeover mercury switch and shall be supplied complete with the requisite length of integral flexible cable, which shall terminate at a junction box. Suspension clamps, permitting height adjustment, shall be installed at the top of the wet wells, tanks or suction chambers with suitable restraining devices to prevent entanglement of cables and shall be installed at a suitable distance above each float.

(c) Electronic Level Control Relays

Level control relays shall be installed within the appropriate panel and shall be activated by remote level switches installed in the associated well.

(d) Adjustment

Level control suspension cables, and electrode lengths shall be adjusted for optimum levels during commissioning of the plant, settings being determined by operational conditions.

864 PRESSURE GAUGES

The suction and delivery pipes of each pump shall be fitted with pressure gauges of an approved type and pattern with a scale calibrated in meters. Pressure gauges shall be connected to pipes through a three way isolating cock to allow for bleeding by releasing air to the atmosphere. All necessary connections, piping, fixing clips and other installation materials shall be provided and allowed for in the Contractor's rates and prices.

Unless specified otherwise, pressure gauges only for delivery pipes shall be provided.

Pressure gauges shall comply with SSRN 507. Each pressure gauge shall have its serial number clearly marked on its face and it shall be marked with the value of the rated measured pressure and whether the measured pressure is above or below atmospheric pressure. Pressure gauge fitted to water pipeline shall be filled with glycerine for dampening and the indicated range of the gauge shall span 120% of the operational pressure range specified for the particular equipment.

Type: Bourdon;

Class 1;

Material: 316 stainless steel;

Diameter: Over 100 mm

CHEMICAL PLANT**General Dosing Arrangement**

Plant for the handling, stock preparation and dosing of the necessary water treatment chemicals shall be provided.

Dosing shall be by gravity feeders or chemical metering pumps, supplied with one unit being provided as a standby dosing facility.

Batch mixing of chemical solutions and slurries shall be carried out manually including changeover from empty to full stock tanks.

In preparing his designs the Contractor shall pay particular attention to maintaining continuity of dosing from any existing chemical dosing facilities during installation of new plant.

The layout, design and materials of construction of chemical plant shall conform to the latest relevant technical information data sheets and literature published by potential chemical suppliers and equipment manufacturers.

Gravity Chemical Feeders

Gravity feeders shall be designed to give constant discharge of chemical solution at the selected rate and maintain this over the drain down range of the stock preparation tank. Flow setting shall be adjustable by means of a clearly calibrated regulator. The discharge orifice shall be submerged under all operating conditions.

Gravity chemical feeders shall be of robust construction and all parts in contact with chemical solutions (including external surfaces, supporting feet, etc. likely to be affected by spillage or overflow) shall be of suitable non-corrodible materials appropriate to the chemical being handled.

Chemical Dosing Pumps

Chemical dosing pumps shall be selected taking into account the chemical being dosed, wear, leakage, resistance to corrosion and accuracy.

Chemical dosing pumps shall be of the diaphragm type driven by electric motors. Pump, motor and driving arrangement shall be mounted on a robust combined baseplate incorporating a drain connection.

The operating range of dosing pumps shall be not less than 6:1 under manual control with an overall repeatable accuracy within $\pm 3\%$ of the set rate within the full operating range.

Diaphragm pumps shall have thermoplastic diaphragms faced with polypropylene, butyl rubber or PTFE. Pump heads shall be either stainless steel or polypropylene. Mechanical glands shall not be used.

Variable stroke mechanisms shall be incorporated which enable pump output to be varied manually locally, while the pump is running by means of a micrometer handwheel or similar device.

Dosing pumps and motors shall preferably incorporate an integral reduction gearbox drive which shall be totally enclosed and oil bath lubricated. The gear box shall incorporate the cams for the diaphragm drive and shall be provided with filling and drain connections and visible oil level indication.

Each pump shall be provided with inlet and outlet isolating valves and, where necessary, with pressure relief and non-return valves. Dosing pumps shall be provided with back pressure loading valves and pulsation dampeners in the delivery lines depending on the downstream conditions.

A relief valve shall be incorporated in the delivery lines under conditions where the pump discharge pipe can be shut off or where pressure may rise to an excessive point. The relief valve shall be sized to handle the system pressure and to discharge maximum pump

output freely, and shall be located in the discharge line between the pump and the back pressure loading valve. Relief valves when used on pumps handling non-hazardous chemicals, shall discharge the vented liquid to waste. When used on hazardous chemicals, the valve outlet shall be piped back to the suction supply tank or bunded area. The open end of the return pipe shall be located where it is visible, so that any relief valve leakage/operation can be detected.

Unless otherwise specified flushing connections shall be provided at each pump inlet and flushing shall be manual. When flushing, water shall be discharged either locally through a drain valve or to the point of application of the chemical. Facilities shall also be provided for flushing chemical pump suction and delivery manifold and delivery lines to point of application.

Aluminium Sulphate

The Contractor shall design, supply and install a complete system for the administration of aluminium sulphate necessary as a coagulant, including but not limited to solution preparation and dilution systems, service water supply and carrier water systems, chemical dosing arrangements, pipework, distributors, valves, drains and fittings.

Aluminium sulphate is locally available in lump form packed in bags. The Contractor shall inform himself of the particular characteristics and variability of local sources of the chemical and shall design the plant accordingly.

The preparation and dilution of aluminium sulphate in a desired solution strength shall be undertaken manually. All plant shall be designed to handle fully saturated aluminium sulphate.

Solution tanks shall be provided with special dissolving baskets constructed of plastic or hard teak wood. Mixing of the tank contents shall be carried out with the aid of either motor driven agitators or hand operated mixers of fixed vertically mounted design.

Tanks shall be provided with overflow and drain facilities together with liquid level indicating device in the form of a float and calibrated scale or similar approved arrangement.

In-line uPVC strainers shall be provided on each solution tank outlet pipe at an accessible point external to the tank.

A service water supply shall be provided to each solution tank and shall include a manually operated isolating valve.

Distributors at the dosing points shall be designed to provide even distribution of the aluminium sulphate solution and allow for ease of dismantling and cleaning in the event of blockages.

Hydrated Lime

The Contractor shall design, supply and install a complete system for the administration of hydrated lime necessary for pH correction, including but not limited to slurry preparation and dilution systems, service water supply and carrier water systems, chemical dosing arrangements, pipework, distributors, valves, drains and fittings.

Hydrated lime supplied in the powdered form in bags shall be made up as a slurry in suitably coated steel preparation tanks. Each enclosed tank shall incorporate a powder feed hopper with cover, dust extraction vent, fitted access manway and motor driven slow speed paddle agitator which shall run continuously in order to maintain the lime in suspension.

Tanks shall be provided with water inlet, overflow and drain facilities together with a liquid level indicating device in the form of a float and calibrated scale.

The lime slurry delivery pipes shall be of flexible material and inserted within a pipe sleeve or duct having facilities for ease of delivery pipe maintenance and replacement. All slurry lines shall have provision for flushing the entire system with service water.

A service water supply shall be provided to each slurry preparation tank and shall include a manually operated isolating valve and shall terminate in a ball valve.

Distributors at the dosing points shall be designed to provide even distribution of the hydrated lime slurry and allow for dismantling and cleaning in the event of blockages.

Chlorine

Chlorine shall be applied for disinfection of the total flow, either metered as a gas and transferred to dosing points through carrier waterlines or made up as a chemical solution by the use of calcium/sodium hypochlorite (chloride of lime/chlorous).

(a) Gas Chlorination

Plant for gas chlorination shall be housed in a separate self-contained room with larger installations being provided with a full partition wall between the chlorinator area and the chlorine cylinder/drum store.

The following items of gas chlorination plant shall be equipped where applicable, by the same manufacturer:

- (a) Chlorinators and injectors
- (b) Chlorine gas vacuum regulator and isolating valve
- (c) Automatic gas cylinder/drum changeover device
- (d) Chlorine leak detector

The chlorinators shall be vacuum operated aqueous solution feed type units working in conjunction with remote mounted injectors.

The units shall be either cylinder or wall mounted and shall each be fitted with the following principle components:

- gas inlet vacuum regulating valve;
- pressure/vacuum relief valve with safety vent;
- gas feed rate regulator preferably of the 'V' notch cylindrical plug and variable area orifice type;
- variable area type flowmeter with linear feed rate indicator calibrated in kg;
- remote mounted injector, preferably of the adjustable throat type;
- plastic tubing to remote mounted injector;
- plastic tubing from safety vent arranged for high level atmospheric discharge outside the chlorination plant room.

Chlorinator units shall be suitable for manual dosage control with manual start-up of standby chlorinators on failure of a duty unit.

Injector water supply shall be designed to suit the maximum rated output of each chlorinator offered.

The installation shall include the provision of all necessary motive water pumps, pipework, valves, pressure gauges, variable area flow indicators and injector fittings to serve the chlorination system.

(b) Chlorine Solution Dosing

The preparation and dilution of chlorine in the form of commercial grade bleaching powder supplied in drums shall be made up as a solution at the desired strength.

Solution tanks shall be of robust construction from thermoplastic material such as polyethylene, polypropylene or uPVC, but when proposing materials the Contractor shall consider the deteriorating effect on some materials of the action of ultra-violet light.

Each tank shall be totally enclosed with a fitted access manhole, charging chute with cover and provided with a dissolving basket constructed of chemical resistant materials.

Mixing of the tank contents shall be carried out with the aid of either motor driven agitators or hand operated mixers of fixed vertical design. Agitators and mixers shall be mounted on reinforced support members so that the drive may be easily removed and replaced.

Tanks shall be provided with water inlet, overflow and drain facilities together with a liquid level gauge.

In-line uPVC strainers shall be provided on each solution tank outlet pipe at an accessible point external to the tank.

A service water supply shall be provided to each solution tank and shall include a manually operated isolating valve.

(c) Chlorine Solution Distributors and Injection Fittings

Where chlorine solution is to be dosed into flow in an open channel, chamber or downstream of a hydraulic jump it shall be applied using a chlorine solution distributor.

The distributor shall be a drilled uPVC tubular type diffuser, designed to ensure uniform distribution of the specified flow rate of chlorine solution at the point of application.

The distributor shall be adequately supported and designed to withstand the stream velocity at the point of application and any flow turbulence induced vibrations.

Where chlorine solution is to be dosed into flow in pipelines it shall be applied using an injection fitting/device designed for specified duty flow-rate.

The injection tube shall extend across the pipe bore and be drilled at pre-determined centres to ensure uniform distribution across the flow profile.

The injection fittings shall be adequately supported and designed to withstand the flow velocity at the point of application and any flow or turbulence induced vibrations. Provisions shall also include necessary support brackets.

Chlorine solution distributors or injection fittings shall be supplied complete with necessary non-return and isolation valves.

866 SAFETY EQUIPMENT**(a) Ventilation**

The room housing chlorinators and the chlorine cylinder/drum store shall be made generally gas tight and provided with low level forced ventilation facilities as specified. The controls for ventilation systems shall be situated outside the room.

In single cylinder installations situated at ground level natural ventilation facilities shall be made available provided there is external access to the room.

(b) Chlorine Leak Detection

Equipment shall be provided where specified to detect abnormal concentrations of chlorine in air such as would occur on significant leakage or failure of chlorination plant or

chlorine cylinder/drums.

The detectors shall be specific to chlorine, have two adjustable alarm levels and be sensitive to gas concentrations greater than 1 ml/m³ at a concentration level in the range of up to 4 ml/m³.

The detector unit shall be housed within a fume proof plastic cabinet suitable for wall mounting. The front panel of the cabinet shall be provided with facilities for indicating the gas concentration together with leak alarm, detector failure, circuit test and alarm reset indicator buttons.

The alarm switches shall be provided with volt free contacts for initiating a locally mounted 'klaxon' alarm facility.

Sensor cells shall be suitable for remote wall mounting and located at low level in the proximity of chlorine handling items/equipment.

(c) Breathing Apparatus

Suitable canister type gas mask respirators shall be provided for the chlorinator room and chlorine gas store. The respirators shall be of an approved make and housed in a wall mounted weatherproof cabinet within the room. Spare canisters shall be provided.

(d) Self-Contained Air Breathing Apparatus

Self-contained emergency air breathing apparatus shall provide complete respiratory protection independent of the surrounding toxic or oxygen deficient atmosphere for about 35 minutes depending upon the degree of exertion. The unit shall combine total reliability with a high degree of mobility to facilitate unhindered emergency rescue or maintenance work.

Each set of apparatus shall comprise, but not limited to, a cylinder, pressure reducing valve, demand valve, panoramic vision face mask, bypass valve, and harness and waist strap made from rot proof materials. The apparatus shall incorporate a warning whistle in the pressure gauge line to indicate approaching exhaustion of the cylinder. The cylinder shall have 180 litres free air capacity at a working pressure of 207 bar and shall conform to SSRN 090.

A recharging compressor of delivery pressure 207 bar compatible with the breathing apparatus shall be supplied for the central workshop. Each set of apparatus shall be capable of accepting an additional face mask complete with its own demand valve and supply hose in an emergency.

Each set shall be displayed in a glass fronted non-locking wall cabinet with a spare fully charged cylinder, all mounted near the entrance on the outside of the chlorine gas store.

(e) Breathing Apparatus

Set of PVC overalls, gloves, goggles and rubber boots all in medium sizes, obtained from an approved supplier, shall be provided as necessary. **(f) Safety Signs**

Safety signs to SSRN 091 shall be provided as necessary for the gas chlorination plant together with an instruction card for first aid in case of gas poisoning.

General Requirements

(a) Supply

Air compressor shall be of the electric driven 2 cylinder type mounted on a bed plate with anti vibration mountings. The compressor shall be of the air cooled oil free set suitable for charging the main surge vessels and pneumatic air systems where specified. Unless otherwise stated air shall be compressed to 10 bars.

The compressor shall normally operate in automatic mode controlled by:

- One pressure switch (min/max pressure)
- A manual/automatic selector switch

The compressor set shall comprise of compressor –electric motor combination, V-belt drive and guard, compressor accessories, motor starter and controls and cabling from the motor to the starters.

The compressor accessories shall include but not be limited to the following:

- Air drier
- One air receiver of capacity as specified but not less than 500 litres
- Pressure relief and safety valves
- Isolating and check valves
- Air intake filter (throw away type) and silencer
- Automatic pilot unloading valve
- Oil filter cap, level dipstick and oil drain cock
- Connection between motor and starter, motor and pilot valve
- Pressure gauge
- Pressure operated electrical switch

(b) Spare Parts

Where specified the following compressor spare parts shall be provided.

Spares for the overhaul of air compressor shall include:

- Set of piston rings (Compression and oil rings)
- Set of spring leaf
- Set of scrapper rings

- V belts
- Set of bearings including for electric motor
- Set of overhauling gaskets
- Set of oil seals
- Pilot unloading valve

868 AIR SCOUR BLOWERS

The air scour blowers shall be twin cylinder Roots double-lobe type. The exact specifications shall be confirmed depending on the filter media and type of nozzles used.

The air scour blower shall be complete with:

- ☐ Pressure Reduction Valve where specified
- ☐ Pressure Release (Safety) Valve
- ☐ Air Cleaner
- ☐ Pressure gauge
- ☐ Starter

869 POWER/MANUALLY OPERATED OVERHEAD CRANES

Cranes shall be manufactured in accordance with SSRN 087 medium duty class 2. For a generating station crane, its lifting capacity shall be 50% in excess of the weight of either the generator crankshaft, or the alternator, or of any other item which it could reasonably be required to lift, whichever is the heaviest. For a pumping station crane its lifting capacity shall be 50% in excess of the weight of either the heaviest main pump, or the motor which drives it, whichever is the heavier.

The winch shall be either of wire rope or chain as specified and the hook shall be provided with a safety latch.

The crane shall be complete with the gantry, angle support irons, columns, rails, end stops, holding down bolts and all other items required for a complete installation.

Sufficient slings, ropes, shackles, lifting beams etc. shall be supplied to allow the lifting of all the items plant served by the crane. In accordance with the safety code, these shall be marked with their safe working load and the purpose for which they are intended.

The crane shall not be operated unless the Contractor obtains a test certificate after a statutory inspection of the crane by a person approved by the relevant authority to undertake such statutory inspections.

CHAPTER 9

**STANDARD SPECIFICATION REFERENCE
NUMBERS (SSRN)**

STANDARD SPECIFICATION REFERENCE NUMBERS
(SSRN)

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CONCRETE

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SSRN	SUBJECT	BS	BS EN	BS ISO	PART	YEAR	DIN	PART	ICS No	OTHER
100 (a)	CONCRETE-GUIDE TO SPECIFYING	[5328]			1	1997	1045		91.100.30	
100 (b)	CONCRETE - SPECIFICATION, PRODUCTION, CONFORMITY		206		1	2000				
100 (c)	CONCRETE - CONSTITUENT MATERIALS SPECIFICATION		8500			2006				
101	STRUCTURAL USE OF CONCRETE	[8110]	1992		1	2004	See VOB		91.080.40	BS 8110 remains current
102	CONCRETE-WATER RETAINING STRUCTURES	[8007]	1992		3	2006			91.080.40	BS 8007 remains current
103 (a)	ORDINARY PORTLAND CEMENT		197		1	2000	1164	1, 2, 8	91.100.10	
103 (b)	ORDINARY PORTLAND CEMENT		197		1	2000	1164	1, 2, 8	91.100.10	
104	SULPHATE RESISTING PORTLAND CEMENT						1164	1;CL.4	91.100.10	
105	MORTAR, SCREEDS & PLASTERS-TESTING						1164	1;CL.4-4	91.100.10	
106 (a)	CEMENT - TEST FOR SETTING TIME & SOUNDNESS		196		3	2005	1164	EN 196	91.100.10	
106 (b)	CEMENT - TEST FOR FINENESS		196		6	2010	1164	EN 196	91.100.10	
107 (a)	TESTING AGGREGATES-SAMPLING AND TESTING								91.100.20	
107 (b)	TESTING AGGREGATES-METHODS OF SAMPLING								91.100.20	
107 (c)	TESTING OF AGGREGATES (CONT)						4226	1-4	91.100.30	
108 (a)	FINE AGGREGATES FOR CONCRETE - GENERAL		12620			2002			91.100.20	
108 (b)	FINE AGG. FOR CONCRETE - GENERAL (CONT)						4226	1-4	91.100.30	
109 (a)	FINE AGGREGATES FOR CONCRETE - GRADING		12620			2002			91.100.20	
109 (b)	FINE AGGREGATES FOR CONCRETE-GRADING (CONT)						4226	1-4	91.100.30	
110 (a)	COARSE AGGREGATES FOR CONCRETE - GENERAL		12620			2002			91.100.20	
110 (b)	COARSE AGG. FOR CONCRETE - GENERAL (CONT)						4226	1-4	91.100.30	
111 (a)	COARSE AGGREGATES FOR CONCRETE-GRADING		12620			2002			91.100.20	
111 (b)	COARSE AGG. FOR CONCRETE GRADING (CONT)						4226	1-4	91.100.30	
112 (a)	AGGREGATES-CON. SHRINKING & ABSORPTION	812			2, 120	1995			91.100.20	
112 (b)	COARSE AGG.-CON SHRINKING & ABSORPTION (CONT)						4226	1-4	91.100.30	
113 (a)	COARSE AGGREGATE FOR CONCRETE-FLAKINESS	812				1989			91.100.20	
113 (b)	COARSE AGGREGATE FOR CON.-FLAKINESS (CONT)						4226	1-4	91.100.30	
114	CONCRETE-WATER FOR MAKING		1008			2002			13.060.25; 91.100.30	
115 (a)	CONCRETE - SPECIFYING MIXES	5328			1	2000			91.100.30	
115 (b)	CONCRETE - CHOOSING MIXES & CONSTITUENTS	5328			1	2000	1084	1	91.100.30	
115 (c)	CONCRETE - SAMPLING, TESTING & ASSESSING	5328			1	2000			91.100.30	
115 (d)	CONCRETE - LAB. TESTING OF FRESH CONCRETE		12350		2	2000			91.100.30	
116	CONCRETE TESTING-SLUMP TEST	1881			125	1986			91.100.30	
117 (a)	CONCRETE TESTING-TEST CUBES		12390		2	2000	1048	5	91.100.30	
117 (b)	CONCRETE TESTING-TENSILE/COMPR. STRENGTH		12390		6	2000			91.100.30	
117 (c)	CONCRETE TESTING - FLEXURAL STRENGTH		12390		5	2000			91.100.30	
117 (d)	CONCRETE TESTING - WORKABILITY		12390		5	2000			91.100.30	
117 (e)	CONCRETE TESTING - COMPRESSION TEST MACHINE		12390		4	2000			91.100.30	
117 (f)	CONCRETE TESTING - AFTER HARDENING		12390		7	2000	1048	2	91.100.30	
117 (g)	CONCRETE TESTING - AFTER HARDENING (CONT)	1881			207, 208,2	various			91.100.30	
117 (h)	CONCRETE TESTING - LAB. MIXING & SAMPLING	1881			125	1986			91.100.30	
117 (j)	CONCRETE TESTING - FRESH, SEMI-DRY DENSITY	1881	12350		6	2000	1048	1	91.100.30	
118	CONCRETE MIXERS-BATCH TYPE	1305				1974			91.22	
119	CONCRETE MIXERS-PERFORMANCE	3963				1974			91.22	
120	STRUCTURAL USE OF CONCRETE	8110	1992-1		1	2004			91.080.40	
121	CONCRETE - READY MIXED	8500			1,2	2002			91.100.30	
122	BITUMEN RUBBER JOINT SEALING COMPOUND	2499			1, type A1	1993			93.080.20	
123 (a)	JOINT SEALING-POLYSULPHIDE COMPOUND			11600		2003			91.100.50	
123 (b)	JOINT SEALING-THERMOPLASTIC SEALING STRIPS						18541	1, 2	91.100.50	
123 (c)	POLYSULPHIDE JOINT SEALING COMP. (CONT)								91.100.50	

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SSRN	SUBJECT	BS	BS EN	BS ISO	PART	YEAR	DIN	PART	ICS No	OTHER
124	WATERPROOF BUILDING PAPERS		1521		(Class A)	1997			91.100.99	
125	IMPACT TESTING OF MILD STEEL						50115		77.040.10	
126 (a)	STEEL R/F-HOT ROLLED STEEL BARS	4449				2005			77.140.60	
126 (b)	STEEL R/F-HOT ROLLED STEEL BARS (CONT)						488	1-3	77.140.15	
127 (a)	STEEL R/F-COLD TWISTED	4449				2005			77.140.60	
127 (b)	STEEL R/F-COLD TWISTED (CONT)						488	1-3	77.140.15	
128 (a)	STEEL R/F STEEL FABRIC	4482				2005			77.140.65	
128 (b)	STEEL R/F STEEL FABRIC (CONT)	4483				1998			77.140.99	
128 (c)	STEEL R/F STEEL FABRIC (CONT)						488	4-5	77.140.15	
129	BAR REINFORCEMENT & BENDING			4066		2000			77.140.60	
130 (a)	SAND FOR INTERNAL PLASTERING		13139			2002			91.100.20	
130 (b)	SAND FOR INTERNAL PLASTERING (CONT)		1200			2005			91.100.20	
131	PLYWOOD SHUTTERING					1995			79.060.10	
132 (a)	CONCRETE COMPACTION-GUIDE TO	8500			1,2	2002			91.100.30	
132 (b)	CONCRETE COMPACTION-VIBRATION EQUIPMENT						4235	1,2	91.22	
133	CONCRETE - SITE QUALITY CONTROL	8500			3	2002			91.100.30	
134	DESIGN OF CONCRETE MIXES-METHODOLOGY	8500			2	2002			91.100.30	
135	SAND FOR MORTAR	1200				1998			91.100.20	
136	SAND FOR RENDERING	1199				2005			91.100.20	
137	HOT APPLIED JOINT SEALER	2499			2	1992			93.080.20	
138 (b)	WATER STOPS AND WATER BARS (CONT)						7865	12	83.140.10; 91.100.50	
139	CONCRETE TESTING - COMP. MODULUS OF ELAST'ITY	1881			121	1983			91.100.30	
140	CONCRETE TESTING - WATER ABSORPTION	1881			122	2011			91.100.30	
141	CONCRETE TESTING - FRESH CONCRETE CYLINDERS	1881	12390		1,2	2000			91.100.30	
142	PRECAST CONCRETE COMPONENTS - COPINGS	5642			2	1983			91.060.10	
143	STRUCT. USE OF CONC. - DESIGN & CONSTRUCTION	8110			1	1997			91.080.40	
144	STRUCT. USE OF CONC. - SPECIAL CIRCUMSTANCES		1992		1	2004			91.080.40	
145	IN-SITU-CONCRETE DIAPHRAGM WALLS						4126		93.02	
146	TEST SIEVES FOR THE AGGREGATES	410			2	2000			19.12	≠ ISO 565; ISO 2194; ISO 3310/1; ISO 3310-2:1990; ISO 3310-3:1990
147 (a)	LIGHTWEIGHT AGGREGATES FOR CONCRETE		13055		1	2002			91.100.20	
147 (b)	LIGHTWEIGHT AGGREGATES FOR CONCRETE (CONT)						4226	2	91.100.30	
148	SUPERSULPHATED CEMENT	4550				1978			91.100.10	
149	BLAST FURNACE SLAG AGGREGATE	1047	12620			2002			91.100.20	
150	LIGHTWEIGHT AGGREGATES	3797	13055		1	2002			91.100.20	
151	NON METALLIC PRODUCTS & POTABLE WATER	6920			1	2000			13.060.20	
152	CONCRETE. COMPLIANCE CRITERIA		206		1	2000			91.100.30	
153	EPOXY COATED REINFORCING STEEL	7295		14654	1, 2	1999			77.140.60	
154	FORMWORK-DESIGN, ERECTION, USE	5975				2008			91.22	
155	WATER AGGRESSIVENESS TO CONCRETE						4030	1, 2	91.100.30	
156 (a)	STEEL, CONC. & COMPOSITE BRIDGES - DESIGN	5400			1	1988	1072		93.04	≠ ISO 2394
156 (b)	STEEL, CONC. & COMPOSITE BRIDGES - MAT. & WORK'P	5400			6	1999			93.04	≠ ISO 2394
156 (c)	STEEL, CONC. & COMPOSITE BRIDGES - BEARINGS	5400	1337		2,3,5,7,8	various			93.04	≠ ISO 2394
156 (d)	STEEL, CONC. & COMPOSITE BRIDGES - FATIGUE	5400			10	1999			93.04	≠ ISO 2394
157	PRE-CAST REINFORCED CONCRETE CULVERTS									SABS 986:2006 ed. 3.01
158 (a)	PORTLAND CEMENT EXTENDERS - GROUND GRANULATED BLAST-FURNACE SLAG									1491-1:2005 ED. 2
158 (b)	PORTLAND CEMENT EXTENDERS - FLY ASH									1491-2:2005 ed. 2
158 (c)	PORTLAND CEMENT EXTENDERS - SILICA FUME									1491-3:2006 ed. 2.01

≠: related but not equivalent to BS =: technically equivalent to BS =: identical to BS

METALLIC PIPES

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SSRN	SUBJECT	BS	EN	BS ISO	PART	YEAR	DIN	PT:YR	ICS No	OTHER
200 (a)	GREYCAST IRON PRESSURE PIPES AND FITTINGS (see BS 4722)	[1211]				1958			23.040.10	≠ ISO 13; ISO 49
200 (b)	GREY IRON PIPES AND FITTINGS (CONT)	(4722)				1970			23.040.10; 23.040.40	≠ ISO 13
200 (c)	GREY IRON PIPES AND FITTINGS - SEWERAGE	(4772)	598			2007			23.040.10; 23.040.40	
201 (a)	CAST IRON FLANGED PIPES & FITTINGS	[2035]	598			2007			23.040.10; 23.040.40	
201 (b)	CAST IRON FLANGED PIPES & FITTINGS - GAS	(4772)	969			2009			23.040.10; 23.040.40	
202 (a)	DUCTILE IRON PIPES & FITTINGS (WATER)		545	2531		2006			23.040.10; 23.040.40	
202 (b)	DUCTILE IRON PIPES & FITTINGS (SEWERAGE)		598			2007			23.040.10; 23.040.41; 93.030	
202 (c)	DUCTILE IRON PIPES & FITTINGS (GAS)		969			2009			23.040.10; 23.040.40	
203 (a)	STEEL TUBES WITH PLAIN OR THREADED ENDS	(1387)	10255			2004			23.040.10	= ISO 65
203 (b)	STEEL TUBES WITH THREADED ENDS - MEDIUM WEIGHT		10255			2004	(2440)		23.040.10	
203 (c)	STEEL TUBES WITH THREADED ENDS - HEAVY WEIGHT		10255			2004	(2441)		23.040.10	
203 (d)	STEEL TUBES WITH THREADED ENDS NP 1 - 100						2442	:1963	23.040.10	
203 (e)	STEEL TUBES WITH THREADED ENDS - THREADS - WHITWORTH (Partially replaced by BS EN 10226-1:2004.	21				1985	76	2:1984	21.040.10	= ISO 7/1:1982; ≠ ISO 7/2:1982
203 (e)	STEEL TUBES WITH THREADED ENDS-THREADS		10226		1, 2, 3	04, 05, 06			21.040.30	≠ ISO 7/1:1982
204 (a)	WROUGHT STEEL PIPE FITTINGS TO SSRN 203	(1740-1)	10241			2000			23.040.40	≠ ISO 4145
204 (b)	TH. STEEL PIPE FITTINGS TO SSRN 203						[2980]	:1977	23.040.40	
204 (c)	TH. STEEL PIPE FITTINGS TO SSRN 203-LONG THREAD						[2981]	:1982	23.040.40	
204 (d)	TH. STEEL PIPE FITTINGS TO SSRN 203-NIPPLES						[2982]	:1977	23.040.40	
204 (e)	TH. STEEL PIPE FITTINGS TO SSRN 203-BENDS						[2983]	:1977	23.040.40	
204 (f)	TH. STEEL PIPE FITTINGS TO SSRN 203-TEES ETC.		10241			2000	[2987]	1, 2	23.040.40	
204 (g)	W. STEEL PIPE FITT. TO SSRN 203-BUSHINGS						[2990]	:1977	23.040.40	
204 (h)	W. STEEL PIPE FITT. TO SSRN 203-PLUGS & CAPS						[2991]	:1977	23.040.40	
204 (i)	TH. STEEL PIPE FITTINGS TO SSRN 203-SOCKETS						[2986]	:1977	23.040.40	ISO 7-2:1982
204 (j)	W. STEEL PIPE FITT. TO SSRN 203-RED'NG SOCKETS						[2988]	:1977	23.040.40	
205 (a)	COPPER TUBES FOR WATER		1057			2006/10			23.040.15; 77.150.30	
205 (b)	COPPER TUBES FOR WATER - PREFERRED DIMENSIONS		12499			2003	(1754)	3	23.040.15	
205 (c)	COPPER TUBES FOR WATER (CONT)		12499			2003	(1755)	3	23.040.15	
206 (a)	COPPER TUBES - GENERAL PURPOSE - PIPELINES	(2871-2)	12449			2003			23.040.30; 77.150.30	≠ ISO 196:1978
206 (b)	COPPER TUBES - GENERAL PURPOSE - ELECTRICAL PURPOSES		13600			2002	(1754)	1, 2	23.040.15	
206 (c)	COPPER TUBES - GENERAL PURPOSE - DIMENSIONS		12499			2003	(1755)	1, 2	23.040.15	
207	FLANGES FOR FERROUS PIPES - COPPER ALLOY BY PN		1759		3	2003			23.040.60	ISO 7005-3:1988;
207 (a)	FLANGES FOR FERROUS PIPES - STEEL BY PN	(4504-3.1)	1092		1	2007	(2519)	1	23.040.60	ISO 7005-1:2011
207 (b)	FLANGES FOR FERROUS PIPES - STEEL BY CLASS	(1560-3.1)	1759		1	2007			23.040.60	≠ ANSI B 16.5
207 (c)	FLANGES FOR FERROUS PIPES - C.I. BY CLASS	1560			3.2	1989			23.040.60	≠ ISO 7005-2
207 (d)	FLANGES FOR FERROUS PIPES - C.I. BY PN	(4504-3.2)	1092		2	1997			23.040.60	≠ ISO 2531:1991; ≠ ISO 7005-2:1988
207 (e)	FLANGES FOR FERROUS PIPES-SLIP ON FOR WELDING		1092		1	2002	(2576)		23.040.60	
207 (f)	FLANGES FOR FERROUS PIPES-WELDING NECK						[2627-38]	:1975	23.040.60	
207 (g)	FLANGES FOR FERROUS PIPES-SCREWED		1092		1	2002	(2566)		23.040.60	
207 (h)	FLANGES FOR FERROUS PIPES-LAPPED-PLAIN COLLAR		1092		1	2002	(2655-56)		23.040.60	
207 (i)	FLANGES FOR FERROUS PIPES-LOOSE-WELDING NECK		1092		1	2002	(2673)		23.040.60	
207 (j)	FLANGES FOR FERROUS PIPES-CONTACT SURFACES						[2526]	:1975	23.040.60	
207 (k)	FLANGES FOR FERROUS PIPES-BLANK - NP 6 to 100		1092		1	2002	(2527)		23.040.60	
208 (a)	GASKET DIMENSIONS TO SSRN 207 (a) & (d)		1514		1	1997			23.040.80	
208 (b)	GASKET DIMENSIONS TO SSRN 207 (a) & (d) (CONT)		1514		2	2005			23.040.80	
208 (c)	GASKET DIMENSIONS TO SSRN 207 (a) & (d) (CONT)		1514		3	1997			23.040.80	
208 (d)	GASKET DIMENSIONS TO SSRN 207 (a) & (d) (CONT)		1514		4	1997			23.040.80	
208 (e)	GASKETS-FOR GROOVED FLANGES		1514		8	2005	(2693)		23.040.80	
208 (f)	GASKETS-COVERED SERRATED METAL		1514		6	2003	(2697)		23.040.80	
208 (g)	GASKET DIMENSIONS TO SSRN 207 (a) & (d)-COVERED METAL JACKETED		1514		7	2004			23.040.80	
208 (h)	GASKETS-SPIRAL WOUND FOR STEEL FLANGES TO BS 1560	3381				1989			23.040.80	
208 (i)	GASKETS-DIMENSIONS-NON-METALLIC TO BS 1560	7076			3	1989			23.040.80	
208 (j)	GASKETS-NON-METALLIC FLAT WITH/WITHOUT INSERTS TO SSRN 208 (b)		12560		1	2001			23.040.80	

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SSRN	SUBJECT	BS	EN	BS ISO	PART	YEAR	DIN	PT:YR	ICS No	OTHER
208 (k)	GASKETS-SPIRAL WOUND TO SSRN 208 (b)		12560		2	2001			23.040.80	
208 (l)	GASKETS-NON-METALLIC PTFE ENVELOPE TO SSRN 208 (b)		12560		3	2001			23.040.80	
208 (m)	GASKETS-CORRUGATED FLAT OR GROOVED METALLIC TO SSRN 208 (b)		12560		4	2001			23.040.80	
208 (n)	GASKETS-METALLIC RING JOINT TO SSRN 208 (b)		12560		5	2001			23.040.80	
208 (o)	GASKETS-QUALITY ASSURANCE AND TESTING TO SSRN 208 (a) to (n)		14772			2005			23.040.80	
209	CAST IRON - PIPE FITTINGS - MALLEABLE - THREADED		10242			1995			23.040.40	≠ ISO 49:1994
210	STEEL PIPES, JOINTS & SPECIALS - GENERAL [BS 534:1990 withdrawn 01/01/12]	(534)								
		(534)								
210 (a)	STEEL PIPES - WATER - TUBES & FITTINGS		10224			2002	(2460)		23.040.10, 23.040.40	AWWA C200-97, (NF A 49-150)
210 (b)	STEEL PIPES - WATER - JOINTS		10311			2005			23.040.60	
210 (c)	STEEL PIPES & FITTINGS - DESIGN, ETC-CODE OF PRACTICE-PIPELINES IN	PD 8010			1	2004			23.040.10, 75.200	AWWA M11
210 (c)	STEEL PIPES & FITTINGS - DESIGN, ETC - PIPES & BENDS						[2413]	1, 2:1993	23.040.10, 75.200	AWWA M11
210 (d)	STEEL PIPES & FITTINGS - WELDING JOINTS - CODE OF PRACTICE	CP 2010			2	1970			23.040.10	AWWA M11
210 (d)	STEEL PIPES & FITTINGS - WELDING JOINTS - EDGE PREPARATION						[2559]		23.040.10	AWWA M11
211 (a)	CEMENT MORTAR LINING - D.I. PIPES		545			2010			23.040.10, 23.040.40	AWWA C104/A21.4-03, C602-06
211 (b)	CEMENT MORTAR LINING - D.I. PIPES						2880	:1999	23.040.99	
211 (c)	CEMENT MORTAR LINING - D.I. PIPES (CONT)			4179		2005			23.040.10	DVGW W343, ISO 4179:1985, ISO 6600:1980,
212 (a)	CEMENT MORTAR LINING, SHOP APPLIED - STEEL PIPES	(534)				1990	2880	:1999	23.040.10; 91.140.60; 91.140.80	AWWA C 205-2012, DVGW-W343/W346
212 (b)	CEMENT MORTAR LINING, IN SITU - STEEL PIPES						2880	:1999	23.040.99	AWWA C 602-95 ISO / DIS 8324
212 (c)	CEMENT MORTAR LINING - STEEL PIPES		10298			2005			23.040.10, 23.040.40, 25.220.99	(NF A 49-701)
213 (a)	STEEL PIPES & TUBES-MATERIAL, PROPERTIES & TESTS	(3600)	10220			2002			23.040.10, 77.140.75	AWWA C200-97
213 (b)	CARBON STEEL PIPES AND TUBES-SEAMLESS- FOR PRESSURE PURPOSES	(3601)	10216		1	2002	[1629]		23.040.10, 77.140.75	≠ ISO 2604/2 /3 /6
213 (b)	CARBON STEEL PIPES AND TUBES-WELDED-NON ALLOY STEEL		10217		1	2002	[1630]			
213 (c)	STEEL PIPES AND TUBES - WELDED-SPECIAL REQUIREMENTS		10217		1	2002	(1626)		23.040.10	
213 (d)	STEEL PIPES AND TUBES - SEAMLESS		10220			2002	(2448)		23.040.10	
213 (d)	STEEL PIPES AND TUBES - SEAMLESS - FOR PRESSURE PURPOSES		10216		4	2002			23.040.10	
213 (e)	STEEL PIPES AND TUBES-WELDED		10220			2002	(2458)		23.040.10	
214 (a)	BITUMEN PROTECTION TO IRON AND STEEL - HOT	(4147)	10300			2005			23.040.99, 25.220.60, 75.180.10	(BS 4147 type I, grade 'd')
214 (b)	BITUMEN PROTECTION TO IRON AND STEEL- COLD	3416				1991			25.220.60	(BS 3416 type II)
214 (c)	BITUMEN PROTECTION TO STEEL PIPES ETC.		10300			2005	(30673)	Type E4	23.040.10; 23.040.40	
214 (d)	ZINC & BITUMEN PROTECTION TO DUCTILE IRON PIPES						30674	3:2001	23.040.10	
215	EXT. PROTECTION - IRON & STEEL-EPOXY C.									AWWA C210-97
216 (a)	STEEL FITTINGS - REINFORCING									AWWA C208-07 AWWA M11
216 (b)	STEEL FITTINGS - DIMENSIONS		10224			2002			23.040.10, 23.040.40	AWWA C208-07
217	D.I. PIPES & FITT.-SCREWED GLAND JOINTS									See SSRN 219
218	D.I. PIPES & FITT.-BOLTED GLAND JOINTS									See SSRN 219
219 (a)	D.I. PIPES & FITTINGS - CODE OF PRACTICE	[8010]			2.1	1987			23.040.10, 91.060.01	
219 (b)	D.I. PIPES & FITT.-S & S JOINTS (CONT)		545			2010			23.040.10; 23.040.40	
219 (c)	D.I. PIPES & FITT.-S & S JOINTS (CONT)						28603	:2002	23.040.60	
219 (d)	D.I. PIPES - DRAINS & SEWERS - HYDRAULIC DESIGN		752			2008			93.030	
219 (e)	D.I. PIPES - DRAINS & SEWERS - CONSTRUCTION & TESTING		1610			1998			91.140.80, 93.030	
220	D.I. PIPES-ZINC COATING & PROTECTIVE FINISHING LAYER						30674	pt 3:2001	23.040.10	
221 (a)	IRON AND STEEL PIPES-ENAMEL-HOT APPLIED - CODE OF PRACTICE	7873				1996			23.040.10; 25.220.50	AWWA C203-08
221 (b)	STEEL FLANGED PIPES & FITTINGS - ENAMELLED - PN 10 & 16						2873	:2002	23.040.60	
222 (a)	ELASTOMERIC JOINTS RINGS - THERMOPLASTIC ELASTOMERS	(2494)	681		2	2000			23.040.80	
222 (b)	ELASTOMERIC JOINTS RINGS-VULCANISED RUBBER	(2494)	681		1, 3	'96, '00			23.040.80, 83.060	
222 (c)	ELASTOMERIC JOINTS RINGS-DRAINS & SEWERS						4060	:1998	23.040.80	
223	PIPE THREADS-TUBES & FITT. (WATERTIGHT)	[21]	10226		1	2004			21.040.30	= ISO 7/1:1982; ≠ ISO 7/2:1982

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224	CAST IRON S & S PIPES AND FITTINGS	4772				1988			23.040.40	
224 (a)	DUCTILE IRON PIPES AND FITTINGS-SEWERAGE-REQUIREMENTS & TEST METHODS	(4772)	598			2007			23.040.10, 23.040.40	≠ ISO 2531, ISO 4179, ISO 8179
224 (b)	DUCTILE IRON PIPES AND FITTINGS-WATER-REQUIREMENTS & TEST METHODS		545			2010				
224 (c)	DUCTILE IRON PIPES AND FITTINGS-GAS PIPELINES-REQUIREMENTS & TEST METHODS		969			2009				
225	STEEL PIPES-HOT DIP GALVANISING		10240			1998			23.040.10, 25.220.40, 77.140.75	
226 (a)	CARBON STEEL FITTINGS - BUTT-WELDING-GENERAL	[1965-1]	10253		1	1999			23.040.40	
226 (a)	STEEL FITTINGS - BUTT WELDING - FITTINGS - GENERAL						[2609]	:1991	23.040.40	
226 (b)	STEEL FITTINGS - BUTT-WELDING-TEES						[2615]	1, 2:1992	23.040.40	
226 (c)	STEEL FITTINGS - BUTT-WELDING-REDUCERS						[2616]	1, 2:1991	23.040.40	
226 (d)	STEEL FITTINGS - BUTT-WELDING-CAPS						[2617]	:1991	23.040.40	
227 (a)	POLYTHENE SLEEVEING FOR D. I. PIPES & FITTINGS								23.040.10	ISO 8180:2006
227 (b)	POLYTHENE COATING FOR D. I. PIPES		14628			2005	(30674)	pt 1:1982	23.040.10	
228 (a)	STEEL PIPES - DIMENSION & MASSES - PRESSURE PURPOSES	(3600)	10220			2002	(2413)	1, 2:1993	23.040.10, 77.140.75	
228 (b)	STEEL PIPES - DIMENSION & MASSES - WATERWORKS PURPOSES						[2460]	:1992	23.040.10	
228 (c)	STEEL PIPES - PREFERRED MINIMUM THICKNESS AND GRADES		10224			2002			23.040.10	≠ ISO 559:1991, AWWA C200-07
229 (a)	STAINLESS STEEL TUBES AND WIRES	(1554)	10088		3	2005	(17440)		77.140.20, 77.140.50, 77.140.65	
229 (b)	STAINLESS STEEL TUBES AND WIRES (CONT) - SPEC. FOR TUBES	4825			1	1991			67.260; 77.140.75	≡ ISO 2037:1992
229 (c)	STAINLESS STEEL TUBES AND WIRES (CONT)	6362				1990			23.040.10	≡ ISO 7598:1988
229 (d)	STAINLESS STEEL TUBES FOR PRESSURE PURPOSES			10217	7	2005	(17457)		23.040.10	
229 (e)	STAINLESS STEEL BARS, RODS AND WIRES									
229 (f)	STAINLESS STEEL TUBES - WELDED - CONVEYANCE OF AQUEOUS LIQUIDS		10312			2002			23.040.10	
229 (g)	STAINLESS STEEL TUBES - SEAMLESS - PRESSURE PURPOSES		10216		5	2004			23.040.10	
230 (a)	STEEL PIPES FOR WATER FLEXIBLE S&S JOINTS - W/WORKS SERVICES	CP 2010			2	1970	[2460]	:1992	23.040.10	≠ ISO 559:1991
230 (b)	STEEL PIPES FOR WATER FLEXIBLE SOCKET & SPIGOT JOINTS	(539)	10224			2002			23.040.10	AWWA C200-05
231	PIPE COMPONENTS - DEFINITION OF NOMINAL PRESSURE									ISO 7268:1983
232	PIPELINES - TAPE COATING SYSTEMS - NO CATHODIC PROTECTION						30672	:2000	23.040.99	AWWA C214-07
233 (a)	BURSTING DISCS & DEVICES - DESIGN, INSPECTION & PACKAGING	[2915]	4126		2	2003			13.240, 23.060.40	
233 (b)	BURSTING DISCS & DEVICES - SELECTION & INSTALLATION	[2915]	4126		6	2003			13.240, 23.060.40	
233 (c)	BURSTING DISCS & DEVICES - COMMON DATA	[2915]	4126		7	2004			13.240, 23.060.40	
234	STEEL PIPES FOR PETROLEUM AND GAS INDUSTRY (INC. FOR WATER)		10208		1, 2	2009	(17172)		23.040.10	API 5L-04 (43rd EDITION)
235 (a)	FITTINGS TO STAINLESS STEEL TUBES - BENDS & TEES	4825			2	1991			67.260, 77.140.75	≠ ISO 2851:1993
235 (b)	FITTINGS TO STAINLESS STEEL TUBES - CLAMP TYPE COUPLINGS	4825			3	1991			67.260, 77.140.75	≠ ISO 2852:1993
235 (c)	FITTINGS TO STAINLESS STEEL TUBES - THREADED COUPLINGS	4825			4	1991			67.260, 77.140.75	≠ ISO 2853:1993
235 (d)	FITTINGS TO STAINLESS STEEL TUBES - RECESSED JOINT COUPLINGS	4825			5	1991			67.260, 77.140.75	
235 (e)	FITTINGS TO STAINLESS STEEL TUBES (CONT) - TUBES	4825			1	1991			67.260, 77.140.75	≡ ISO 2037:1992
236	COPPER FITTINGS TO TUBES FOR ENGINEERING PURPOSES (OBSELECENT, CURRENT)	2051			1	1973			23.040.40	
237	ELASTOMERIC SEALS FOR JOINTS FOR PIPELINES	(2494), 7874:98 (3574)	681 682		1, 2, 3, 4	'96,'00 2002			23.040.80	≠ ISO 4633:2002; ISO 6447:1983; ISO 6448:1985
238	STORAGE OF VULCANISED RUBBER			2230		2002			83.06	
239	BITUMINOUS VARNISH TO DUCTILE IRON PIPES									ISO 8179-2:1995
240 (a)	FOUNDING - SPHEROIDAL GRAPHITE CAST IRON		1563			2011			77.080.10	
240 (b)	FOUNDING - AUSTEMPERED DUCTILE IRON CASTINGS		1564			2011			77.140.80	
241 (a)	FUSION BONDED EPOXY COATINGS FOR STEEL PIPES		10289			2002	(30671)		23.040.99, 25.220.60	AWWA C213-07
241 (b)	PRECAST CONCRETE KERBS, CHANNELS & FLAGS - SPEC:		1339			2003			23.040.99, 25.220.60	AWWA C213-07
241 (c)	STEEL PIPES - 2 LAYER POLYETHYLENE FBE COATING		10288			2006			23.040.10, 23.040.40, 25.220.60	
242	FLEXIBLE BOLTED SLEEVE COUPLINGS		10311			2005			23.040.60	AWWA C219-06
243	FLEXIBLE GROOVED AND SHOULDERED COUPLINGS	CP 2010			2	1970			23.040.10	AWWA C606-11
244	SPHERICAL JOINTS FOR WELDING, STEEL PIPES	(534)	10311			2005			23.040.60	UNI 6363

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245	SEAL COATINGS ON D.I. PIPE WITH CEMENT MORTAR LINING	(7892)		16132		2004			23.040.10, 77.140.75	
246	POLYMERIC FILM PROT. SLEEV'G FOR IRON PIPES - FIELD & FACTORY	6076				1996			83.140.10	
247	HOT ENAMEL COATING AND LINING TO IRON & STEEL PIPES	7873				1996			23.040.10; 25.220.50	
248	EXTERNAL ZINC COATINGS ON DI PIPES			8179	1	2004			23.040.10	
249 (a)	FLANGES AND THEIR JOINTS - BOLTING - SELECTION		1515		1	2000	(2507)		21.060.10	
249 (b)	FLANGES AND THEIR JOINTS - BOLTING - CLASSIFICTION FOR STEEL FLANGES BY PN		1515		2	2001			21.060.10	
249 (c)	FLANGES AND THEIR JOINTS - BOLTING - CLASSIFICTION FOR STEEL FLANGES BY CLASS		1515		3	2005			21.060.10	
249 (d)	FLANGES AND THEIR JOINTS - BOLTING - SELECTION FOR EQUIPMENT		1515		4	2009			21.060.10	
250	STEEL PIPELINES - THERMOSET PLASTIC COATINGS								23.040.10	AWWA C213-07, N FA 49-706:1988
251 (a)	STEEL PIPES - POLYOLEFIN COATINGS (3LPE & PP)			21809	1	2011	[30670]	:1991	75.200	NF A49-711:1992 (3LPE)
251 (b)	STEEL PIPES & FITTINGS - POLYPROPYLENE COATINGS						30678	:2012		
252	STEEL TUBES - ELECTROMAGNETIC TESTING - LEAKS			10893	1	2011			23.040.10, 77.040.20	
253	EXTRUDED POLYOLEFIN COATINGS FOR STEEL WATER PIPE LINES						[30670]	:1991		AWWA C606-11, (NFA 49-704)
254	LIQUID EPOXY COATINGS FOR STEEL PIPES									AWWA C210-07
255	LIQUID EPOXY LININGS FOR STEEL PIPES		10339			2007			23.040.99, 25.220.60	AWWA C210-07
256	LIQUID EPOXY & MODIFIED EPOXY COATINGS FOR STEEL PIPES		10289			2002	(30671)		23.040.99, 25.220.60	AWWA C222-08
257	LIQUID POLYURETHANE LININGS FOR STEEL PIPES									AWWA C222-08, XP A 49-709:2002
258	COATING OF DUCTILE CAST IRON PIPES; POLYETHYLENE COATING		14628			2006	(30674)	pt 1:1982		NF A49-710:1988
259	CEMENT MORTAR COATINGS FOR D.I. PIPES		15542			2008	(30674)	pt 2:1992		
260	EXTERNAL COATINGS FOR D.I. PIPES - DESCRIPTION		545			2010			23.040.10; 23.040.40	
261	FUSION BONDED EPOXY COATINGS & LININGS FOR D.I. FITTINGS		14901			2006			23.040.10, 23.040.40, 25.220.60	AWWA C116-09
262	LIQUID POLYURETHANE COATINGS FOR D.I. PIPES		15189			2006			23.040.01, 25.220.60	
263	INTERNAL LININGS FOR D.I. PIPES - DESCRIPTION		545			2010			23.040.10; 23.040.40	
264	POLYAMIDE COATINGS & LININGS FOR STEEL PIPES		10310			2003			23.040.99, 25.220.60	AWWA C224-11
265	STAINLESS STEEL SADDLES WITH SERVICE TAPPINGS									AWWA C223-07
266	D.I. PIPELINES - DESIGN - CODE OF PRACTICE	[8010]			[2.1]	1987			23.040.10, 91.060.01	AWWA C150/A21.50-08
267 (a)	PIPES, SELECTION & STRUCTURAL DESIGN OF BURIED PIPELINES		1295		1:B.1.12	1997			23.040.01	WRc Pipe Materials Selection Manual, 1995
267 (b)	STRUCTURAL DESIGN OF BURIED PIPELINES - GUIDE TO SSRN 267 (a)	9295				2010			23.040.01, 93.030	
268	PIPELINES ON LAND - GENERAL - CODE OF PRACTICE	(8010-1)	14161			2011			23.040.01, 75.200	ISO 13623:2009
269	PIPELINES ON LAND; DESIGN, CONSTRUCTION AND INSTALLATION: STEEL FOR OIL AND GAS	(8010-2.8)	14161			2011			23.040.01, 75.201	ISO 13623:2009
270	PIPELINES - SUBSEA - CODE OF PRACTICE	(8010-3)	14161			2011			23.040.01, 75.202	ISO 13623:2009
271	STEEL PIPES - EXTERNAL CORROSION PROTECTION OF BURIED PIPES						30675	pt 1:1992		
272	D. I. PIPES - EXTERNAL CORROSION PROTECTION OF BURIED PIPES						30675	pt 2:1993		
273	CATHODIC PROTECTION DESIGN & APPLICATION FOR EXT. SURFACES	7361-1	13509			2001	[30676]	:1985		
274	EXT. CORROSION PROTECT'N OF BURIED VALVES - NORMAL COATINGS						30677	pt 1:1991		
880	CONCRETE KERB UNITS - REQUIREMENTS		1340			2003				
275	EXT. CORROSION PROTECT'N OF BURIED VALVES - THERMOSET COATINGS						30677	pt 2:1988		
Last update	D. I. WIDE TOLERANCE COUPLINGS & FL. ADAPTORS - JOINING DIFF. PIPES		14525			2004			23.040.10	
277 (a)	THREADED PIPE FITTINGS IN MALLEABLE CAST IRON & CAST COPPER ALLOY	143	10242			2000			23.040.40	
277 (b)	Concrete kerb units. Requirements and test methods	1256	10242			2000			23.040.40	
278 (a)	INFLUENCING FACTORS FOR CORROSION - HOT DIP GALV. FERROUS METALS		12502		3	2004			23.040.99	
278 (b)	INFLUENCING FACTORS FOR CORROSION - WATER DISTRIBUTION SYSTEMS-GENERAL		12502		1	2004			23.040.99	
279	PROBABILITY OF SOIL CORROSIVENESS ON METAL SURFACES						50929	pt 1, 3:1985		
280 (a)	HOLIDAY DETECTION - PIPELINE COATINGS - STANDARD TEST METHODS								23.040.99	ASTM G 62:2007
280 (b)	HOLIDAY DETECTION-EVALUATING PIPELINE COATING PATCH MATERIALS-TEST METHODS								23.040.99	ASTM G 55:2007

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280 (c)	HOLIDAY DETECTION - FBE PIPELINE COATINGS OF 250 TO 760 microns									NACE SP0490-2007
281 (a)	HOLIDAY DETECTION - INTERNAL TUBULAR LININGS OF LESS THAN 250 microns									NACE TM0384-2002
281 (b)	HOLIDAY DETECTION - INTERNAL LININGS OF 250 TO 760 microns									NACE TM0186-1985
282 (a)	STEEL TUBES-NON DESTRUCTIVE TESTING OF WELDS-RADIOGRAPHIC TESTING		10893-6			2011			23.040.10, 25.160.40, 77.040.20, 77.140.75	API 5L
282 (b)	STEEL TUBES - NON DESTRUCTIVE TESTING OF WELDS - IMAGE QUALITY								19.100	ISO 19232-1:2004
283	PROTECTION OF JOINTS AFTER LAYING - HEAT SHRINKABLE WRAP FOR JOINTS									AWWA C216-07, NACE RP0303-2033
284	STEEL PIPE END PREPARATION FOR ON-SITE WELDING		10224,			02, '05			23.040.10, 23.040.40	
285	D. I. PIPES AND FITTINGS - INTERNAL POLYURETHANE LININGS - REQUIREMENTS & TESTS		15655			2009			23.040.10, 23.040.40	

≠: related but not equivalent to BS =: technically equivalent to BS ≡: identical to BS
 () superceded & replaced as shown [] obsolecent or replaced as shown but remains current

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300 (a)	uPVC PIPES FOR COLD WATER - GENERAL	[3505]	1452		1	2010			23.040.20; 23.040.45; 91.140.60; 93.025	≠ EN ISO 1452-1:2009; ISO 4422-1:1996
300 (b)	uPVC PIPES FOR COLD WATER - PIPES		1452		2	2010			23.040.20; 23.040.45; 91.140.60; 93.025	≠ EN ISO 1452-2:2009; ISO 1452-2:2009
300 (c)	uPVC PIPES FOR COLD WATER - FITTINGS		1452		3	2012			23.040.20; 23.040.45; 91.140.60; 93.025	≠ EN ISO 1452-3:2010; ISO 1452-3:2009
300 (d)	uPVC PIPES FOR COLD WATER - VALVES		1452		4	2010			23.040.20; 23.040.45; 91.140.60; 93.025	≠ EN ISO 1452-4:2009; ISO 1452-4:2009
300 (e)	uPVC PIPES FOR COLD WATER - FITNESS FOR PURPOSE OF THE SYSTEM		1452		5	2010			23.040.20; 23.040.45; 91.140.60; 93.025	≠ EN ISO 1452-5:2009; ISO 1452-5:2009
301 (a)	uPVC PIPES-JOINTS & FITTINGS-INJECTION MOULDED FITTINGS - PRESSURE	(4346-1)	1452		1	2010			23.040.20; 23.040.45; 91.140.60; 93.025	≠ EN ISO 1452-1:2009; ISO 1452-1:2009, ISO 2035:1974, ISO 2048:1990
301 (b)	uPVC PIPES-JOINTS & FITTINGS - MECHANICAL JOINTS - PRESSURE	(4346-2)	1452		3	2012			23.040.20; 23.040.45; 91.140.60; 93.025	≠ EN ISO 1452-3:2010; ISO 1452-3:2009
301 (c)	uPVC PIPES-JOINTS & FITTINGS-QUALITY & TESTING						8063	5:1999	23.040.45	
301 (d)	uPVC PIPES-JOINTS & FITTINGS-NOMEN. & SYMBOLS						16450	:1994	23.040.45	
302 (a)	uPVC PIPELINES - LAYING AND JOINTING	[CP 312]			2	1973			83.140.30; 91.140.60	≠ ISO/TR 4191
302 (b)	uPVC PIPELINES - LAYING AND JOINTING (CONT)						16928	:1979	23.040.20	
303 (a)	uPVC PIPELINES - PRESSURE TESTING	[CP 312]			2	1973			83.140.30; 91.140.60	≠ ISO/TR 4191
303 (b)	uPVC PIPELINES - PRESSURE TESTING (CONT)						4279	1,9,10	23.040.01	
304 (a)	uPVC PIPELINES - ADHESIVES FOR JOINTING	[4346]	14814			2007			83.18	EN 14814:2007
304 (b)	uPVC PIPELINES - ADHESIVES FOR JOINTING (CONT)						16970		83.180	
305 (a)	uPVC PIPES - GENERAL	[3505]	1452		1	2010			23.040.20; 23.040.45; 91.140.60; 93.025	≠ EN ISO 1452-1:2009; ISO 4422-1:1996
305 (b)	uPVC PIPES - GENERAL - INDUSTRIALIZED USES	3506				1969			83.140.30; 91.140.60	
305 (c)	uPVC PIPES - QUALITY & TESTING						8061	:1994	23.040.20	
305 (d)	uPVC PIPES - DIMENSIONS						8062		23.040.20	
306 (a)	uPVC PIPES-PRESSURE TESTS TO DESTRUCTION	[4728]	921			1995			23.040.20	≠ EN 921:1994, ISO 1167:1973
306 (b)	uPVC PIPES-PRESSURE TESTS TO DESTRUCTION (CONT)		1167		3	2007			23.040.20; 23.040.45	≠ EN ISO 1167-3:200; ISO 1167-3:2007
306 (c)	uPVC PIPES-PRESSURE TESTS TO DESTRUCTION (CONT)		1167		4	2007				≠ EN ISO 1167-4:2007; ISO 1167-4:2007
306 (d)	uPVC PIPES-PRESSURE TESTS TO DESTRUCTION (CONT)		1167		2	2006			23.040.20; 23.040.45	EN ISO 1167-2:2006; ISO 1167-2:2006
306 (e)	uPVC PIPES-PRESSURE TESTS TO DESTRUCTION (CONT)		1167		1	2006			23.040.20; 23.040.45	EN ISO 1167-1:2006; ISO 1167-1:2006
306 (f)	uPVC PIPES-PRESSURE TESTS	2782	1053		11	1996			23.040.21	
307 (a)	HDPE PIPES (GENERAL)	[3284]	12201		1	2011			23.040.01; 91.140.60; 93.030	≠ EN 12201-1:2011
307 (b)	HDPE PIPES (PIPES)	(6572)	12201		2	2011			13.060.20; 91.140.60	EN 12201-2:2011
307 (c)	HDPE PIPES (FITNESS FOR PURPOSE OF THE SYSTEM)	(6730)	12201		5	2011			23.040.01; 91.140.60; 93.030	≠ EN 12201-5:2011
307 (d)	HDPE PIPES (CONT)						16963	5:1999	23.040.20	
307 (e)	HDPE PIPES-DIMENSIONS						8074	:1999	23.040.20	
307 (f)	HDPE PIPES-QUALITY & TESTING						8075	:1999	23.040.20	
307 (g)	HDPE PIPES-JOINTS & FITTINGS - PERFORMANCE REQUIREMENTS	[5114]				1975			23.040.60; 83.140.30	≠ ISO 3458; ISO 3459; ISO 3501; ISO 3503; ≠ KS 06-470, ISO 7/1
307 (h)	HDPE PIPES - COPPER AND COPPER ALLOY - COMPRESSION FITTINGS	864			3	1975			23.040.40	ISO 14236:2000
307 (i)	HDPE PIPES-JOINTS & FITTINGS		12201		3	2011	16963 parts as shown,	1-4, 7-11, 13-15	23.040.45	EN 12201-3:2011
307 (j)	HDPE PIPES - CODE OF PRACTICE	[CP 312]			3	1973				
308 (a)	RUBBER RINGS FOR MECHANICAL JOINTS		681		1	1996			83.140.50	
308 (b)	RUBBER RINGS FOR MECHANICAL JOINTS		681		1	1996				
309	uPVC UNDERGROUND DRAIN PIPES & FITTINGS	[4660:00]	13598		1	2010			93.03	≠ EN 13598-1:2010
310	uPVC P. IMPACT TEST 20 DEGREE CENTIGRADE	[3505]	1452		1 to 5	2000			83.140.30; 91.140.80	≠ ISO 3127
311	uPVC PIPES SHORT TERM HYDROSTATIC TEST	[3505]	1452		1 to 5	2000			83.140.30; 91.140.80	≠ ISO 3127

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312	uPVC PIPES LONG TERM HYDROSTATIC TEST	[3505]	1452		1 to 5	2000			83.140.30; 91.140.80	
313 (a)	THERMOPLASTIC PIPES - INTERNAL PRESSURE ENDURANCE TEST (GENERAL METHOD)	2782	1167		1	2006			23.040.20; 23.040.45	≠ EN ISO 1167-1:2006, ISO 1167-1:2006
313 (b)	THERMOPLASTIC PIPES - INTERNAL PRESSURE ENDURANCE TEST (PREPARATION OF PIPE TEST PIECES)	2782	1167		2	2006	8061	:1994	23.040.20; 23.040.45	EN ISO 1167-2:2006; ISO 1167-2:2006 ≠ EN 921:1994
314 (a)	THERMOPLASTIC PIPES - WATER ABSORPTION TEST	2782	62			2008			83.080.01	EN ISO 62:2008; ISO 62:2008 ≠
314 (b)	THERMOPLASTIC PIPES - ABSORPTION TEST (CONT)						8061	:1994	23.040.20	
315 (a)	THERMOPLASTIC PIPES - VARIOUS OTHER TESTS	2782			11-1101A, 1103V, 1105D, 1107A, 1108A/B/C,	various			23.040.20; 23.040.45	≠ Method 1101A: ISO 3126 ≠ Method 1108A: ISO 3127:1980
315 (b)	THERMOPLASTIC PIPES - VARIOUS OTHER TESTS*(CONT)	2782			1110, 1110B, 1114A/B/C, 1127A, 1140A	various			23.040.20; 23.040.45	
315 (c)	THERMOPLASTIC PIPES - VARIOUS OTHER TESTS (CONT)		743	2505		2005			23.040.20	EN ISO 2505:2005, ISO 2505:2005 ≠
315 (d)	THERMOPLASTIC PIPES - VARIOUS OTHER TESTS (CONT)		578	7686		2005			23.040.20; 23.040.45	EN ISO 7686:2005, ISO 7686:2005 ≠
315 (e)	THERMOPLASTIC PIPES - VARIOUS OTHER TESTS (CONT)	Various ENs								ISO 2505-1,-1:1994, 3114:1997, 3472:1975, 3473:1977, 3474:1976
316 (a)	THERMOPLASTIC PIPES-DIMENSIONS & PRESSURES	5556				1978			23.040.20	≠ ISO 161/1; ISO 4065
316 (b)	THERMOPLASTIC PIPES-DIMENSIONS & PRESSURES (CONT)	2782			11-1121B	1997			23.040.20	≡ ISO 161-1:1996
316 (c)	THERMOPLASTIC PIPES-DIMENSIONS & PRESSURES (CONT)			11922	1	1997			23.040.20	
317	HDPE - COMPRESSION FITTING - NUTS									ASTM D 2565:99
318	HDPE PIPES, ELECTROFUSION CONTROL UNITS									EN 60335-1; EN 60335-2-45; EN 50081-1; EN 50082-1; EN 55014; EN 61000-3-3
319	DETERMINATION OF TESTING FREQUENCY ETC									SABS 966-1:06 Table B.1
320	DETERMINING DIMENSIONS OF THERMOPLASTIC PIPE AND FITTINGS									ASTM D 2122:04
321	IDENTIFICATION CARDS		7810			1996				≡ ISO 7810
322	IDENTIFICATION CARDS - RECORDING TECHNIQUE		7811		all					≡ ISO 7811
323	PVC PIPES - EXTRACTABILITY OF LEAD AND TIN - TEST METHOD									ISO 3114:1997

≠: related but not equivalent to BS ≡: technically equivalent to BS ≡: identical to BS

OTHER PIPES

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SSRN	SUBJECT	BS	BS EN	BS ISO	PART	YEAR	DIN	PART	ICS No	OTHER
401 (a)	FIBRE CEMENT PRESSURE PIPES & FITTINGS		512			1995			23.040.50	
401 (b)	ASBESTOS CEMENT (A/C) PIPES - TESTING		588-1			1997			23.040.50	≡ ASTM C500/ C500M
401 (c)	ASBESTOS CEMENT (A/C) PIPES & JOINTS		512			1995	EN 512:1994/A1:2001		23.040.50	
402 (a)	FIBRE CEMENT SEWER PIPES, JOINTS, FITTINGS		588		1	1997			91.140.80	
402 (b)	FIBRE CEMENT SEWER PIPES, JOINTS, FITTINGS					1996	19850	1		
403	A/C PIPES FOR THRUST BORING						WITHDRAWN			
404	A/C PIPES - GUIDE FOR LAYING		1444			2001				
405	A/C PIPES - FIELD PRESSURE TESTING		805			2000	EN 805:2000-		23.040.01; 91.100.40	
406	PIPE SUPPORTS	3974			1	1974	See DVGW		23.040.99	DVGW GW 310:2008, MSS SP-58-2009
407	CONCRETE PIPES & FITTINGS - OGEE TYPE		1916			2002	EN 1916:2003		23.040.50	
408 (a)	PRESTRESSED CONCRETE PRESSURE PIPES		639 & 642			1995			23.040.50	≡ EN 639:1994 Identical
408 (b)	PRESTRESSED CONCRETE PRESSURE P. (CONT)		642			1995			23.040.50	
409 (a)	PRECAST CONCRETE PIPES DRAINS & SEWERS	5911-1:2002+A2:2010	1916			2002	EN 1916		23.040.50	
409 (b)	PRECAST CONCRETE PIPES - MANHOLES	5911-1:2002+A2:2011	1917			2002	EN 1917		91.140.80	
410	UNREINFORCED CONCRETE PIPES - POROUS	5911-1:2002+A2:2012	1918			2002	EN 1918		23.040.50	
411	NON PRESSURE DUCTILE IRON PIPES ETC.	No equivalent British Standard							77.140.80	ISO 7186:2011
412 (a)	RUBBER & PLASTIC HOSES AND ASSEMBLIES		1307	1307		2008			23.040.70	
412 (b)	RUBBER & PLASTIC HOSES & ASSEMB. (CONT)		7751+A1	7751+A1		2011			23.040.70	
412 (c)	RUBBER & PLASTIC HOSES AND ASSEMBLIES - METHODS OF TESTING	5173			100, 102, 103, 106.	various			23.040.70	
412 (c)	RUBBER & PLASTIC HOSES AND ASSEMBLIES - METHODS OF TESTING (CONT)		4671	4671		2001				
412 (c)	RUBBER & PLASTIC HOSES AND ASSEMBLIES - METHODS OF TESTING (CONT)		1402	1402		1997				
412 (c)	RUBBER & PLASTIC HOSES AND ASSEMBLIES -		6803	6803		1997				
412 (c)	RUBBER & PLASTIC HOSES AND ASSEMBLIES -		8308	8308		1996				
412 (c)	RUBBER & PLASTIC HOSES AND ASSEMBLIES -		6945	6945		1996				
413	R/F CONC. CYLINDRICAL PIPES & FITTINGS		641			1995			23.040.50	AWWA C300-11
414	CLAY PIPES & FITTINGS - SEWERAGE		295 & AMD 9290, AMD 9249, AMD 10621		1	1991			23.040.50; 91.100.20; 91.140.80	
415	HDPE PIPES & FITTINGS	see SSRN 307 (a) to (f)								

OTHER PIPES

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SSRN	SUBJECT	BS	BS EN	BS ISO	PART	YEAR	DIN	PART	ICS No	OTHER
416	HDPE PIPE FITTINGS	see SSRN 307 (g) to (i)								
417	CONCRETE PIPES - R/C JACKING PIPES	5911 +			1	2002			23.040.50	
418	CONCRETE NON PRESSURE PIPES-PRE STRESSED	5911 +			5	2004			23.040.50	
419	PIPE CLAMPS AND CAGES						WITHDRAWN			
420	CLAY PIPES, FITTINGS, AND DUCTS	65 & AMD 8622				1991			91.140.60	
421	CONC. PRESS. PIPES-COMMON REQUIREMENTS		639			1995			23.040.50	
422	R/F CONC. NON-CYLINDRICAL PIPES & FITTINGS		640			1995			23.040.50	

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VALVES, SURFACE BOXES, & METERS

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SSRN	SUBJECT	BS	BS EN	BS ISO	PART	YEAR	DIN	PART	ICS No	OTHER
501 (a)	C.I. GATE VALVES (WATER)	5163			1,2	2004			23.060.30	≠ ISO 7259, type A
502 (a)	C.I. GATE VALVES (GENERAL)		1171			2002	3352	5	23.060.30	≠ ISO 5996
502 (b)	C.I. GATE VALVES (GENERAL) (CONT)						3202	4	23.060.01	
502 (c)	C.I. GATE VALVES (GENERAL) (CONT)								23.060.01	
503	C.I. (PARALLEL SLIDE) GATE VALVES (GENERAL)		1171			2002			23.060.30	
504	C.I. GLOBE VALVES (GENERAL)		13789			2010	3356		23.060.10; 23.060.50	
505 (a)	C.I. CHECK VALVES (GENERAL)		12334			2001			23.060.50	
505 (b)	C.I. CHECK (BACKFLOW) VALVES (GENERAL)		13959			2004	See DVGW		91.140.60	
506 (a)	C.I. & STEEL BUTTERFLY VALVES (GENERAL)	5155	593			2004			23.060.99	
506 (b)	C.I. & STEEL BUTTERFLY VALVES (GENERAL)								23.060.30	
507	BOURDON TYPE PRESSURE GAUGES		837		1	1998		1	17.1	
508	FLOAT OPERATED VALVES N.E. 50 MM	1212			1,2	1990			91.140.60	
509	FIRE HYDRANTS-BELOW GROUND	750				2012			13.220.10	
510 (a)	WATER METERS - SINGLE		14154		3	2011			17.120.10	
510 (a)	WATER METERS - GENERAL	5728	14154		1	2011				ISO 4064/1
510 (b)	WATER METERS - COMBINATION		14154		1	2011			17.120.10	
511 (a)	COPPER ALLOY GLOBE, STOP, GATE VALVES								23.060.30	
511 (b)	COPPER ALLOY GLOBE, STOP, CHECK VALVES		12288		3	2010			23.060.10; 23.060.50	
512	FIRE HOSE COUPLINGS & EQUIPMENT	336				2010			13.220.10	
513 (a)	SURFACE BOXES - UND'GR'ND STOPVALVES	5834			1	2009			91.140.40; 91.140.60	
513 (b)	SURFACE BOXES - SMALL	5834			2	2011			91.140.40; 91.140.60	
513 (c)	SURFACE BOXES - LARGE			5834	3	2005			91.140.40; 91.140.60	
513 (d)	SURFACE BOXES - PREFORMED CHAMBERS			5834	4	2005			91.140.40; 91.140.60	
514	METALLIC BALL VALVES - GENERAL PURPOSE			7121		2006			23.060.20	≠ ISO 7121
515 (a)	uPVC VALVES									
515 (b)	uPVC VALVES - TESTS	2782	various		11-1131/34	various			23.060.01; 23.060.20; 83.140.30	
516	FIRE HYDRANT SYSTEMS FOR BUILDINGS	5041			1-5	various			13.220.10	
517	VALVES - PRESSURE TESTING FOR	6755	12266		1,2	2012			23.060.01	≠ ISO 5208:1993
518 (a)	BUTT-WELD & FLANGED VALVES - DIMENSIONS		12627	2080		various			23.060.01	= ISO 5752:1982
518 (b)	FLANGED VALVES - DIMENSIONS		558			2011			23.060.01	
519	STEEL GATE (PARALLEL SLIDE) VALVES		1984			2010			23.060.30	
520 (a)	WATER METERS - SINGLE - INSTALLATION		14154		1	2011			17.120.10	= ISO 4064/2 & 2/Add. 1
520 (b)	WATER METERS-COMBINAT'N - INSTALLATION		14154		1	2011			17.120.10	
521	STEEL GLOBE & CHECK VALVES		13709			2010			23.060.50	
522 (a)	VALVES - CORROSION PROTECTION - EPOXY						3476		91.140.60	
522 (b)	VALVES-CORROSION PROTECTION						30677	1, 2	23.040.99	
523	CAST IRON PLUG VALVES	5158				1989			23.060.20	
524	INDUSTRIAL-PROCESS CONTROL VALVES		60534		various	various			23.060.0125.040.40	

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ENGINEERING GENERAL

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SSRN	SUBJECT	BS	BS EN	BS ISO	PART	YEAR	DIN	PART	ICS No	OTHER
600 (a)	NON-DESTRUC. TESTING OF WELDS (TUBES)			10893	1	2011			23.040.10	
600 (b)	NON-DESTRUC. TESTING OF WELDS (TUBES)			10893	1	2011			23.040.10; 77.140.75	
600 (c)	NON-DESTRUC. TESTING OF WELDS (TUBES)								25.160.40	
600 (c)	NON-DESTRUC. T. OF WELDS (TUBES) (CONT)			6072		2011				
601 (a)	SOILS FOR C. ENG.- TEST METH.-AFTER SAMPLING	1377			1 to 8	1990			93.02	
601 (b)	SOILS FOR C. ENG. - TEST METHOD - IN SITU	[1377-9]		22476	2,3:2005	2011			93.02	
601 (c)	SOILS FOR C. ENG.- CLASSIFICATION						18196		93.02	
602	TESTING OF WATER PIPELINES - INTERNAL PRESSURE						4279	1-6,9,10	23.040.01	
603 (a)	TESTING OF CEMENT - CHEMICAL ANALYSIS		196		2	2005			91.100.10	
603 (b)	TESTING OF CEMENT- POZZALINIC CEMENT		196		5	2011			91.100.10	
603 (c)	TESTING OF CEMENT - CHLORIDE, CO ₂ , ALKALI CONTENT		196		2	2005			91.100.10	
604	MATERIAL TESTING - DOCUMENTATION						50049			ISO 404:1992, EN 21
605 (a)	MEASUREMENT OF WATER FLOW - SINGLE METERS		14154		2	2005			17.120.10	
605 (b)	MEASUREMENT OF PIPE WATER FLOW - MULTIPLE METERS		14154		1	1988			17.120.10	
605 (c)	MEASUREMENT OF PIPE WATER FLOW - COMBIN'TN METERS		14154		2	1988			17.120.10	
605 (d)	MEASUREMENT OF PIPE WATER FLOW - COMBIN'TN METERS		14154		3	1988			17.120.10	
606	DRINKING WATER QUALITY - TESTING			10304	1	2009			13.060.01	
607	MEASUREMENT OF WATER FLOW - VOLUMETRIC		8316	8316		1997			17.120.10	
650 (a)	SITE INVESTIGATIONS	5930				1999			91.2	
651 (a)	WATER SUPPLY - DOMESTIC - WITHIN BUILDINGS								91.140.60	
651 (b)	WATER SUPPLY-PRINCIPLES & REQUIREMENTS	6700				2006	2000		13.060.20	
651 (c)	WATER SUPPLY-TECHNICAL DRAWINGS						2425	3-6	01.100.99	
652 (a)	BUILDING DRAINAGE		752			2008	1986	1, 2, 4	91.140.80	
652 (b)	BUILDING DRAINAGE								13.060.30; 91.140.80	
653 (a)	WATER PIPELINE CONSTRUCTION - DUCTILE IRON		1610			1998			23.040.10	
653 (c)	WATER PIPELINE CONSTRUCTION - PRESTRESSED CONC.								23.040.50	
653 (d)	WATER PIPELINE CONSTRUCTION - GRP	8010			2.5	1989			23.040.20	
653 (e)	WATER PIPELINE CONSTRUCTION - PRECAST CONCRETE								23.040.50	
653 (f)	WATER PIPELINE CONSTRUCTION - STEEL	CP 2010			2	1970			23.040.01	
653 (g)	WATER PIPELINE CONSTRUCTION - GENERAL	8010			1	2004			13.060.01	
654	TRENCHING FOR PIPELINES						4124		93.02	
655	SEWAGE PIPELINE CONSTRUCTION		752			2008			13.060.30	
656 (a)	WALLING - BRICK & BLOCK MASONRY	6697				2010			91.080.30	
656 (b)	WALLING - BRICK & BLOCK MASONRY	6697				2010			91.080.30	
656 (c)	WALLING (BRICK & BLOCK MASONRY) (CONT)						18330	Part C	91.010.20	
657	USE OF STRUCTURAL STEEL IN BUILDING								91.080.10	
658 (a)	SEWERAGE - GENERALITIES & DEFINITIONS								13.060.30	
658 (b)	SEWERAGE - PERFORMANCE REQUIREMENTS								91.140.80	
658 (c)	SEWERAGE - GUIDE TO NEW CONSTRUCTION		752			2008			13.060.30	
658 (d)	SEWERAGE - PUMPING & PUMPING STATIONS		752			2008			13.060.30	
658 (e)	SEWERAGE - SEWERS IN TUNNELS		752			2008			13.060.30	
658 (f)	SEWERAGE - OUTFALLS		752			2008			13.060.30	
659	SMALL SEWERAGE WORKS & CESSPOOLS								13.060.30; 91.140.80	
660	TEST PUMPING OF WATER WELLS			14686		2003			13.060.10	
661 (a)	MEASURING LIQUID FLOW IN CHANNELS - BY DILUTION	3680			2A	1995			17.120.20	≡ ISO 9555-1:1994
661 (b)	MEASURING LIQUID FLOW IN CHANNELS - ULTRASONIC		6416			2005			17.120.20	
661 (c)	MEASUR'G LIQ'D FLOW IN CHANNELS - ELECTROMAGNETIC			9213		2004			17.120.20	≡ ISO 9213:2004
661 (d)	MEASURING LIQUID FLOW IN CHANNELS - SAFE PRACTICES								17.120.20	
661 (e)	MEASURING LIQUID FLOW IN CHANNELS - TIDAL AREAS			2425		2010			17.120.20	
661 (f)	MEASURING LIQUID FLOW IN CHANNELS - HYDRO. EQUIP'T.	3680			8H	1996			17.120.20	≡ ISO 11655:1995

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661 (g)	MEASURING LIQUID FLOW IN CHANNELS - BED SAMPLING	3680			10C	1996			17.120.20	≠ ISO 4364:1977
662	MEASUREMENT OF FLOW IN CLOSED CONDUITS - BY PITOT STATIC TUBES OR CURRENT METERS	1042			2:Sec 2.1 2:Sec 2.4	1983 1989			17.120.20	≡ ISO 3966:2008 ≡ ISO 3354:2008
663	CONSTRUCTION & DEMOLITION OF CONCR. & MASONRY								91.2	
664	DRAINAGE OF ROOFS AND PAVED AREAS		12056		3	2000			91.060.20; 91.140.80	
665	FOUNDATIONS		6100			2007			93.02	
666	STRUCTURAL USE OF TIMBER - DESIGN, MATERIALS & WORMSHIP								91.080.20	
667	EARTH RETAINING STRUCTURES						4126		93.02	
668	WATERPROOFING OF BUILDINGS & STRUCTURES						18195	1-10	91.120.30	CP 102, BS 8215
669	WATER QUALITY - SAMPLING		6068	5667	3	2003			13.060.01	ISO 5667-3:2003
670 (a)	WELDING PROCEDURES - APPROVAL TESTING			15614	8	2002			25.160.01	
670 (b)	WELDING PROCEDURES - APPROVAL OF PROCEDURES		288-9	15607		2003			25.160.01	
670 (c)	WELDING PROCEDURES - PIPELINES - BUTT WELDING		4515						25.160.01	
671	WELDERS - APPROVAL TESTING		287		1	2011			25.160.01	
672	LOGGING OF ROCK CORES									
673	QUALITY SYSTEMS - DESIGN/ DEVELOPMENT, PRODUCTION, INSTALLATION & SERVICING								03.120.10	ISO 9004-2009 KS 10-1131-ISO 9001
674	QUALITY SYSTEMS: PRODUCTION AND INSTALLATION								03.120.10	
675(a)	QUALITY SYSTEMS: FINAL INSPECTION AND TESTING								03.120.10	ISO 17025:2005
675(b)	ENVIRONMENTAL MANAGEMENT SYSTEMS									ISO 14001
676	REINFORCED SOILS		14475, 14490, 8006-2, 8006-1			various			93.02	
677	GEOTECHNICAL INVESTIGATIONS FOR C. ENG. PURPOSES						4020		93.020	
678	GROUND ANCHORAGES	8081				1989	4125		93.020	
679	PIPE MATERIAL SELECTION AND DESIGN		1295		1:B.1.12	1997			23.040.01	
680	CODE OF PRACTICE FOR SAFE USE OF EXPLOSIVES	5607				1998				
681	METHODS OF TEST FOR SOILS FOR CIVIL ENG. CHEMICAL & ELECTRO-MECHANICAL	1377			3					
682	GULLEY TOPS & MANHOLE TOPS FOR VEHICULAR & PEDESTRIAN AREAS		124			1994				
683	PRECAST CONCRETE PRODUCTS- RETAINING WALL ELEMENTS		15258			2008				
684	CONCRETE BLOCK PAVING - CODE OF PRACTICE FOR LAYING	7533			3	2009				
685	CONCRETE PAVING BLOCKS -REQUIREMENTS & TEST METHODS		1338			2003				
686 (a)	ROAD MARKING MATERIALS - PHYSICAL PROPERTIES		1871			2000				
686 (b)	ROAD MARKING MATERIALS - PERFORMANCE FOR ROAD USERS		1436			2007				
686 (c)	ROAD MARKING MATERIALS - SPECIFICATION FOR APPLICATION	3262			3	1989				
687	HEATERS FOR TAR AND BITUMEN - SPECIFICATION	1676				1970				
688	HOT BINDER DISTRIBUTORS FOR ROAD SURFACE DRESSING	1707				1989				
689	COLD EMULSION SPRAYING MACHINE FOR ROADS - SPECIFICATION	3136			2	1972				

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BUILDING WORKS

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SSRN	SUBJECT	BS	BS EN	BS ISO	PART	YEAR	DIN	PART	ICS No.	OTHER
801	LIME FOR MORTAR		459		1	2001	EN ISO 81060	1	91.100.10	EN 459-1:2001
802	SILLS - PC CONCRETE, STONE, CLAYWARE, SLATE	5642			1	1978			91.060.50	
803 (a)	DAMP PROOF COURSES-BRICKS & SLATES	6398, 6515, 8215				Various			91.100.01; 91.120.30	
803 (b)	DAMP PROOF COURSES-BITUMEN	6398				1983			91.120.30	
803 (c)	DAMP PROOF COURSES-POLYETHYLENE	6515				1984			91.120.30	
803 (d)	DAMP PROOF COURSES-DESIGN-INSTALLATION	8215				1991			91.120.30	
804 (a)	CONCRETE BLOCKS		772		2	1998			91.100.30	
804 (a)	CONCRETE BLOCKS (CONT)		771		3	2003			91.100.30	
804 (b)	CONCRETE BLOCKS (CONT)	6073			2	2008			91.100.30	
805	HOLLOW CLAY PARTITION BLOCKS		772		3,7	1998			91.100.20	
805	HOLLOW CLAY PARTITION BLOCKS (CONT)		771		1	2003			91.100.20	
806 (a)	MASONRY - UNREINFORCED - BRICK WALLING		1052		1	1999			91.080.30	
806 (a)	MASONRY - UNREINFORCED - BRICK WALLING (CONT)		5628		1	2005			91.080.31	
806 (b)	MASONRY - REINFORCED & PRESTRESSED	5628			2	2000			91.080.30	
806 (c)	MASONRY - MATERIALS & WORKMANSHIP	5628			3	2001			91.080.30	
807 (a)	FIBRE-CEMENT ROOF SLATES & FITTINGS		492			2004			91.100.20; 91.100.40	
807 (a)	FIBRE-CEMENT ROOF SHEETING & FITTINGS		494			2004			91.060.20; 91.100.40	
808	FIXINGS FOR ROOF & WALL COVERINGS	1494			1	1964			21.060.01; 91.060.10; 91.060.20	
809 (a)	FIBRE BUILDING BOARDS-HARDBOARD, MEDIUMBOARD, MEDIUM DENSITY FIBREBOARD & SOFTBOARD-GENERAL		120, 310, 316, 317, 318, 319, 320, 321, 322, 323, 325,			Various	68755		79.060.20	
809 (a)	FIBRE BUILDING BOARDS-HARDBOARD, MEDIUMBOARD, MEDIUM DENSITY FIBREBOARD & SOFTBOARD-GENERAL		324		1 & 2	1993	68755		79.060.20	
809 (a)	FIBRE BUILDING BOARDS-HARDBOARD, MEDIUMBOARD, MEDIUM DENSITY FIBREBOARD & SOFTBOARD-GENERAL		382		1	1993	68755		79.060.20	
809 (a)	FIBRE BUILDING BOARDS-HARDBOARD, MEDIUMBOARD, MEDIUM DENSITY FIBREBOARD & SOFTBOARD-GENERAL		622		1,2,3,4,5	1997	68755		79.060.20	
809 (b)	FIBRE BUILDING BOARDS-SPECIFICATIONS FOR		622		1-5	2003 to 2006			79.060.20	
809 (c)	FIBRE BUILDING BOARDS-FORMALDEHYDE CONTENT		120			1992			79.040	
809 (d)	FIBRE BUILDING BOARDS-BENDING STRENGTH		310			1993			79.040	
809 (e)	FIBRE BUILDING BOARDS-OF WOOD-GENERAL		316			1999			79.040	
809 (f)	FIBRE BUILDING BOARDS-SWELLING FROM WATER		317			1993			79.060.20	
809 (g)	FIBRE BUILDING BOARDS-HUMIDITY EFFECTS		318			2002			79.040	
809 (h)	FIBRE BUILDING BOARDS-PERP. TENSILE STRENGTH		319			1993			79.040	
809 (i)	FIBRE BUILDING BOARDS-SCREW WITHDRAWAL RES.		320			2011			79.040	
809 (j)	FIBRE BUILDING BOARDS-CYCLIC HUMID TESTS		321			2002			79.040	
809 (k)	FIBRE BUILDING BOARDS-MOISTURE CONTENT		322			1993			79.060.01	
809 (l)	FIBRE BUILDING BOARDS-DENSITY DETERMINATION		323			1993			79.060.01	
809 (m)	FIBRE BUILDING BOARDS-DIMENSION DETERMINAT'N		324		1, 2	1993			79.060.01	
809 (n)	FIBRE BUILDING BOARDS-TEST PIECE DIMENSIONS		325			2012			79.060.01	
809 (o)	FIBRE BUILDING BOARDS-SURFACE ABSORPTION		382		1, 2	1993/94			79.060.20	
810	BLOCKBOARD AND LAMINBOARD			12466	2	2007			79.060.10; 79.060.20	

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811 (a)	PLYWOOD - DIMENSIONS & GENERAL		315			2000	4078		All pts: 79.060.10; Pt 2, also: 01.040.79	
811 (b)	PLYWOOD - DRY, HUMID, & EXTERIOR CONDITIONS		636			2003			79.060.10	
811 (c)	PLYWOOD - CLASSIFICATION & TERMINOLOGY		313		1, 2	1996/2000			01.040.79; 79.060.10	
811 (d)	PLYWOOD - BONDING QUALITY		314		1, 2	2004			79.060.10	
811 (e)	PLYWOOD - DIMENSIONAL TOLERANCES		315			2000			79.060.10	
811 (e)	PLYWOOD - SURFACE APPEARANCE CLASSIFICATION		635		1-3	1995			79.060.10	
812	SEALING OF EXTERNAL WALL JOINTS	No British Standard					18540		91.100.50	
813 (a)	PARTICLEBOARD - SAMPLING, CONDITIONING & TEST METHODS		120, 309, 310, 311, 317, 323, 325			Various			79.060.20	
813 (a)	PARTICLEBOARD - SAMPLING, CONDITIONING & TEST METHODS (CONT)		324		2	1993			79.060.20	
813 (a)	PARTICLEBOARD - SAMPLING, CONDITIONING & TEST METHODS (CONT)		312		1,2,3,4,5,6	Various			79.060.20	
813 (b)	PARTICLEBOARD - WOOD CHIPBOARD - GENERAL		312		5,7	1997			79.060.20	
813 (d)	PARTICLEBOARD-CHIPBOARD-SPECIAL PURPOSES						6872		79.060.20	
813 (e)	PARTICLEBOARD-ORIENTED STRAND BOARD		300			2006			01.040.79; 79.060.20	
813 (f)	PARTICLEBOARD-CEMENT BONDED		634		2	1997			79.060.20	
813 (f)	PARTICLEBOARD-CEMENT BONDED (CONT)		1328			1997			79.060.20	
813 (g)	PARTICLEBOARD-REQUIREMENTS & SPECIFICATIONS		312			2003			79.060.20	
813 (h)	PARTICLEBOARD-SPECIFIC PURPOSE SELECTION	7916				1998			79.060.20	
814 (a)	LAMINATED PLASTIC SHEETING		438		1, 2	2005			83.140.20	
814 (b)	LAMINATED PLASTIC SHEETING-TEST METHODS		438		1,2,3,4,5,6 ,7	2005	EN 438		83.140.20	
814 (b)	LAMINATED PLASTIC SHEETING-TEST METHODS (CONT)		14323			2004	EN 14323		83.140.20	
815 (a)	WOOD WOOL CEMENT SLABS UP TO 125 mm THICK		13168			2001			91.100.40	
815 (b)	WOOD WOOL SLABS-REQUIREMENTS & TESTING						1101		79.060.99	
815 (b)	WOOD WOOL SLABS-INSTALLATION						1102		79.060.99	
816	QUALITY OF TIMBER JOINERY - WORKMANSHIP	1186			2	1988			79.02	
817 (a)	WOODEN DOORS - GENERAL	4787			1	1980			91.060.50	
817 (b)	WOODEN DOORS - EXTERNAL	459				1988			91.060.50	
817 (c)	WOODEN DOORS - INTERNAL						68706	1	91.060.50	
818	WATERPROOF ADHESIVE - FOR PLYWOOD	1203				2001			83.180	
819 (a)	STRUCTURAL STEELS - WEATHER RESISTANT	7668				2004			77.140.70	
819 (b)	STRUCTURAL STEELS - REQUIREMENTS		10210		1	2006			77.140.75	
819 (c)	STRUCTURAL STEELS - STEEL PLATES ABOVE 3 mm		10029			2010			77.140.50	
819 (d)	STRUCTURAL STEELS - WELDABLE		10025		1,3,4	2004			77.140.10	
819 (e)	STRUCTURAL STEELS - HIGH YIELD PLATES & FLATS		10025		1, 6+A1	2004			77.140.50	
819 (f)	STRUCTURAL STEELS - IMP. CORROSION RESISTANCE		10025		1,5	2004			77.140.10	
820	CONNECTORS FOR TIMBER		912			2000			21.060.01	
821	STEEL WINDOWS	6510				2005			91.060.50	
822 (a)	GLASS FOR GLAZING - CLASSIFICATION	952			1	1995			81.040.20	
822 (b)	GLASS FOR GLAZING - TERMINOLOGY FOR WORK ON	952			2	1980			01.040.81; 81.040.20	
822 (c)	GLASS FOR GLAZING - TOUGHENED (INC. TESTING)	3193				2008			81.040.30	
822 (d)	GLASS FOR GLAZING-TOUGHENED						1249	12	81.040.20	
823 (a)	STEEL TUBES FOR SCREWING OR WELDING - ALL		10255			2004			77.140.75	
823 (b)	STEEL TUBES-THREADS FOR PRESSURE TIGHT JOINTS	21				1985			77.140.75	= ISO 7-1:1994 ≠ ISO 7-2:1982
823 (c)	STEEL TUBES FOR SCREWING OR WELDING-MEDIUM						2440		23.040.10	
823 (d)	STEEL TUBES FOR SCREWING OR WELDING-HEAVY						2441		23.040.10	

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823 (e)	STEEL TUBES FOR SCREWING-SPECIFIED QUALITY						2442		23.040.10	
824 (a)	FITTINGS TO TUBING - MALLEABLE CAST IRON		10242			1995			23.040.40	
824 (b)	FITTINGS TO TUBING - MALLEABLE CAST IRON	1256				2000			23.040.40	
824 (c)	FITTINGS TO TUBING - MALLEABLE CAST IRON		10242			1995			23.040.40	
824 (d)	FITTINGS TO TUBING - STEEL		10241			2000	2980		23.040.40	
825 (a)	POLYTHENE TUBING-COLD WATER SERVICES		12201		1,2,5	2003			13.060.20; 91.140.60	
825 (b)	POLYTHENE TUBING-COLD W.S. (CONT)		12201		1,2,5	2003			13.060.20; 91.140.60	
825 (c)	POLYTHENE TUBING-HOT & COLD W.S.	7291			1, 3	2001			83.140.30; 91.140.60	
825 (c)	POLYTHENE PIPES-LOW DENSITY-DIMENSIONS						8072		23.040.20	
825 (d)	POLYTHENE PIPES-LOW DENS.-QUALITY & TESTING						8073		23.040.20	
825 (e)	POLYTHENE PIPES-HIGH DENSITY-DIMENSIONS						8074		23.040.20	
825 (e)	POLYTHENE PIPES-HIGH DENS.-QUALITY & TESTING						8075		23.040.20	
826	BRASSWORK & FITT. FOR TAPS & STOPVALVES	1010			2	1973			91.140.60	
827	BALL VALVES FOR CISTERNS (EXC. FLOATS)	1212			3	1990			91.140.60	
828	PLASTIC FLOATS FOR BALL VALVES	2456				1990			91.140.60	
829 (a)	CAST IRON SOIL, WASTE & VENT PIPES PART 1: S & S; PART 2: SOCKETLESS SYSTEMS	416	877+A1		1	1990 1999			23.12; 91.140.30; 91.140.80	
829 (b)	C. IRON SOIL, WASTE & VENT PIPES (CONT)						19522	1, 2	23.040.10	
830	GALVANIZED STEEL HOT & COLD WATER TANKS	417			2 cl A	1987			91.140.60	
831	ENAMELLED CAST IRON BATH	1189				1986			91.140.70	
832	PILLAR TAPS (SPRAY TAPS)	5388				1976			91.140.60	
833 (a)	GLAZED VITREOUS CHINA W.C. PAN		37, 33, 997			1999			91.140.70	
833 (b)	GLAZED VITREOUS CHINA W.C. PAN (CONT)						1381		91.140.70	
834	HINGED PLASTIC SEAT TO W.C. PAN	1254				1981			91.140.70	
835 (a)	GLAZED VITREOUS CHINA LAVATORY BASIN	1188				1974			91.140.70	
835 (b)	GLAZED VITREOUS CHINA LAVATORY BASIN (CONT)		32			1999			91.140.70	
836	METAL SINKS - CAST IRON, PRESSED & STAINLESS STEEL	1244			1	1956			91.140.70	
837 (a)	WASTES - PLASTICS 'S' AND 'P' TRAPS		274		1,2,3	2002			91.140.70	
837 (b)	WASTES - MATERIALS & DIMENSIONS		274		1,2,3	2002			91.140.70	
839 (a)	FIBRE/CEMENT DRAIN PIPES & FITTINGS		588		1	1997			91.140.80	
839 (b)	FIBRE/CEMENT DRAIN PIPES & FITTINGS-DIMENSIONS						19850	1	23.040.50	
840 (a)	CONC. DRAIN PIPES - NON PRESSURE-PRESTRESSED	5911+A1			5	2004			23.040.50	
840 (b)	CONC. DRAIN PIPES - MANHOLES & SOKAWAYS	5911	1917:2002		3	2002			91.140.80	
840 (c)	CONCRETE DRAIN PIPES - ROAD GULLEYS	5911+A1			6	2004			93.080.30	
840 (d)	CONCRETE DRAIN PIPES - OGEE	5911			110	1992			23.040.50	
841	PITCH FIBRE DRAIN PIPES	2760				1973			23.040.50	
842 (a)	CAST IRON DRAIN PIPES	437				2008			91.140.80	
843	JOINTING COMPOUND FOR C.I. DRAIN PIPES	6956			5	1992			91.140.10; 91.140.40; 91.140.60	
844	C.I. S. & S. DRAIN PIPES & FITTINGS	437				2008			91.140.80	
845 (a)	STEP-IRONS TO MANHOLES & SEPTIC TANKS		13101			2002			13.060.30; 93.010	
845 (b)	STEP-IRONS TO MANHOLES & SEPTIC TANKS (CONT)						1211	1, 2	97.145	
845 (c)	STEP-IRONS TO MANHOLES & SEPTIC TANKS (CONT)						1212	1, 2	97.145	
845 (d)	STEP-IRONS TO MANHOLES & SEPTIC TANKS (CONT)						1264	2	97.145	
846 (a)	C.I. MANHOLE COVERS & FRAMES		124			1994			93.080.30	
846 (b)	C.I. MANHOLE COVERS & FRAMES (CONT)						4271	1, 2, 3	93.080.30	
846 (c)	C.I. MANHOLE COVERS & FRAMES (CONT)						19596		93.080.30	
847 (a)	LADDERS-STEEL- FOR PERMANENT ACCESS	4211				1994			65.040.20; 97.145	
847 (b)	LADDERS-STEEL- FOR PERMANENT ACCESS (CONT)	5395			3	1985			91.060.30	

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847 (c)	LADDERS- FOR PERMANENT ACCESS (CONT)						18799	1, 2	97.145	
848	HANDRAILING IN & ABOUT BUILDINGS	6180				1999			91.060.99	
849 (a)	FENCING - METAL	1722			1, 2, 3, 8, 9, 10, 12, 14, 16	various			91.090	
849 (b)	FENCING - WOOD	1722			4, 5, 6, 7, 11	1986			91.090	
850 (a)	FLOORING, WALKWAYS; TREADS - STEEL (EXP. METAL)	4592			0, 2	2006			91.060.30	
850 (a)	FLOORING, WALKWAYS; TREADS - STEEL (EXP. METAL) - CONT		14122+A1		1,2,3,4	2010			91.060.30	
850 (b)	FLOORING, WALKWAYS; TREADS - SOLID PLATE	4592			0,5	2006			91.060.30	
850 (b)	FLOORING, WALKWAYS; TREADS - SOLID PLATE (CONT)	14122			1,2,3,4	2010			91.060.30	
851	MASTIC ASPHALT FOR ROOFING	6925				1988			75.140	
852	ALUMINIUM FOR LOUVRE WINDOWS	1161				1977			77.150.10	
853 (a)	FIXING ACCESSORIES FOR BUILDING PURPOSES	1494			1	1964			21.060.01; 91.060.10; 91.060.20	
853 (b)	FIXING ACCESSORIES FOR BUILDING PURPOSES	1494			2	1967			21.060.01	
854 (a)	PRECAST CONCRETE INSPECTION CHAMBERS	5911+A2	1917		4	2002			91.140.80	
854 (b)	PRECAST CONCRETE MANHOLES-COMPONENTS FOR						4034	1, 10	93.030	
855 (a)	PRECAST CONCRETE KERBS, CHANNELS & FLAGS - SPEC:		1339			2003			91.100.30	
855 (b)	PRECAST CONCRETE KERBS & CHANNELS - LAYING	7533			4	2006	483		93.080.20	
856 (a)	WATERPROOF BUILDING PAPERS-WALLS & ROOFS	1521			class A	1972			91.100.99	
856 (b)	WATER PROOF BUILDING PAPERS-BITUMEN-TESTING						52123		91.100.50	
856 (c)	WATER PROOF BUILDING PAPERS-PLASTIC ROOFING						16726		91.100.50	
856 (d)	WATER PROOF BUILDING PAPERS-BITUMIN. ROOFING						52128		91.100.50	
856 (e)	WATER PROOF BUILDING PAPERS-PVC-FIBRE R/F						16734		91.100.50	
857	METAL TIES FOR CAVITY WALL		845+A1		1	2003			91.060.10; 91.080.30	
858	A/C BUILDING PRODUCTS-TESTS						WITHDRAWN			
859	PRECAST CONCRETE FLAGSTONES	7263			1,3	2001			91.100.30	
860 (a)	ASBESTOS CEM. RAIN WATER GOODS						WITHDRAWN			
860 (b)	ASBESTOS CEM. RAIN WATER GOODS (CONT)						WITHDRAWN			
861	LINTELS - PREFABRICATED	1239	845		2	2003			91.060.10; 91.080.01	
862	uPVC SOIL AND VENT PIPES FITTINGS ETC.		1329		1	2000			83.140.30; 91.140.80	
862	uPVC SOIL AND VENT PIPES FITTINGS ETC.	4514				2001			65.060.35	
863	STRUCTURAL STEEL IN BUILDINGS		1993		1-1,1-5, 1-10, 5-2, 4-2	1969			91.080.10	
864	PROTECTIVE BARRIERS IN & ABOUT BUILDINGS	6180				1999			91.060.99	
865	BUILDINGS-SURFACE REPAIR OF CONCRETE	8221			1,2	2000			91.040.01	
866 (a)	BITUMEN FOR BUILDINGS & CIVIL ENG. - ROADS		12591			2009			75.140	
866 (a)	BITUMEN FOR BUILDINGS & CIVIL ENG. - ROADS (CONT)		13924			2006			75.140	
866 (b)	BITUMEN FOR BUILDINGS & CIVIL ENG. - INDUSTRIAL USE	3690			2	1989			75.140	
866 (c)	BITUMEN FOR BUILDINGS & CIVIL ENG. - MIXTURES						WITHDRAWN			
867 (a)	SOLAR WATER HEATERS-DOMESTIC	5918				1989			27.160	AS 2813-85
867 (b)	SOLAR WATER HEATERS - ELASTOMERIC MATERIALS	7431				1991			27.160; 83.060	= ISO 9808:1990
868	FLOORING INITIAL TREATMENT/MAINTENANCE	6263			2	1991			91.060.30	
869	RIGID FLAT SHEET BUILDING MATERIALS									ISO 2777: 1974
870 (a)	DRAINS & SEWERS - HDPE PIPES - HEAT RESISTANT	No British Standard					19535	1, 2	23.040.20	
870 (b)	DRAINS & SEWERS-HDPE PIPES-DIMENSIONS						19537		23.040.20	
871 (a)	CONCRETE STRUCTURES - REPAIR OF - DEFINITIONS		1504		1, 2, 3	98/04/05			91.080.40	
871 (a)	CONCRETE STRUCTURES-REPAIR OF-TESTS-POLYMERS		1543			1998			91.080.40	
871 (a)	CONCRETE STRUCTURES-REPAIR OF-TESTS-EXPANSION		1770			1998			91.080.40	

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872	NAILS - STEEL	1202			1	2002			21.060.50	
873	PIPE WRENCHES	3594			1, 2	1963/65				
874 (a)	GEOTEXTILE-QUALITY, TENSILE STRENGTH, ELONGATION								59.080.70	ISO 10319:2008
874 (b)	GEOTEXTILE-PUNCTURE RESISTANCE		12236			2006			59.080.70	≡ ISO 12236:2006
875 (a)	GEOGRID-QUALITY, TENSILE STRENGTH		10319			2008			59.080.70	≡ ISO 10319:2008
876 (b)	GEOGRID-CREEP LIMITED TENSILE STRENGTH		13431			1999			59.080.70	≡ ISO 13431:1999
877 (c)	GEOGRID-JOINT STRENGTH		10321			2008			59.080.70	≡ ISO 10321:2008
878 (d)	GEOGRID-SITE PARTIAL FACTORS (CODE OF PRACTICE)	8006			1,2	2010/11			93.02	
879	CERAMIC TILES		14411			2012			91.100.23	
880	CONCRETE KERB UNITS - REQUIREMENTS		1340			2003				

≠: related but not equivalent to BS =: technically equivalent to BS ≡: identical to BS

METALWORK

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900	ZINC SPRAY PROTECTION		2063	2063		2005			25.220.20	
900	ZINC SPRAY PROTECTION (CONT)					2010	55634		91.080.10; 77.060	
901	METALLIC ZINC RICH PRIMER	4652				1995			87.040	
902	COLOUR OF FINISH (BUILDING MATERIALS)	4800				2011			87.040	
903 (a)	HOT DIP GALVANISING ON IRON & STEEL	729	1461	1461		1999			25.220.40	
903 (b)	HOT DIP GALV. ON IRON & STEEL (CONT)		12944 & 14713		1, 2, 3, 4, 5, 6, 7, 8	Various	50978		25.220.01; 91.080.10	
904 (a)	BLACK BITUMEN COAT. (COLD APP) - WATER TANKS	3416				1991			25.220.60	
904 (b)	BLACK BITUMEN SOL. (COLD APP)-M. TANKS						See DVGW			DVGW-GWS
905 (a)	STRUCTURAL STEELS - WEATHER RESISTANT	7668				2004			77.140.70	
905 (b)	STRUCTURAL STEELS - REQUIREMENTS		10210		1, 2	2006			77.140.75; 77.140.70	
905 (c)	STRUCTURAL STEELS - STEEL PLATES ABOVE 3 mm		10029 & 10286			2010			77.140.50	
905 (d)	STRUCTURAL STEELS - WELDABLE		10025		1, 3, 4	2004			77.140.10	≠ Pt 1:ISO 4950-1:1995;
905 (e)	STRUCTURAL STEELS - HIGH YIELD PLATES & FLATS		10025		1, 6	2004			77.140.50	
905 (f)	STRUCTURAL STEELS - IMP. CORROSION RESISTANCE		10155		1, 5	2004			77.140.10	≠ ISO 4952:2006
906	CLASSIFICATION OF GREY CAST IRON		1561			2011			77.140.80	
907	BEARING DESIGN LIFE	No British Standard								AGMA ST 510
908 (a)	BITUMEN HOT APPLIED - COATS TO IRON & STEEL		10300			2005			25.220.60	
908 (b)	BITUMEN HOT APP. - COATS TO IRON & STEEL (CONT)		12944 & 14713		1, 2, 3, 4, 5, 6, 7, 8	Various	50978		25.220.01; 91.080.10	
909	PRESSED STEEL RECTANGULAR TANKS	1564 & AMD 4150				1975			23.020.10	
910	FOUNDING. GREY IRON CASTINGS		1561		grade 10	2011	1686	1	77.140.80	
911 (a)	FOUNDING. MALLEABLE CAST IRON		1562			2012	1684	1	77.140.80	
911 (b)	MALLEABLE CAST IRON (CONT)									ASTM A 47-77
912	STEEL PLATES-HOT ROLLED-3mm & ABOVE		10029 & 18286			2010			77.140.50	
913	STRUCTURAL STEEL - HOT ROLLED SECTIONS	4			1	2005	1025	1, 5	77.140.70	
914	ISO METRIC BLACK HEX. BOLTS, SCREWS, NUTS	4190				2001			21.060.10; 21.060.20	= ISO 272; ISO 885; ISO 888; ISO 4759/1
915	SIZES FOR FERROUS & NON FERROUS BARS	6722				1986			77.140.01; 77.150.01	
916	FOUNDING. MEEHANITE IRON, GRADE E		1561		grade 14	2011			77.140.80	ASTM A 48, No.308
917 (a)	CORROSION PROTECTION - STEEL STRUCT.-CP		12944 & 14713		1, 2, 3, 4, 5, 6, 7, 8	Various			25.220.01; 91.080.10	
917 (b)	CORROSION PROTECTION-S. STRUCT.-PAINT		12944		1, 2, 3, 4, 5, 6, 7, 9	Various	EN ISO 12944:1-8		91.080.10	
918 (a)	PRIMARY ZINC		1179			2003			77.120.60	
918 (b)	FOUNDING. ZINC & ZINC ALLOYS		1774			1998			77.120.60; 77.150.60	
919 (a)	WELDING OF STEELS - ARC		1011		2	2001			25.160.10	
919 (a)	WELDING OF STEELS - ARC (CONT)		1011		1	1998			25.160.10	
919 (b)	WELDING OF STEELS-WELDABILITY-FUSION						8528	1, 2	25.160.10	
919 (c)	WELDING OF STEELS-JOINING OF PLATE						8553		25.160.10	
919 (d)	WELDING OF STEELS-WELDING OF VESSELS						8562		25.160.10	
919 (e)	WELDING OF STEELS-STRUCTURES-SUITABILITY FOR						18800	7	25.160.10	
920 (a)	STEEL PLATE, SHEET & STRIP - GENERAL	1449			1-1.1	1991			77.140.50	
920 (b)	STEEL PLATE, SHEET & STRIP - COLD ROLLED		10268			1999			77.140.50	≠ EN 149
920 (c)	STEEL PLATE, SHEET & STRIP - HOT ROLLED	1449			1-1.14	1991	1614	1	77.140.50	

METALWORK

THE LATEST STANDARD IS TO BE USED IN LINE WITH KENYA GAZETTE NOTICE Vol. CXIV—No. 84 NO.:13048

SSRN	SUBJECT	BS	BS EN	BS ISO	PART	YEAR	DIN	PART	ICS No.	OTHER
920 (d)	STEEL PLATE, SHEET & STRIP - COLD ROLLED		10132		1,2,3	2000			77.140.50	
920 (e)	STEEL PLATE, SHEET & STRIP - COLD ROLLED		10268			1999			77.140.50	≠ EN 149
920 (f)	STEEL PLATE, SHEET & STRIP - HOT ROLLED	1449			1-1.8	1991			77.140.50	≠ EN 46
920 (g)	STEEL PLATE, SHEET & STRIP - STAINLESS		10029			1991			77.140.50	
920 (g)	STEEL PLATE, SHEET & STRIP - STAINLESS		10259			1997			77.140.50	
920 (g)	STEEL PLATE, SHEET & STRIP - STAINLESS		10258			1997			77.140.50	
920 (g)	STEEL PLATE, SHEET & STRIP - STAINLESS		10048			1997			77.140.50	
920 (g)	STEEL PLATE, SHEET & STRIP - STAINLESS		10095			1999			77.140.50	
920 (g)	STEEL PLATE, SHEET & STRIP - STAINLESS		10051+ A1			1992/19 97			77.140.50	
920 (h)	STEEL PLATE, SHEET & STRIP - CONT. HOT ROLLED		10051+ A1			1992/19 97			77.140.50	
920 (i)	STEEL FLAT - HIGH YIELD - COLD ROLLED		10131			2006			77.140.50	
920 (j)	STEEL FLAT-COLD ROLLED FOR VITREOUS ENAMELLING		10209			1996			77.140.50	
920 (k)	STEEL FLAT - HOT ROLLED OF HIGH YIELD		10149		1, 2, 3	1996			77.140.50	
921 (a)	ELECTROP. COATINGS - THREADS - CADMIUM/ZINC ON STEEL	7371			12	2008			21.060.01; 25.220.40	
921 (b)	ELECTROP. COATINGS - THREADS - NICKEL ON STEEL OR COPPER	7371			12	2008			21.060.01; 25.220.40	
921 (c)	ELECTROP. COATINGS - THREADS - TIN ON COPPER	7371			12	2008			21.060.01; 25.220.40	
922	ELECTROP. COATINGS - THREADS - THICKER PLATINGS	7371			12	2008			21.060.01; 25.220.40	
923	ISO METRIC SCREW THREADS	3643			1, 2	2007			21.040.10	
924	ISO M. PRECISION HEX. BOLTS, SCREWS, NUTS	3692				2001			21.060.10; 21.060.20	
925	METAL WASHERS FOR GENERAL ENGINEERING	4320				1968			21.060.30	= ISO 887:1983
926	PAINTS FOR STEEL STRUCT. - POLYURETHANE	No British Standard								AAS 2602:83 2603:83
927	SHEAR TEST FOR METALS	No British Standard					50141		77.040.10	
928	WELDED STEEL TANKS FOR OIL STORAGE	799			5	2010			23.020.10	APS 650
929 (a)	LIFTING APPLIANCES- O'HEAD TRAVEL'G CRANES	466				1984			53.020.20	= ISO 4301/1 EQV; ≠ ISO 8306 NEQ
929 (b)	LIFTING APPLIANCES- O'HEAD TRAVEL'G CRANES									ISO 7752-5:1985
930	HIGH STRENGTH FRICTION GRIP (HSFG) BOLTS - PART 1: GENERAL GRADE PART 2: HIGHER GRADE	4395			1, 2	1969			21.060.01	= ISO 225; ISO 272; ISO 885; = ISO 888; ≠ ISO 887; ASTM A 325
931	ELECTRODES FOR MANUAL ARC - WELDING		2560	2560		2005			25.160.20	
932	PHOSPHATE TREAT. OF STEELWORK		12476			2000			25.220.20	
933 (a)	BLAST CLEANING PRIOR TO PAINTING	7079	12944		4	Various	EN ISO 12944	4	25.220.10; 87.020	
933 (b)	BLAST CLEANING PRIOR TO PAINTING		8501	8501	1	2001			17.040.20; 25.220.10; 87.020	
933 (c)	BLAST CLEANING PRIOR TO PAINTING	7079			A1 Supl. 1	1996			17.040.20; 25.220.10; 87.020	≡ ISO 8501-1:1988: Info Supp. of 1994
934	SHERARDIZED COATINGS	4921				1988			25.220.40	
935 (a)	GALVANISED STEEL ROOFING SHEETS	3083				1988			77.140.50	KS 06-02 Part II
935 (b)	GALVANISED STEEL ROOFING SHEETS						59231		77.140.70	
935 (c)	GALVANISED COATINGS ON IRON AND STEEL ARTICLES		1461	1461		1999				
936	WROUGHT AND STAINLESS STEEL- INSPECTION & TESTING		10250		1	2000	17440	:1.4021	77.140.20	
936 (a)	BRIGHT STEEL PRODUCTS		10277		1 to 5	2008			77.140.60	
936 (b)	STAINLESS STEEL						17440	:1.4404	77.140.20	
936 (c)	STAINLESS STEEL						17440	:1.4301	77.140.20	
936 (d)	BRIGHT STEEL PRODUCTS - DIMENSIONS AND TOLERANCES		10278			1999				
937	PREPARATION OF STEEL - BLAST CLEANING		8503	8503	C-C1 to C4	2012			25.220.10	

METALWORK

THE LATEST STANDARD IS TO BE USED IN LINE WITH KENYA GAZETTE NOTICE Vol. CXIV—No. 84 NO.:13048

SSRN	SUBJECT	BS	BS EN	BS ISO	PART	YEAR	DIN	PART	ICS No.	OTHER
938	HEXAGON HEADED BOLTS- GRADES A & B			4014		2001			21.060.10	
939	HEXAGON NUTS- GRADES A & B			4032		2001			21.060.20	
940	DUCTILE IRON CASTINGS		1564			2011			77.140.80	
941 (a)	BRASS FOR NUTS	1981				1991			21.060.10; 21.060.20	
941 (b)	BRASS FOR NUTS (CONT)						17660	:2.0380	77.150.30	
942	ALUMINIUM BRONZE FOR GENERAL PURPOSES - NUTS		12167			2011			77.150.30	
943	USE OF HSFG BOLTS IN STRUCTURAL STEELWORK		1993		1 - 8	2005			21.060.10; 91.080.10	
944	STRUCTURAL USE OF STEELWORK IN BUILDINGS - MATERIALS, FABRICATION & ERECTION	5950			2	2001			13.220.50; 91.080.10	
945	TESTING OF ZINC COATING ON STEEL WIRE		10244		2	2001			25.220.40	
946	EXTERNAL CORROSION OF BURIED METALLIC PIPELINES AND STRUCTURAL COMPONENTS					1985	50929	3	77.06	

≠: related but not equivalent to BS =: technically equivalent to BS ≡: identical to BS

CHAPTER 11

INSPECTION FORMS & CHECKLISTS

STANDARD SPECIFICATION REFERENCE NUMBERS

(SSRN)

INDEX

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THIWASCO JOB NO:

CONCRETE POUR INSPECTION REQUEST

PROJECT: _____ CONTRACTOR: _____

DATE AND TIME OF REQUEST: _____

The following work will be ready for inspection from:

Time: _____

Date: _____

CONCRETE STRENGTH: _____

CONCRETE VOLUME: _____

INSPECTION RECORD

<u>DESCRIPTION</u>		Checked by			Remarks
		Contractor	Engineer		
Excavation:	1. Setting out (centre lines):				
	2. Dimensions, depth:				
	3. Cleanliness:				
Blinding:	1. Type:				
	2. Level:				
Reinforcing:	1. Type , diameter, spacing:				
	2. Cleanliness, secure :				
	3. Cover:				
Formwork:	1. Setting out ,dimensions:				
	2. Levels:				
	3. Fillets, pockets:				
	4. Ties, props:				
Embedded item	1. Type/Mark number:				
	2. Position:				
	3. Fastenings and protection:				
	4. Joints:				
H.D. Bolts:	1. Size and diameter:				
	2. Setting out:				
	3. Projections:				
	4. Pockets and protection:				
water bars, void formers and ther items:					

Date and time of actual inspection: _____

Passed for concreting by: _____ (Engineer)

Note:

Approval of this work by the Engineer does not relieve the Contractor or from his responsibility to produce work in accordance with the standards defined in the contract documents.

CHECK OUT AND ACCEPTANCE CERTIFICATE FOR EMBANKMENT FORMATION

PROJECT: _____ CONTRACTOR: _____

DATE AND TIME OF REQUEST: _____

The following work will be ready for inspection from:

Time: _____

Date: _____

CHAINAGE: _____

FILL VOLUME: _____

INSPECTION RECORD

<u>ITEM</u>	<u>DESCRIPTION</u>	Checked by		Remarks
		Contractor	Engineer	
1.	Approved drawings(latest revision)			
2.	Approved Contractor drawings			
3.	Trial holes dug for existing services location			
4.	Trial holes refilled			
5.	Type of existing service located			
6.	Existing service relocated			
7.	Limits of clearing observed			
8.	All weathered soil removed and replaced with suitable compacted material to the original formation level			
9.	All surface soil/unsuitable material removed from area for construction of embankment			
10.	Proper grade pegs set in the bottom of the foundation			
11.	Area properly cleared (i.e. trees,roots e.t.c)			
12.	All material suitable for re-use kept separate and set aside and protected as necessary to prevent loss or deterioration			
13.	Embankment material suitable/unsuitable			
14.	Embankment material plastic/Non plastic			
15.	Formation level properly dewatered			
16.	Depth of fill layers			
17.	Type and weight of crawl tractor used			
18.	Type and weight of compactor used			
19.	Number of compaction passes			
20.	Large voids filled with broken fragments before the next layer is placed			
21.	Embankment to the lines and heights shown on the Drawings			
22.	Direct constructional traffic uniformly over the full width			
23.	High-bearing capacity materials placed in the top-most level			
24.	Moisture content of fill material			

Date and time of actual inspection: _____

Passed by: _____ (Engineer)

Note: Approval of this work by the the Engineer does not relieve the Contractor from his responsibility to produce work in accordance with the standards defined in the contract documents.

CHECK OUT AND ACCEPTANCE CERTIFICATE FOR FOUNDATION EXCAVATION

PROJECT: _____

CONTRACTOR: _____

DATE AND TIME OF REQUEST: _____

The following work will be ready for inspection from:

Time: _____

Date: _____

STRUCTURE: _____

EXCAVATE VOLUME: _____

INSPECTION RECORD

<u>ITEM</u>	<u>DESCRIPTION</u>	Checked by		Remarks
		Contractor	Engineer	
1.	Approved drawings(latest revision)			
2.	Approved Contractor drawings			
3.	Trial holes dug for existing services location			
4.	Trial holes refilled			
5.	Type of existing service located			
6.	Existing service relocated			
7.	All surface soil removed from area for construction of structures			
8.	Excavation class			
9.	Excavation suitable/unsuitable			
10.	Excavation plastic/Non plastic			
11.	Sides of excavation stable			
12.	Excavation properly dewatered			
13.	Type of excavation(Blasting,ripping,e.t.c)			
14.	Area properly cleared (i.e. trees,roots e.t.c)			
15.	Limits of clearing observed			
16.	Foundation excavated to the lines and depths shown on the Drawings			
17.	Patches of soft ground in the excavations			
18.	All weathered soil removed and replaced with suitable compacted material to the original formation level			
19.	Bottoms of the foundation excavated smooth and free from stones or other projections			
20.	Proper grade pegs set in the bottom of the foundation			
21.	All material suitable for re-use kept separate and set aside and protected as necessary to prevent loss or deterioration			

Date and time of actual inspection: _____

Passed by: _____ (Engineer)

Note: Approval of this work by the the Engineer does not relieve the Contractor from his responsibility to produce work in accordance with the standards defined in the contract documents.

CHECK OUT AND ACCEPTANCE CERTIFICATE FOR GENERAL EXCAVATION

PROJECT:

CONTRACTOR: _____

DATE AND TIME OF REQUEST: _____

The following work will be ready for inspection from:

Time: _____

Date: _____

EXCAVATION TYPE(Mechanical/Hand): _____

EXCAVATE VOLUME: _____

INSPECTION RECORD

DESCRIPTION

Checked by

Contractor Engineer

Remarks

Clearing of the Site	1.	Trees, hedges and undergrowth shall be taken down and grubbed up for disposal			
	2.	Limits of clearing observed			
Trial Holes	1.	Trial holes dug			
	2.	Trial holes refilled			
	3.	Type of existing service located			
Surface Soil	1.	All surface soil removed from area for construction of roads			
	2.	All surface soil removed from area for construction of structures			
	3.	All surface soil removed from area for cuttings/embankments			
	4.	surface soil stock piled for later use			
	5.	Soiling and compacting of side slopes to cuttings and embankments uniform			
Classification of Excavation	1.	Excavation class			
	2.	Excavation suitable/unsuitable			
	3.	Excavation plastic/Non plastic			
Excavation - General	1.	Sides of excavation stable			
	2.	Excavation properly dewatered			

Date and time of actual inspection: _____

Passed by: _____

_____(Engineer)

Note:

Approval of this work by the the Engineer does not relieve the Contractor from his responsibility to produce work in accordance with the standards defined in the contract documents.

THIWASCO

JOB NO:

CONCRETE HAUNCH INSPECTION REQUEST

PROJECT: _____ CONTRACTOR: _____

DATE AND TIME OF REQUEST: _____

The following work will be ready for inspection from:

Time: _____

Date: _____

CONCRETE STRENGTH: _____

CONCRETE VOLUME: _____

INSPECTION RECORD

<u>DESCRIPTION</u>	Checked by		Remarks
	Contractor	Engineer	
Excavation:	1. Setting out (centre lines):		
	2. Dimensions, depth:		
	3. Cleanliness:		
Blinding:	1. Type:		
	2. Level:		
Formwork:	1. Setting out ,dimensions:		
	2. Levels:		
	3. Fillets, pockets:		
	4. Ties, props:		
Embedded item	1. Type/Mark number:		
	2. Position:		
	3. Fastenings and protection:		
	4. Joints:		

Date and time of actual inspection: _____

Passed for concreting by: _____ (Engineer)

Note:

Approval of this work by the the Engineer does not relieve the Contractor from his responsibility to produce work in accordance with the standards defined in the contract documents.

CHECK OUT AND ACCEPTANCE CERTIFICATE FOR PIPELINE EXCAVATION

PROJECT: _____ CONTRACTOR: _____

DATE AND TIME OF REQUEST: _____

The following work will be ready for inspection from:

Time: _____

Date: _____

CHAINAGE: _____

INSPECTION RECORD

<u>ITEM</u>	<u>DESCRIPTION</u>	Checked by		Remarks
		Contractor	Engineer	
1.	Approved drawings(latest revision)			
2.	Approved Contractor drawings			
3.	Trial holes dug for existingservice location			
4.	Trial holes refilled			
5.	Type of existing service located			
6.	Excavation class			
7.	Excavation suitable/unsuitable			
8.	Excavation plastic/Non plastic			
9.	Sides of excavation stable			
10.	Excavation properly dewatered			
11.	Type of excavation(open cutting/tunnelling/heading)			
12.	Limits of clearing observed			
13.	Trenches excavated to the lines and depths shown on the Drawings			
14.	Type of bedding used			
15.	If concrete used,breadth of concrete bedding equal to the width of the trench			
16.	Excavation for water works structure carried out to the levels and outlines of such structures			
17.	All weathered soil removed and replaced with suitable compacted material to the original formation level			
18.	Bottoms of the trenches excavated smooth and free from stones or other projections			
19.	Proper grade pegs set in the bottom of the trench			
20.	Grooves cut across the trench at the required positions to enable the easy removal of pipe slings			
21.	Materials excavated from trenches laid completely and neatly on the sides of the trench			
22.	All material suitable for re-use kept separate and set aside and protected as necessary to prevent loss or deterioration			

Date and time of actual inspection: _____

Passed by: _____ (Engineer)

Note: Approval of this work by the the Engineer does not relieve the Contractor from his responsibility to produce work in accordance with the standards defined in the contract documents.

CHECK OUT AND ACCEPTANCE CERTIFICATE FOR PIPE TRENCH REFILL

PROJECT: _____

CONTRACTOR: _____

DATE AND TIME OF REQUEST: _____

The following work will be ready for inspection from:

Time: _____

Date: _____

CHAINAGE: _____

INSPECTION RECORD**ITEM****DESCRIPTION**

Checked

by

Contractor

Engineer

Remarks

- | | | | |
|--|--|--|--|
| 1. Approved drawings(latest revision) | | | |
| 2. Approved Contractor drawings | | | |
| 3. Bottoms of the trenches excavated smooth and free from stones or other projections | | | |
| 4. Type of bedding used | | | |
| 5. If concrete used,breadth of concrete bedding equal to the width of the trench | | | |
| 6. Compaction depth of bedding material | | | |
| 7. Compaction depth of fill around the pipe | | | |
| 8. soil filled around and for 300 mm over the top of the pipes free from stones, tree roots or similar objects | | | |
| 9. Backfill layer depth | | | |
| 10. The backfill soil free from clay lumps, boulders and rock fragments greater than 150 mm | | | |
| Compaction of fill material and tests done | | | |
| Whether material reused from trench or borrowed | | | |

Date and time of actual inspection: _____

Passed by: _____ (Engineer)

Note: Approval of this work by the the Engineer does not relieve the Contractor from his responsibility to produce work in accordance with the standards defined in the contract documents.

Preamble to the Modified CESMM

CIVIL ENGINEERING STANDARD METHOD OF MEASUREMENT

[CESMM]

INDEX

Preamble to the Modified CESMM

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PREAMBLE TO THE MODIFIED CESMM**CLAUSE 1: DEFINITIONS**

- 1.1 In this document and in Bills of Quantities prepared according to the procedure set forth herein the following words and expressions have the meanings hereby assigned to them, except where the context otherwise requires
- 1.2 Words and expressions defined in the Conditions of Contract have the same meaning herein.
- 1.3 The word 'work' includes work to be carried out, goods, materials and services to be supplied, and the liabilities, obligations and risks to be undertaken by the Contractor under the Contract.
- 1.4 The expression 'expressly required' means shown on the Drawings, described in the Specification or ordered by the Engineer pursuant to the Contract.
- 1.5 'Daywork' means the method of valuing work on the basis of time spent by the workmen, the materials used and the plant employed.
- 1.6 'Work Classification' means the Work Classification set out in Clause 8 hereof.
- 1.7 'Original Surface' means the surface of the ground before any work has been carried out.
- 1.8 'Final Surface' means the surface indicated on the Drawings to which excavation is to be carried out.
- 1.9 'Commencing Surface' means, in relation to an item in a Bill of Quantities, the surface of the ground before any work covered by the item has been carried out. 'Commencing surface' means, in relation to a group of items in a Bill of Quantities for work in different materials in the excavation or bored, drilled or driven hole, the surface of the ground before any work covered by any item in the group has been carried out.
- 1.10 'Excavated Surface' means, in relation to an item in a Bill of Quantities, the surface to which excavation included in the work covered by the item is to be carried out. 'Excavated surface' means, in relation to a group of items in a Bill of Quantities for excavation in different materials, the surface to which excavation included in the work covered by any item in the group is to be carried out.
- 1.11 A hyphen between two dimensions means a range of dimensions which includes all dimensions exceeding that preceding the hyphen but not exceeding that following the hyphen.
- 1.12 'Rock' shall be classified into two categories i.e. class I and class II which are based on the guidelines and definitions set in the Specifications and in tables 1 & 2 in class E herein

CLAUSE 2: GENERAL PRINCIPLES

- 2.1 The title of this document is the Modified Civil Engineering Standard Method of Measurement. It is intended to be used in conjunction with the Conditions of Contract and in connection with works of civil engineering construction.
- 2.2 This document sets forth the procedure according to which the Bill of Quantities are to be prepared and priced and the quantities of work expressed and measured.
- 2.3 The objects of the Bills of Quantities are
- (a) to provide such information as to enable tenders to be prepared efficiently and accurately.
 - (b) when a Contract has been entered into, to provide for use of the priced Bill of Quantities in the valuation of work executed.
- 2.4 Work has been itemised in the Bill of Quantities in different classes ("Work Classification") however in pricing the Bills of Quantities Tenderers shall have due regard for all of their expected costs in fulfilling their obligations under the Contract, and make due allowance for these costs within the available Bills of Quantities items.

CLAUSE 3: APPLICATION OF THE WORK CLASSIFICATION

- 3.1 The Work Classification presented has divided types of work into 18 main classes. Each class comprises up to a maximum of six divisions which classify work at successive levels of detail. Each division comprises a list of up to nine descriptive features of work. Each item description in the Bill of Quantities identifies the component of work covered with respect to one feature from each division of the relevant class. e.g.

Class H (precast concrete) contains three divisions of classification. The first classifies different types of precast units, the second classifies different units by their dimensions, and the third classifies them by their mass. Each item description for precast concrete units therefore identifies the component of work in terms of the type of unit, its dimensions and mass.

- 3.2 To avoid unnecessary length, item descriptions for Permanent Works generally identify the component of the Works and not the tasks to be carried out by the Contract, e.g.

An item is described as 'Mild Steel bar reinforcement to SSRN 126 nominal size 20 mm', not as 'Supply, delivery, cut, bend and fix mild steel bar reinforcement to SSRN 126 nominal size 20 mm'.

- 3.3 Where the work identified by an item is specifically limited, the limitation is stated in the item description, e.g.

'Mild steel bar reinforcement to SSRN 126 nominal size 20 mm excluding supply and delivery to the Site'.

Item descriptions for work which is divided between two classes has such limitations stated, e.g.

Item descriptions for miscellaneous metalwork inserts which are to be cast into concrete require appropriate additional description if items are given in both class G for casting in the inserts and class N for supplying the inserts.

- 3.4 In preparing the Bills of Quantities, an attempt has been made to have work divided into items in the Bills of Quantities so that the component of work which is included in each item does not exhibit more than one feature from each division of any one class of the Work Classification e.g.

One item for precast concrete work does not include more than one of the types of concrete unit listed in the first division of Class H, neither does it include different units whose dimensions are not within one of the classifications listed in the second division of class H, nor does it include different units whose mass does not lie within one of the ranges listed in the third division class H.

- 3.5 Measurement rules in the Work Classification set out the conditions under which work shall be measured and the method by which the quantities shall be computed, save as otherwise provided in the Contract.
- 3.6 Definition rules in the Work Classification define the extent and limits of the class of work represented by a word or expression used in the Work Classification and in a Bill of Quantities prepared in accordance with this document.
- 3.7 Coverage rules in the Work Classification provide that the work stated is deemed to be included in the Contract. A coverage rule is not however exhaustive or limiting, does not state all the work covered by an item and does not preclude any of the work stated being covered by a Method-Related Charge.

CLAUSE 4: CODING AND NUMBERING OF ITEMS

- 4.1 For convenience of reference each item in the Work Classification has been assigned a bill number, a code number consisting of a letter and a maximum of six digits. The initial number designates the Bill Number, the next capital letter corresponds to the class in the Work Classification in which the item occurs and the digits give the position of the item in the respective divisions of the class. In the case of Class I, supply of pipes, sewers and fittings a final lower case letter defines the nominal diameter.

Code 4I 162.4 m identifies an item as

Bill Number	4	
Class I		pipework – pipes, sewers & fitting - supply
First division	1	pipes & sewers
Second division	6	uPVC
Third division	2	S & S standard joints
(if more than three divisions a decimal point separates division three from division four)		
Fourth division	4	N.P. 9/10
Fifth division	m	dia. 200 mm.
Sixth division	(1-9)	if required to differentiate between items

- 4.2 Code numbers may be used to number the items in the Bill of Quantities.
- 4.3 Where a feature of an item is not listed in the Work Classification and the digit 9 has not been categorised it may have been used in the appropriate positions in the code number.

CLAUSE 5: PREPARATION OF THE BILL OF QUANTITIES

- 5.1 Appropriate provisions of this Clause shall also apply to the measurement of completed work.
- 5.2 The Bills of Quantities shall be considered as consisting of the following parts.

- (a) Preamble to Bills of Quantities
- (b) Modified CESMM
 - (i) Preamble to Modified CESMM
 - (ii) Work Classification

Where there are significant building works, these are measured according to the Standard Method of Measurement of Building Works (SMMBW) of an acceptable Architectural Association (based on that published by Royal Institution of Chartered Surveyors, London).

- (c) SMMBW
 - (i) General Rules
 - (ii) Work Classifications
- (c) or (d) Bills of Quantities for individual Lots, each divided into:
 - (i) Grand Summary
 - (ii) Work items (divided into Bills)
 - (iii) Daywork Schedule

- 5.3 The Daywork Schedule comprises a list of various classes of Labour, Material and Plant for which the Tenderer is to insert his Daywork rates (inclusive of overheads and profit) for the separate items. These are then be cumulated and carried forward to the respective Preliminary and General (Bill 1) items, as Provisional Sums.
- 5.4 Daywork rates for staff shall include transport to the sites of work about the site, overtime unless work is specifically instructed to be executed outside normal working hours, superintendence, allowances, insurances, tools of the trade, protective clothing, and consumables normally occasioned in pursuit of their trade. The rates are to be priced on the basis of the staff being on the site or engaged from the vicinity of the site at the time works are ordered to be executed on Dayworks rates. Payment shall be on the basis of the times actually worked, excluding any meal or recess times.
- 5.5 Daywork rates for materials shall include procurement, transport to site, loading, offloading, handling, storage, transport to the place of usage and minor materials normally associated with usage of the material such as nails for timber and binding wire for reinforcement.
- 5.6 Daywork rates for plant shall include fuel, oils, lubricants, maintenance, insurance, and the cost of any operators, drivers, loaders and the like. Payment shall be for any reasonable time spent in actual travel to the site (not exceeding that from the capital city) and for the time of actual active usage in executing work. The costs of any loader to transport the plant shall not be paid for separately.
- 5.7 Each part of the Bill of Quantities has been given a heading and groups of items within each part have been given sub-headings. Headings and sub-headings should be read as part of the item description to which they apply. A line has been drawn across the item description column below the last item to which each heading or subheading applies.

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- 5.8 Generally, all work has been itemised and the items described in accordance with the Work Classification, but there are deviations from this where the nature, location, importance or any other special characteristic of the work is thought likely to give rise to special methods of construction or consideration of cost.
- 5.9 Descriptions in the Bills of Quantities items identify the work covered by the respective items, but the exact nature and extent of the work is to be ascertained from the Drawings, Specification and Conditions of Contract, as the case may be, read in conjunction with the Work Classification.
- 5.10 Any detail or description required to be given with the Work Classification may have been omitted from an item description provided that a reference is given in its place which identifies where the omitted information may be found on a drawing or in the Specification.
- 5.11 Where an item description compiled in accordance with the Work Classification is considered insufficient to identify clearly the particular work covered by the item additional description may have been given to identify the work by reference to its location or other physical features shown on the Drawings or described in the Specification.
- 5.12 Where all the components of work included in an item are of one dimension within a range given in the Work Specifications that dimension may be stated in the item description in place of the range of dimensions.
- 5.13 Each Prime Cost Item is followed by an item for a percentage adjustment in respect of the Contractors costs in connection therewith which, in the absence of any express provision in the Contract to the contrary, shall include:
- (a) in any case in which a nominated Sub-Contractor is to carry out work on the Site, for allowing him to use temporary roads, scaffolding, hoists, mess-rooms, sanitary accommodation and welfare facilities which are provided by the Contractor for his own use and for providing space for office accommodation and storage of plant and materials, for disposing of rubbish and for providing light and water for the work of the Nominated Sub-Contractor, for the Contractor supervising, co-ordinating the Nominated Sub-Contractor's work, and for the Contractor assuming risk and responsibility in connection with such work; and
 - (b) in any case in which the work is not to be carried out by a nominated Sub-contractor, for making procurement, unloading, storing and hoisting materials supplied by him and disposing of packaging materials.
- 5.14 Where any goods, materials or services are to be supplied by a Nominated Sub-Contractor, reference has been made in the description, or in the appropriate heading or sub-heading, of the Prime Cost Item under which the goods, materials or service are to be supplied.
- 5.15 A Provisional Sum for a general contingency allowance, is given in the Grand Summary to the Bills of Quantities for each Lot. This sum is only to be expended on the Engineer's instructions.
- 5.16 Quantities shall be computed net, unless directed otherwise by a measurement rule in this document or by the Contract, and no allowance shall be made for bulking, shrinkage or waste.

5.17 The following units of measurement and abbreviation have been used.

<u>Unit</u>	<u>Abbreviation</u>
millimetre	mm
metre	m
square millimetre	mm ²
square metre	m ²
hectare	ha
cubic metre	m ³
kilogramme	kg
tonne	t
sum	Sum
number	nr
hour	h
week	wk
month	mth

5.18 The Commencing surface has been identified in the description of each item for work involving excavation, boring or driving work which the commencing surface is not the Original surface. The Excavated Surface has been identified in the description of each item for work involving excavation for which the excavated surface is not the Final Surface. The depths of excavation stated in accordance with the Work Classification are to be measured from the Commencing surface to the Excavated Surface.

5.19 The Grand Summary for each Lot contains a tabulation of the parts of the Bill of Quantities for that Lot, with provision for insertion of the total of the amounts brought forward from the individual Bill Summaries.

CLAUSE 6: COMPLETION, PRICING AND USE OF THE BILL OF QUANTITIES

- 6.1 Rates and prices shall be inserted in the rate columns of the Bill of Quantities in the stated currency.
- 6.2 Where appropriate, a unit rate shall be inserted for each item, and the unit rate extended against the quantity to give the line totals. The line totals are to be summated on each page to give the page totals. Summary pages are provided at the end of each Bill, into which the Tenderer shall carry the individual page totals, and summate them to obtain the Bill totals. Bill totals shall be carried to the Grand Summary of the respective Lot.
- 6.3 It has been found necessary to draw the attention to certain aspects of pricing and in particular to the separation of supply of cement from the supply and placing of concrete and of the separation of the supply of pipes and fittings from their laying.
- 6.4 For the supply of pipes and fittings, the rates to be inserted for each supply item shall be the Works-site CIF price obtained from the pipe manufacturer or supplier including the contractor's mark-up.

CLAUSE 7: METHOD-RELATED CHARGES

- 7.1 For the purpose of this Clause the following words and expressions shall have the meanings hereby assigned to them.
- (a) 'Method-Related Charge' means the sum for an item inserted in the Bill of Quantities by a Tenderer in accordance with Sub-clause 7.2.
 - (b) 'Time-Related Charge' means a Method-Related Charge for work the cost of which is to be considered as proportional to the length of time taken to execute the work.
 - (c) 'Fixed Charge' means a Method-Related Charge which is not a Time-Related charge.

- 7.2 A Tenderer may insert in the Bill of Quantities such items for Method-Related Charges as he may decide to cover items of work relating to his intended method of executing the Works, the costs of which are not to be considered as proportional to the quantities of the other items and for which he has not allowed in the rates and prices for the other items.
- 7.3 Where possible the itemisation of Method-Related Charges should follow the order of classification and the other requirements set out in class A of the Work Classification, distinguishing between Time-Related Charges and Fixed Charges. Method-Related Charges may be inserted to cover items of work other than those set out in class A.
- 7.4 Each item for a Method-Related Charge inserted in the Bill of Quantities shall be fully described so as to define precisely the extent of the work covered and to identify the resources to be used and the particular items of Permanent Works or Temporary Works, if any, to which the item relates.
- 7.5 The insertion by the Contractor of any item for a Method-Related Charge in the Bill of Quantities when tendering shall not bind him to adopt the method stated in the item description in executing the Works.
- 7.6 Method-Related Charges shall not be subject to any measurement.
- 7.7 In the event of the satisfactory execution of any part of the Works which has been the subject of an item for a Method-Related Charge using, whether in whole in part, a method other than that described in the item, the Contractor shall nevertheless be entitled to payment of the Method-Related Charge, or the balance thereof, as the case may be, by such instalments at such times and upon such events as may from time to time be agreed between the Engineer and the Contractor. The amount of a Method-Related Charge shall be neither increased nor decreased by reason only of any change in method made by the Contractor of Conditions of Contract, unless such change has been ordered by the Engineer, in which case the provisions of Clause 52 shall apply.

CLAUSE 8: WORK CLASSIFICATION

The Work Classifications to apply are as follows:

Class A:	General Items
Class B:	Ground Investigation (not used)
Class C:	Geotechnical and other specialist processes (not used)
Class D:	Demolition and site clearance
Class E:	Earthworks
Class F:	In situ concrete
Class G:	Concrete ancillaries
Class H:	Precast concrete
Class I:	Pipework – pipes, sewers and fittings – supply only
Class J:	Pipework – pipes, sewers and fittings – install only
Class K:	Pipework-manholes, sewers and pipework ancillaries
Class L:	Pipework-supports and protection, ancillaries to laying and excavation.
Class M:	Structural Metalwork (not used)
Class N:	Miscellaneous metalwork

Class O:	Timber
Class P:	Piles
Class Q:	Piling ancillaries
Class R:	Roads and pavings
Class S:	Rail Track (not used)
Class T:	Tunnels (not used)
Class U:	Brickwork, blockwork and masonry
Class V:	Painting
Class W:	Waterproofing
Class X:	Miscellaneous work
Class Y:	Sewer Renovation and ancillary works

CLASS A: GENERAL ITEMS

Includes: General obligations site services & facilities, Temporary Works, testing of materials & work, Provisional Sums & Prime Cost Items, and Items to cover elements of the cost of the work which are not to be considered as proportional to the quantities of the Permanent Works

FIRST DIVISION	SECOND DIVISION	THIRD DIVISION	FOURTH DIVISION
1 Preliminary (contractual) requirements sum	1 Advance Payment Bond 2 Performance Bond 3 Insurance of Works 4 Insurance against Damage to Persons & Property 5 Third Party Insurance 6 Insurance of Workmen 7 Establishment & maintenance of Contractors Camp, inc. T. Levy	1 Onshore (local currency) 2 Offshore (foreign currency)	
2 General (specified) requirements	1 Facilities for the Engineer's Staff	1 Establish & remove offices, land provided by Contractor sum 2 Establish & remove offices, on land provided by Client sum 3 Establish offices on land provided by Client sum 4 Establish & remove laboratory, land provided by Contractor sum 5 Establish & remove mess room/canteen, land provided by Contractor sum 6 Maintain offices wk 7 Maintain laboratory wk 8 Maintain canteen/messroom wk 9 Other (stated)	1 Floor area n.e. 50 m ² 2 Floor area 50 - 150 m ² 3 Floor area exc. 150 m ² (stated)
	2 Accommodation for the Engineer's Staff	1 Establish houses on land provided by Client sum 2 Establish houses on land provided by Contractor sum 3 Maintain houses wk	1 Grade IX type A house (double unit) 2 Type B house (single unit) 3 Type C house (single unit) 4 Type D house (single unit)
	3 Services for the Engineer's Staff	1 Transport vehicles 2 Telephones 3 Radio Telephones 4 Water & Electricity 5 Signboards	1 Provide wk 2 Percentage on % 3 Maintain wk
	4 Equipment for use by the Engineer's staff	1 Office equipment to Specification 2 Laboratory equipment to Specification 3 Survey equipment to Specification 4 Stationery & other consumables to Specification 5 Photographic films	1 Provide wk 2 Percentage on % 3 Maintain wk 4 Develop and print wk
	5 Attendance upon the Engineer's staff	1 Drivers 2 Chainmen 3 Laboratory assistants 4 Secretary/typist 5 Office messengers 6 Watchmen	1 Provide wk 2 Percentage on % 3 Maintain wk
	6 Testing of Materials nr	1 By Contractor (natural materials) 2 By Third Party Inspection (natural materials) 3 By Contractor (man made other than pipes) 4 By Third Party Inspection (man made other than pipes)	1 Clay 2 Fine sand 3 Coarse sand 4 Aggregate 5 Stone fill 6 Rubble 7 Other (stated) 1 Cement 2 Concrete cubes, (stated) 3 Steel reinforcement 4 Structural steel 5 Sheet steel 6 uPVC 7 Fibre reinforced cement 8 Other (stated)

FIRST DIVISIONGeneral (specified)
requirements (cont'd)

3 Method related
charges sum**SECOND DIVISION**Testing of materials
(cont'd)

7 Testing of Works

-
8 Temporary Works sum

1 Accommodation & buildings

-
2 Services

-
3 Plant

4 Plant

5 Temporary Works**THIRD DIVISION**5 By Contractor (man made-
pipes)
6 By Third Party Inspection
(man made -pipes)

1 Water Retaining Structures nr
2 Other Concrete Structures nr

3 Pressure pipelines n.b. not
exc. 200 mm m
4 Pressure pipelines n.b. exc.
200 mm m
5 Sewers & drains m

6 Non concrete Structures nr

7 Test run Works 2 weeks
prior & 2 weeks after
substantial completion Sum

1 Traffic diversions
2 Traffic regulation
3 Access roads
4 Bridges
5 Cofferdams
6 Pumping
7 De-watering
8 Compressed air for
tunnelling
9 Other (stated)

1 Offices
2 Laboratories
3 Cabins
4 Stores
5 Canteens & messrooms

1 Electricity
2 Water
3 Security
4 Hoardings
5 Site transport
6 Personnel transport
7 Welfare

1 Cranes
2 Transport
3 Earthmoving
4 Compaction
5 Concrete mixing
6 Concrete transport
7 Pile driving
8 Pile boring

1 Pipelaying
2 Paving
3 Tunnelling
4 Crushing & screening
5 Boring & drilling

1 Traffic diversions
2 Traffic regulation
3 Access roads
4 Bridges
5 Cofferdams
6 Pumping
7 De-watering
8 Compressed air for
tunnelling
9 Other (stated)

FOURTH DIVISION

- -
1 Pipes & fittings, (stated)
2 Clay pipes & fittings
3 Concrete pipes & fittings
4 Ductile pipes & fittings
5 Steel pipes & fittings
6 uPVC pipes & fittings
7 A/C pipes & C.I. fittings
8 GS or GI pipes & fittings
9 Valves, hydrants, meters

- -----
-
1 Mixing chamber
2 Flocculating elements
3 Sedimentation tanks
4 Filters
5 R/f blockwork reservoirs
6 R/f concrete reservoirs
7 Intakes & weirs
8 Pipe bridges
9 Pump basements

- 1 Ferrous pipes & fittings
2 uPVC pipes & fittings
3 Concrete pipes & fittings
4 Pipes & fittings, (stated)

- 1 Steel panel tanks
2 Chemical dosing tanks
3 Other, (stated)

- 1 Including supply of chemicals for test run period
2 Including supply of chemicals for test run period & additional period (stated)

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FIRST DIVISION

Method related charges
(cont'd)

4 Provisional Sums

5 Prime Cost Items

SECOND DIVISION

6 Temporary works

7 Supervision & labour

1 Daywork

2 Other Provisional Sums (stated) sum

1 Including work on Site by a nominated sub-contractor sum
2 Percentage adjustment to work on site by a nominated sub-contractor %
3 Not including work on Site by a nominated sub-contractor sum
4 Percentage adjustment to prime cost sum not including work on site by a nominated sub-contractor %
5 Supply only, item (stated)
6 Percentage adjustment to supplied item
7 Percentage adjustment to P.C. sum items (stated) %

THIRD DIVISION

1 Access scaffolding
2 Support scaffolding & propping
3 Piling
4 Formwork
5 Shafts & pits
6 Hardstandings

1 Supervision
2 Administration
3 Labour teams

1 Labour sum
2 Percentage adjustment to provisional sum for daywork labour %
3 Materials sum
4 Percentage adjustment to provisional sum for daywork materials %
5 Plant sum
6 Percentage adjustment to provisional sum for daywork plant %

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FOURTH DIVISION

NOTES:

1. The unit of measurement for *general items* shall be the sum, except where another unit of measurement is indicated (see note 5).

2. Items for insurance classed as *contractual requirements* shall cover only the provision of insurance in accordance with clauses 21 and 23 unless otherwise stated. Method Related Charges may be inserted by the tenderer in accordance with paragraph 5 (a) for additional insurances.

3. Items shall be given in the Bill of Quantities and classed as *specified requirements* to cover all work other than the Permanent Works which is expressly stated in the Contract to be carried out by the Contractor and of which the nature and extent is expressly stated in the Contract.

4. Item descriptions for plant associated with Temporary Works which are classed as *specified requirements* shall distinguish between plant operating and standing by.

5. A quantity shall be given against all items for *specified requirements* of which the value is to be ascertained and determined by admeasurement in accordance with clause 56(1). A unit of measurement shall be stated for each such item.

6. Item descriptions for work classed as *specified requirements* (except work quantities in accordance with note 5) shall distinguish between the establishment and removal of the services or facilities and their continued operation and maintenance.

7. Item descriptions for *testing of materials and testing of the Works* shall include particulars of samples and methods of testing. Items shall be given in this class for all testing for which items are not given separately as set out in other classes.

8. Items for *Method Related Charges*, if any, shall be inserted by the tenderer in accordance with section 5 distinguishing between Time Related and Fixed Charges.

9. Items for *percentage adjustment of Provisional Sums for Daywork* shall be given only where a Daywork Schedule in accordance with alternative form (b) of paragraph 8 is given in the Bill of Quantities. Adjustments shall be inserted against such items to correspond with the adjustments, if any, inserted by the tenderer in the Daywork Schedule.

10. Each *Prime Cost item* shall be followed by an item for labour and an item for other charges and profit.

11. The sum determined for *Third Party Inspection* shall be expended at the discretion of the Engineer.

12. *Test running of the Works* shall include for the supply of all fuel, oil, and chemicals, and for the computation of the quantities needed subsequently for the proper operation of the Works.

CLASS D: DEMOLITION AND SITE CLEARANCE

Includes: Demolition and removal of natural and artificial articles, objects and obstructions which are above the Original Surface

Excludes: Removal of articles, objects, obstructions and materials other than tree roots at or below the Original Surface (included in class E)

FIRST DIVISION

1	General Clearance	ha
<hr/>		
2	Removal of trees and stumps	nr
<hr/>		
3	Demolition of buildings, disposal (stated)	sum
4	Demolition of other structures, disposal (stated)	sum
<hr/>		
5	Clearance of Pipeline wayleaves, disposal (stated)	m
<hr/>		
6	Removal of ant and termite hills and nests	m ³
<hr/>		
7	Removal of man placed or naturally deposited material	m ³

SECOND DIVISION

1	Urban land
2	Agricultural land
3	Woodland
4	Rough grassland
5	Open bush and thicket
6	Dense bush and thicket
7	Forest
8	Seasonal swamp
<hr/>	
-	
1	Trees of girth: 500 mm. - 1 m
2	Trees of girth: 1 - 2 m
3	Trees of girth: 2 - 3 m
4	Trees of girth: 3 - 5 m
5	Trees of girth: exc 5 m., (stated)
6	Stumps of diameter: 150-500 mm
7	Stumps of diameter: 500- 1 m
8	Stumps of diameter: exc. 1 m., (stated)
<hr/>	
-	
1	Brickwork construction
2	Concrete construction
3	Masonry construction
4	Metal construction
5	Timber construction
6	No predominant material
7	Blockwork construction
8	Mud and pole construction
<hr/>	
-	
1	Nominal bore not exc. 100 mm
2	Nominal bore: 100 - 300 mm
3	Nominal bore: 300 - 500 mm
4	Nominal bore: exc 500 mm
<hr/>	
-	
1	General site clearance
2	Along pipeline routes
<hr/>	
-	
1	In existing channels
2	In existing chambers
3	In existing cellular structures
4	In other structures, (stated)

THIRD DIVISION

1	Removed from site and disposed of
2	Locally disposed
3	Set aside for reuse
4	Removed from site and disposed of as directed
5	Burnt
<hr/>	
1	Volume: not exc. 50 m ³
2	Volume: 50 - 100 m ³
3	Volume: 100 - 250 m ³
4	Volume: 250 - 500 m ³
5	Volume: 500 - 1000 m ³
6	Volume: 1000 - 2500 m ³
7	Volume: 2500 - 5000 m ³
8	Volume: exc. 5000 m ³ , (stated)
<hr/>	
1	Pipeline only
2	Pipeline and access track
<hr/>	
1	Excess material - removed from site and disposed of
2	Excess material - locally disposed
<hr/>	
1	Removed from site and disposed of
2	Locally disposed
3	Set aside for reuse
4	Removed from site and disposed of as directed
5	Burnt

NOTES:

1. *General clearance* shall include the demolition and removal of all articles, objects and obstructions which are expressly required to be cleared, except those for which separate items are given as set out in this class.

2. Item descriptions for *general clearance* shall identify the area included unless it is the total area of the Site.

3. Item descriptions for work from which the materials arising remain the property of the Employer shall so state.

4. Girths of trees shall be measured one metre above ground level. Separate items are not required for removal of stumps of trees which are themselves to be removed.

5. *Buildings and other structures* shall be identified in item descriptions. An identified group of buildings or other structures may be given as a single item.

6. The volume stated in the classification of *buildings and other structures* shall be their approximate volume occupied, excluding any volume below the Original Surface.

7. Parts of *buildings and other structures* below the original Surface shall be excluded from items in this class unless otherwise stated.

8. *Pipelines* within buildings and other structures shall be measured only where their nominal bore exceeds 300 mm. Separate items are not required for demolition of supports of pipelines.

9. Wayleave clearance for *pipeline only* shall refer to clearance where the proposed pipeline is within 20 metres of an existing road or track or where no new access is required. Clearance width shall then be measured as nom. bore of pipe plus two metres.

10. Wayleave clearance for *pipeline and access track* shall be used where no existing track exists and one is required, in which case the width to be cleared and measured shall be the nom. bore of pipe plus five metres.

11. *Ant and termite hills* shall be excavated and removed complete. The below ground excavation shall be filled using the excavated material after its treatment with an approved insecticide, with refilling being made progressively in layers not exc. 200 mm. deep, compacted to 95% MOD at optimum moisture content to the Final Surface or as otherwise indicated.

CLASS E: EARTHWORKS

Includes: Excavation, dredging, filling, compaction, landscaping

Excludes: Excavation for: site investigation (inc. in class B): diaphragm walls (inc. in class C): pipes, and sewers, manholes, trenches and ditches, (inc. in classes J,K,L): piles (inc. in classes P and Q): tunnels, shafts, headings, and other subterranean cavities (inc. in class T): foundations of fences and gates (inc. in class X)

FIRST DIVISION	SECOND DIVISION	THIRD DIVISION	FOURTH DIVISION
1 Excavation by dredging m ³	1 Topsoil		
2 Excavation for cuttings m ³			
3 Excavation for foundations m ³	2 In class I material	-	1 For reuse
4 General Excavation m ³	3 In class II material	1 Max. depth: not exc. 0.25 m	2 to surfaces inclined at an angle exc. 10° to the horizontal
	4 In class III material	2 Max. depth: 0.25 - 0.5 m	
	5 In artificial hard material exposed at Commencing Surface for disposal	3 Max. Depth: 0.50 - 1 m	
	6 In artificial hard material not exposed at Commencing Surface for disposal	4 Max. Depth: 1 - 2 m	
		5 Max. Depth: 2 - 5 m	
		6 Max. Depth: 5 - 10 m	
		7 Max. Depth: 10 - 15 m	
		8 Maximum depth: exc. 15 m (stated)	
5 Excavation ancillaries	1 Trimming of excavated surfaces m ²	-	
	2 Preparation of excavated surfaces m ²	1 topsoil	
	3 Disposal of excavated material m ²	2 class I material	
	4 Double handling of excavated material m ²	3 class II material	
		4 class III material	
		5 artificial hard material	
		6 other artificial material	
	5 Dredging to remove silt m ³		
	6 Excavation of material below Final Surface and replacement with material (stated) m ³		
	7 Timber supports left in m ²		
	8 Metal supports left in m ²		
6 Filling and compaction	1 To structures m ³	-	
	2 Embankments m ³	1 using excavated	
	3 General m ³	2 using imported	
	4 To depth and thickness (stated) m ³		
	5 Pitching m ³		
	6 To roads m ³		
7 Filling Ancillaries	1 Trimming of filled surfaces inclined at an angle not exc 10° to the horizontal m ²	-	
	2 Trimming of filled surfaces inclined at an angle exc 10° to the horizontal m ²	1 in topsoil	
	3 Preparation of filled surfaces inclined an angle not exc. 10° to the horizontal m ²	2 in class I material	
	4 Preparation of filled surfaces inclined an angle exc. 10° to the horizontal m ²	3 in class II material	
		4 in class III material	
		5 in artificial hard material	
		6 in other artificial material	
	5 Geotextiles, (stated) m ²		
8 Landscaping	1 Turfing m ²		
	2 Grass seeding, type (stated) m ²		
	3 Grassing, type (stated) m ²		
	4 Other seeding, type (stated) m ²		
		1 to surfaces inclined at an angle not exc. 10° to the horizontal	

2 For disposal

-
- 1 topsoil
 - 2 class I material
 - 3 class II material
 - 4 selected class III
mat
erial
 - 5 unselected class III
mat
erial
 - 6 artificial material
-

FIRST DIVISION

Landscaping (cont'd)

SECOND DIVISION

- | | | |
|-------|--|----|
| 5 | Plant plants, species and size
(stated) | nr |
| 6 | Plant shrubs, species and size
(stated) | nr |
| 7 | Plant trees, species and size
(stated) | nr |
| <hr/> | | |
| - | | |
| 8 | Plant hedges, species and size
(stated) | nr |

THIRD DIVISION

- | | |
|---|-------------------------------|
| 1 | Single row |
| 2 | Single row & protective fence |
| 3 | Double row |
| 4 | Double row & protective fence |

NOTES

1. The location and limits of *dredging* shall be stated in item descriptions where its extent would otherwise be uncertain. Such excavation classes in the Bill of Quantities shall be measured as dredging, irrespective of the method of excavation adopted by the Contractor.

2. Excavation below embankments shall be classed as *excavation of cuttings*.

3. The location and limits of *excavation of foundations* shall be stated in item descriptions where the limits would otherwise be uncertain. Excavation around pile shafts shall be so described and classed as *excavation of foundations*.

4. Excavation from borrow pits on the Site shall be classed as *general excavation* and shall be measured only to the extent that it is expressly required.

5. Excavated material shall be deemed to be for re-use unless it is stated in item descriptions to be for disposal. Disposal shall mean disposal by the Contractor off the Site unless otherwise stated in item descriptions. Where material is for disposal on the Site the location of the disposal areas shall be stated in item descriptions.

6. Material to be excavated shall be deemed to be natural material other than rock or topsoil, unless otherwise stated in item descriptions. The nature of artificial hard material to be excavated shall be stated in item descriptions.

7. An item shall be given for each separate stage of excavation where separate stages in the conduct of the work are expressly required.

8. The volume measured for excavation of a structure or foundation shall be the volume which is to be either occupied by or vertically above any part of the structure or foundation. Additional excavation necessary to provide working space shall not be measured.

9. Separate items are not required for disposal of excavated material upholding the sides of excavations or keeping excavations free of water.

10. Disposal of surplus excavated material arising from piling operation shall be classified as piling ancillaries (class Q).

11. Measurements for *dredging* shall be made from soundings, unless otherwise stated.

12. *Dredging to remove silt* shall be measured only to the extent that it is expressly required that silt which accumulates during the period of maintenance shall be removed.

13. An isolated volume of artificial hard material or rock occurring within other material to be excavated shall not be measured separately unless its volume exceeds one cubic metre.

14. *Double handling of excavated material* shall be measured only to the extent that it is expressly required. The volume measured for double handling shall be that of the voids formed in the temporary stockpile from which the material is removed.

15. The area measured for *supports left in* shall be the area of supported surfaces for which the supports are expressly required to be left in.

16. Filling material shall be deemed to be excavated material other than rock or topsoil, unless otherwise stated in item descriptions.

17. Filling of excavations around completed structures shall be measured only to the extent that the volume filled is also measured as excavation according to note 8.

18. Separate items are not required for compaction of embankments and other filled volumes. Where different compaction requirements are specified for the same filling material they shall be stated in item descriptions.

19. The volume of *filling and compaction* measured shall be that of each compacted embankment or other filled volume. The volume of imported filling material measured shall be the difference between the total volume of filling material and the volume of excavated material used for filling. A volume of excavated material used for filling shall be deemed to form the same volume of compacted fill. Additional filling and compaction necessitated by settlement of or penetration into underlying material shall be measured only to the extent that its depth exceeds

75
mm.

20. Where rock fill is deposited into soft areas the volume shall be measured in the transport vehicles at the place of deposition.

21. Where material is deposited below water, and the quantity cannot be calculated satisfactorily by any other means, the volume shall be measured in the transport vehicles at the place of deposition.

22. Where the rate of deposition of filling material is limited the limitation shall be stated in item descriptions.

23. Filling material shall be classed as rock and excavated rock shall be classed as for re-use only where the use of rock as filling at stated locations is expressly required.

24. Filling shall be classed as *to stated thickness* where material is provided of uniform total compacted thickness or depth such as in drainage blankets or topsoiling. Bulk filling shall not be classed as *to stated thickness* notwithstanding that it may be compacted in separate layers of material of stated thickness.

25. The nature and dimensions and the depth or thickness of materials used for *pitching* shall be stated in item descriptions.

26. *Trimming of slopes* shall be measured only for the sides of earthworks inclined at an angle exceeding 10° to the horizontal.

27. *Preparation of surfaces* shall be measured only to the extent that surfaces are to receive Permanent Works other than *earthworks*.

28. Items descriptions for *turfing, seeding, pitching and filling to stated thickness* which is carried out on surfaces inclined at an angle exceeding 10° to the horizontal shall so state. Item descriptions for *turfing* which is pegged or wired shall so state.

29. The lengths of *hedges* measured shall be their developed lengths along centre lines.

30. Unless specifically stated otherwise, every item for excavation shall have as its *Commencing surface* the surface of the ground exposed prior to start of work under that item.

Classification:-

The classification of excavation material type will be as follows:

Class I: "Rock" or "Hard material" will be as detailed in specification clause 206.

Class II: "Compact gravel" or "Altered rock" detailed description of which is also outlined in specification clause 206.

Class III: "Normal" or "Soft material" detailed classification of which is given in Table 2-2.
Description of class III material characteristics is given fully in specification clause 206.


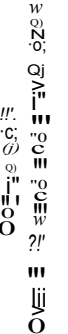
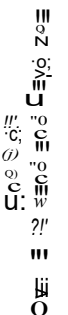
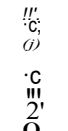
Assistance in identification for the three classes of material is given in Table 1 (below).

Table 2-2 on the following page gives a more detailed-classification for soil (Class III material).

Table 1: Identification of the three classes

	Class 1	Class II	Class III
Typical Material	Black Volcanic Rocks Trachyte, Phonolyte and Igmnibrite	Altered Rocks Agglomerate and Tuff	Weathered Rock and Soils
Hammer Blow	Solid note from Ringing to a Dully sound	Drummy Noise or crushes pieces	Dents Sample
Pliers Crushing	Not possible or Grani Fracture	Fractures or Crushes small piece	
50 mm dia. Core in Hand	Cannot break 500 mm long piece	Can break 300 mm piece	Can be crushed into pieces
Soaked in water for One hour	No change	Some change on weaker pieces pieces	Disintegrates in the hand after soaking
Expected Crushing Strength	Above 40 N/mm ²	1.5 to 40 N/mm ²	Below 1.5 N/mm ³

TABLE 2- 2: IDENTIFICATION OF SOIL TYPES

	Basic Soil Type	Particle size (mm)	Visual Identification	Nature and Plasticity	Composite Soil Types (mixture of basic soil types)				
	BOULDERS	200	Only seen complete in pits or exposure		Scale of Secondary Constituents with coarse soils				
	COBBLES		Often difficult to recover from boreholes		Term	%of clay or silt			
	GRAVELS	60	Easily visible to naked eye; particle shape can be described; grading can be described	Particle shape: Angular Subangular Subrounded Rounded Flattened Elongate	slightly clayey	GRAVEL	under 5%		
		coarse				SAND			
		20			Well graded: wide range of grain sizes, well distributed. Poorly graded: not well graded. (May be uniform: size of most particles lies between narrow limits; or gap graded; an intermediate size of particle is markedly under represented)	Texture; Rough Smooth Polished	clayey	GRAVEL	5 to 15%
		medium						SAND	
		6					very clayey	GRAVEL	15 to 35%
		fine						SAND	
	SANDS	2	Visible to the naked eye; very little or no cohesion when dry; grading can be described	Rough Smooth Polished	Sandy GRAVEL Sand or Gravel and				
		coarse			Important second constituent of the coarse fraction				
		0.6			Gravelly SAND				
		medium							
		0.2							
		fine							
	SILTS	coarse	Only coarse silts barely visible to naked eye; exhibits little plasticity and marked dilatancy; slightly granular or silky to the touch. Disintegrates in water; lumps dry quickly; loses cohesion but can be powdered easily between fingers.	Non plastic or low plasticity	Scale of secondary constituents with fine soils				
		0.02			Term	%of sand or gravel			
		medium			sandy	CLAY	35 to 65%		
		0.006			gravelly	SILT			
	CLAYS	0.002	Dry lumps can be broken but not powdered between the fingers; they can also disintegrate under water but more slowly than silt; smooth to the touch; exhibits plasticity but no dilatancy; sticks to the fingers and dries slowly; shrinks appreciably on drying usually shows cracks. Intermediate and high plasticity clays show these properties to a moderate to high degree respectively.	Intermediate plasticity (Lean clay)	CLAY SILT	under 35%			
				High plasticity (Fat clay)	Examples of composite types				
					Loose, brown, subangular very sandy, fine to coarse GRAVEL with small pockets of soft clay.				
					Medium dense, light brown, clayey, fine and medium sand.				
					Stiff, orange brown, fissured sandy CLAY.				
					Firm, brown, thinly laminated SILT and CLAY				
	ORGANIC CLAY-SILT or SAND	Varies	Contains substantial amounts of organic vegetable matter.		Plastic, brown, amorphous PEAT				
	PEATS	Varies	Predominantly plant remains usually dark brown or black in colour, often with distinctive smell; low bulk density.						

CLASS F: IN-SITU CONCRETE

Excludes: In situ concrete for:

Capping of boreholes (inc. in class B): diaphragm walls (inc. in class C): drainage and pipework (inc. in classes K and L): piles (inc. in classes P and Q): roads (inc. in class R): rail track foundations (inc. in class S): tunnels and shaft linings (inc. in class T): foundations of fences and gates (inc. in class X)

FIRST DIVISION

1 Provide cement for concrete t

2	Designed mix for ordinary structural concrete for class C exposure using ordinary portland cement	m ³
3	Designed mix for ordinary structural concrete for class B exposure using ordinary portland cement	m ³
4	Special design mix for special structural concrete for class A exposure using ordinary portland cement	m ³
5	Designed mix for ordinary structural concrete for class B exposure using sulphate resistant cement	m ³
6	Special design mix for special structural concrete for class A exposure using sulphate resistant cement	m ³
7	Place mass concrete	m ³
8	Place reinforced concrete	m ³
9	Place prestressed concrete	m ³

SECOND DIVISION

1 Ordinary portland cement
2 Sulphate resistant cement
3 Other (stated)

-	
1	Provide concrete grade: 10
2	Provide concrete grade: 15
3	Provide concrete grade: 20
4	Provide concrete grade: 25
5	Provide concrete grade: 35
6	Provide concrete grade: 40
7	Provide concrete grade: 50
8	Provide concrete grade: 60
9	Provide concrete grade: (stated)

-	
1	As blinding
2	In bases, footings, and ground slabs
3	In suspended slabs
4	In walls

-	
5	In columns and piers
6	In beams
7	As casing to metal sections
8	In other concrete forms, (stated)

THIRD DIVISION

1 in 50 kg. bags
2 in 200 kg. drums
3 in bulk by lorry

1	aggregate	size 10 mm
2	aggregate	size 14 mm
3	aggregate	size 20 mm
4	aggregate	size 40 mm
5	aggregate	size (stated)
6	All-in aggregate, size range (stated)	

1	thickness:	not exc. 50 mm
2	thickness:	50 - 100 mm
3	thickness:	100 - 150 mm
4	thickness:	150 - 300 mm
5	thickness:	300 - 500 mm
6	thickness:	exc. 500 mm (stated)

1	X- sectional area:	n.e. 0.03 m ²
2	X- sectional area:	0.03 - 0.10 m ²
3	X- sectional area:	0.10 - 0.25 m ²
4	X- sectional area:	0.25 - 1 m ²
5	X- sectional area:	exc. 1 m ² , (stated)
6	Special beam section: m. (stated)	

NOTES:

1. Items for *provision of concrete* shall be classified and described in accordance with SSRN 101, 'Specification of concrete'. The mix specification and type of cement used shall be as stated in item description for *provision of concrete* in accordance with SSRN 101. Concrete mixes shall be classed as *designed mixes for ordinary structural concrete* where the mix proportions are stated in the Contract and as *special mixes for special structural concrete* where the mix proportions are to be selected by the Contractor.

2. Prestressed concrete which is also reinforced shall be classed as *prestressed concrete*.

3. The thickness used for classification of *blinding* shall be the minimum thickness.

4. *Columns and piers* integral with a wall shall be measured as part of the wall.

5. The cross-sectional dimensions of *special beam sections* shall be stated in the item descriptions, except where a beam type or mark number is stated for which dimensions are given on the Drawings.

6. Beams shall be classed as *special beam sections* where their cross-section profiles are rectangular or approximately rectangular over less than 4/5 ths. of their length and where they are of box or other composite section.

7. Item descriptions for components classed as *other concrete forms* shall include one of the following:

- (a) the principal dimensions of the concrete component
- (b) a type or mark number of a concrete component whose principal dimensions are given on the Drawings
- (c) a statement identifying or locating a concrete component whose principal dimensions are given on the Drawings.

8. *Beams* integral with a slab shall be measured as part of the slab.

9. Concrete in *suspended slabs* and *walls* less than one metre wide or long shall be classed as concrete in *beams and columns* respectively. The thickness used for classification of *suspended slabs* and *walls* shall exclude the additional thickness of integral columns, piers, beams and other projections.

10. The volume of concrete measured shall include that occupied by

- (a) reinforcement and other metal sections
- (b) prestressing components
- (c) cast-in components each less than 0.1 m³ in volume
- (d) rebates, fillets or internal splays each less than 0.005 m² in cross-sectional area
- (e) pockets and holes which are measured as large or small voids in accordance with note 7 of class G.

11. The volume of concrete measured shall exclude that of nibs or external splays less than 0.005 m² in cross-sectional area.

12. The location of concrete members in the Works shall be stated in item descriptions for placing of concrete where special characteristics may affect the method and placing of concrete ..

Details of the various classes of concrete are given in the following table:

TABLE CLASSES OF CONCRETE

CLASS	CHARACTERISTIC COMPRESSIVE STRENGTH N/mm ²	MAXIMUM AGGREGATE SIZE mm	MAXIMUM FREE WATER/CEMENT RATIO	MINIMUM CEMENT CONTENT kg/m ³	MAXIMUM CEMENT CONTENT kg/m ³
C25/10/A	25	10	0.55	360	400
C25/20/A	25	20	0.55	360	400
C25/20/B	25	20	0.55	290	400
C25/20/C	25	20	-	240	540
C20/20/B	20	20	0.55	290	400
C20/40/B	20	40	0.55	260	400
C20/40/C	20	40	-	220	540
C15/40/B	15	40	-	180	540
C15/20/C	15	20	-	180	540
C10/40/C	10	40	-	150	540

* Compressive strength (N/mm²) / aggregate size (mm) / class of exposure

Class of Exposure :

- A - exposed to a moist or corrosive atmosphere or alternate wetting and drying
- B - exposed to continuous or almost continuous contact with liquid
- C. not exposed to liquid nor to resist corrosion

CLASS G: CONCRETE ANCILLARIES

Includes: Form work for in-situ concrete: Reinforcement for in-situ concrete: Joints in in-situ concrete: Post-tensioning prestressing: Accessories for in-situ concrete.

Excludes: Reinforcement in diaphragm walls (inc. in class C): Post-tensioned pre-stressing reinforcement (inc. in class H): Formwork reinforcement ancillary to drainage and pipework, (inc. in classes K & L): Formwork reinforcement in piles (inc. in classes P & Q): Formwork & reinforcement in concrete roads & pavings, (inc. in class R): Formwork for concrete rail track foundations, (inc. in class S): Formwork for tunnels and shaft linings, (inc. in class T): foundations of fences and gates (inc. in class X). Formwork for foundations of fences and gates (inc. in class X).

FIRST DIVISION

- 1 Formwork: rough finish
- 2 Formwork: fair finish
- 3 Formwork: other finish (stated)
- 4 Formwork: surface features (stated)

5 Reinforcement

6 Joints (stated)

7 Post-tensioned prestressing nr

SECOND DIVISION

- 1 Plane horizontal
- 2 Plane sloping
- 3 Plain battered
- 4 Plane vertical
- 5 Curved to one radius in one plane

6 Other, curved to radius in m. m²
(stated)

7 For voids nr

8 For concrete components of constant cross section m

-
- 1 Mild steel bars to specification t
 - 2 High yield bars to specification t
 - 3 Stainless steel bars, quality (stated) t
 - 4 Reinforcing bars of quality (stated) t

5 Special joints, (stated) nr

6 High yield steel fabric to specification m²

7 Fabric of material (stated) m²

-
- 1 Open surface plain joint m²
 - 2 Open surface joint with filler m²
 - 3 Formed plain surface joint m²
 - 4 Formed surface joint with filler m²

5 Plastic or rubber waterstop m

6 Metal waterstop m

7 Sealed rebate or grooves m

8 Doweled joints nr

1 Horizontal internal tendons in in-situ concrete

- 2 Inclined and vertical internal tendons in in situ concrete
 - 3 Horizontal internal tendons in pre-cast concrete
 - 4 Inclined and vertical internal tendons in pre-cast concrete
-

THIRD DIVISION

- 1 Width: not exc. 0.1 m m²
 - 2 Width: 0.1 - 0.2 m m²
 - 3 Width: 0.2 - 0.4 m m²
 - 4 Width: 0.4 - 1.22 m m²
 - 5 Width: exc. 1.22 m (stated) m²
-

-
- 1 Small void, depth: not exc. 0.5 m
 - 2 Small void, depth: 0.5 -1 m
 - 3 Small void, depth: 1 -2 m
 - 4 Small void, depth: exc. 2 m (stated)
 - 5 Large void, depth: not exc. 0.5 m
 - 6 Large void, depth: 0.5 - 1 m
 - 7 Large void, depth: 1 - 2 m
 - 8 Large void, depth: exc. 2 m (stated)
-

- 1 Beams
 - 2 Columns
 - 3 Walls
 - 4 Other members (stated)
 - 5 Projections
 - 6 Intrusions
-

- 1 Diameter: 6 mm
 - 2 Diameter: 8 mm
 - 3 Diameter: 10 mm
 - 4 Diameter: 12 mm
 - 5 Diameter: 14 mm
 - 6 Diameter: 16 mm
 - 7 Diameter: 20 mm
 - 8 Diameter: exc. 20 mm (stated)
 - 9 Diameter 6 mm. to mm. (stated)
-

-
-
- 1 Nominal mass: not exc. 2 kg/m²
 - 2 Nominal mass: 2 - 3 kg/m²
 - 3 Nominal mass: 3 - 4 kg/m²
 - 4 Nominal mass: 4 - 5 kg/m²
 - 5 Nominal mass: 5 - 6 kg/m²
 - 6 Nominal mass: 6 - 7 kg/m²
 - 7 Nominal mass: 7 - 8 kg/m²
 - 8 Nominal mass: exc. 8 kg/m² (stated)
-

-
- 1 Width or depth: not exc. 0.5 m
 - 2 Width or depth: 0.5 - 1 m
 - 3 Width or depth: exc. 1 m (stated)
-

-
- 1 Width: not exc. 150 mm
 - 2 Width: 150 - 200 mm
 - 3 Width: 200 - 300 mm
 - 4 Width: exc. 300 mm (stated)
-

-
- 1 Plain or greased
 - 2 Sleeved or capped
-

-
- 1 Length: not exc. 5 m
 - 2 Length: 5 - 7 m
 - 3 Length: 7 - 10 m
 - 4 Length: 10 - 15 m
 - 5 Length: 15 - 20 m
 - 6 Length: 20 - 25 m
 - 7 Length: 25 - 30 m
 - 8 Length: exc. 30 m (stated)
-
-

FIRST DIVISION

(Post tensioned pre-stressing (cont'd))

8 Concrete accessories

SECOND DIVISION

5 External jacking operations

-		
1	Finishing of top surfaces, (stated)	m ²
-		
2	Finishing of formed surfaces	m ²
-		
3	Inserts	
-		
4	Grouting under plates	nr

THIRD DIVISION

1	Using wood float	
2	Using steel trowel	
3	Other surface treatment, (stated).	
4	Granolithic finish	
5	Other applied finish, (stated)	
1	Aggregate exposure using retarder	
2	Bush hammering	
3	Other special treatment carried out after striking formwork (stated)	
1	Linear inserts	
2	Other inserts (stated)	
1	Area not exc.	0.1 m ²
2	Area	0.1 - 0.5 m ²
3	Area	0.5 - 1 m ²
4	Area	exc 1 m ² , (stated)

NOTES

1. *Formwork* shall be measured for all final surfaces of in-situ concrete which require temporary support during casting except where otherwise stated.

2. *Formwork* shall be measured for the side surfaces of in-situ concrete cast within excavated volumes except where the concrete is expressly required to be cast against an excavated surface. Such side surfaces shall back sloping surfaces inclined at an angle not exceeding 45° to the vertical. Upper surfaces of concrete inclined at angle exceeding 15° to the horizontal shall be deemed to require temporary support during casting. Item descriptions for formwork which is to upper surfaces shall so state, except where the surfaces are inclined at an angle not exceeding 10° to the vertical.

3. *Formwork* for temporary concrete surfaces shall be measured at locations where temporary surfaces are expressly required but not where temporary surfaces are formed at the discretion of the Contractor. Formwork for blinding concrete shall not be measured.

4. *Plane formwork* shall be classified according to its angle of inclination as follows.

Class	Angle of inclination to the vertical
Horizontal	85 - 90°
Sloping	10 - 85°
Battered	0 - 10°
Vertical	0°

5. *Formwork* may be measured by length as one item instead of by area in items for the separate surfaces where the formwork is for *components of constant cross-section*. Item descriptions for formwork for components of constant cross-section shall state the principal cross-sectional dimensions of the component and its mark number, location or other unique identifying feature.

6. *Formwork* shall be deemed to be for plane areas exceeding 1.22 m. wide unless otherwise stated. The formed surfaces of rebates, grooves, and fillets shall be classed as plane surfaces.

7. *Formwork* for the surfaces of voids larger than those classed as large voids in accordance with note 8 shall be measured as set out in this class for formwork generally.

8. Radii of *curved formwork* shall be stated in item descriptions as follows.
(a) to one radius in one plane (cylindrical), radius stated
(b) to one radius in two planes (spherical), radius stated
(c) varying radius (conical), maximum and minimum radii stated.

9. The classification of *large* and *small voids* shall be as follows.

Class	Maximum cross-section	
	Circular voids (diameter)	Other voids (area)
Large	0.35 - 0.7 m	0.1 - 0.5 m ²
Small	Not exceeding 0.35 m	Not exceeding 0.1 m ²

The depths of voids shall be measured perpendicularly to the adjacent surface of concrete.

10. The area of *formwork* shall include the area of formwork obscured by forms for large and small voids.

11. The mass of steel *reinforcement* shall be taken as 0.785 kg/m per 100 mm² of cross-section (7.85 t/m²). The mass of other reinforcing materials shall be taken as stated in the Contract. Separate items are not required for tying and supporting reinforcement. The mass of reinforcement measured shall include the mass of steel supports to top reinforcement.

12. Reinforcing bars which are not circular in cross-section shall be classified by the diameter of the circular bar in the classification which is nearest in cross-sectional area.

13. Lengths of reinforcing bars next higher multiple of 3 m. where they exceed 12 m. before bending.

14. Item descriptions for *high yield steel fabric* to SSRN 128 shall state the type number in accordance with SSRN 128. Item descriptions for other fabric reinforcement shall state the material, sizes and its nominal mass per square metre. The area of additional fabric in laps shall not be measured.

15. The dimensions, spacing and nature of components shall be stated in item descriptions for *joints* in concrete.

Separate items are not required for formwork to joints or for joining and cutting waterstops.

16. *Joints* for which temporary support of the whole surface area of concrete is required during casting shall be classified as *formed surface joints*. Other joints shall be classed as *open surface joints*.

17. Widths or depths of *joints* shall be measured between the outer surfaces of concrete with no deduction or addition for width or depth occupied by face or internal details such as fillets and waterstops. Joints shall be classified according to the average width or depth of each continuous joint.

18. Item descriptions for *prestressing* shall identify the concrete component to be stressed and state the composition of the tendon and particulars of the anchorage.

19. *Prestressing* shall be measured by the number of *tendons* where tendons are used and by the number of *external jacking operations* where stress is induced by jacking only.

20. Separate items are not required for ducts, anchorages, grouting or other components or tasks ancillary to *prestressing*. Profiled *tendons* in horizontal components shall be classed as *horizontal tendons*. The lengths of tendons used for classification shall be their developed lengths between the outer faces of anchorages.

21. The areas of the tops of walls and of other surfaces which are not given separate finishing treatment shall not be measured for *finishing of top surfaces*. No deduction from the areas measured for *finishing* shall be made for holes and openings in the finished surfaces each less than 0.5 m² in area. The materials and thicknesses of granolithic and other applied surface finishes shall be stated in the item descriptions.

22. All components cast or grouted into in-situ concrete, except reinforcement, structural metalwork, prestressing and jointing materials, shall be classified as *inserts*. Separate items are not required for adapting formwork or boxing out for inserts.

CLASS H: PRECAST CONCRETE

Includes: Manufacture, erection, joining and fixing of precast concrete units

Excludes: Precast concrete pipework, (inc. in classes I & J): Precast concrete manholes, catchpits, and gullies, (inc. in class K): Precast concrete piles, (inc. in classes P & Q): Precast concrete paving, kerbs, and traffic sign supports, (inc. in class R): Precast concrete tunnel linings, (inc. in class T): Precast concrete blockwork, (inc. in class U): Precast concrete fencing, (inc. in class X)

FIRST DIVISION

1	Beams	nr
2	Prestressed tensioned beams	pre-nr
3	Prestressed post-tensioned beams	post-nr
4	Columns	nr

5	Slabs and covers	nr
---	------------------	----

6	Segmental units	nr
---	-----------------	----

7	Units for subways, culverts and ducts	m
---	---------------------------------------	---

8	Copings, sills and weir blocks	m
---	--------------------------------	---

SECOND DIVISION

1	In concrete	grade 10
2	In concrete	grade 15
3	In concrete	grade 20
4	In concrete	grade 25
5	In concrete	grade 30
6	In concrete	grade 40
7	In concrete	grade 50
8	In concrete	grade 60
9	In concrete	grade (stated)

THIRD DIVISION

1	Length:	not exc. 5 m
2	Length:	5 - 7 m
3	Length:	7 - 10 m
4	Length:	10 - 15 m
5	Length:	15 - 20 m
6	Length:	20 - 30 m
7	Length:	exc. 30 m (stated)

1	Area:	not exc. 0.1 m ²
2	Area:	0.1 - 0.5 m ²
3	Area:	0.5 - 1.0 m ²
4	Area:	1.0 - 5.0 m ²
5	Area:	5.0 - 15 m ²
6	Area:	exc. 15 m ² (stated)

1	X-sect. area:	not exc. 0.1 m ²
2	X-sect. area:	0.1 - 0.5 m ²
3	X-sect. Area:	0.5 - 1.0 m ²
4	X-sect. area:	exc. 1 m ² , (stated)

FOURTH DIVISION

1	Mass:	not exc. 100 kg
2	Mass:	100 - 250 kg
3	Mass:	250 - 500 kg
4	Mass:	500 - 750 kg
5	Mass:	750 - 1 t
6	Mass:	1 - 2 t
7	Mass:	2 - 5 t
8	Mass:	5 - 10 t
9	Mass:	exc. 10 t, (stated)

NOTES

1. The position of the Works for each type of precast unit shall be stated in item descriptions. Unless otherwise stated, precast units shall be deemed to be reinforced but not prestressed. Particulars of the prestressing shall be stated in item descriptions for prestressed units.

2. The cross-section type and principal dimensions of *beams, columns, segmental units, box units, copings, sills and weir blocks* and the average thickness of slabs shall be stated in item descriptions

3. Item descriptions shall state the mark or type number of each precast concrete unit.

4. Concrete components which are cast other than in their final position shall generally be classed as *precast concrete* units. Where site precasting of units is adopted for reasons other than to obtain multiple use of formwork, and the nature of the work is characteristic of *in situ* concrete, but involves movement of the cast units into their final positions, the units shall be classed as *in situ* concrete and items given in class A for the Temporary Works associated with the movement of the units

5. Units with different dimensions shall be given different mark or type numbers.

6. The mass used for classification in the fourth division shall be the mass of each unit. The length measured for *box units, copings, sills, and weir blocks* shall be the length of identical units.

7. Where *weir blocks* are laid to precise levels, item descriptions shall so state.

CLASS I: PIPEWORK – PIPES, SEWERS & FITTINGS - SUPPLY

Includes: Provision of pipes, specials, fittings and valves, complete with jointing materials and associated components to site of Works.

Excludes: Associated work included in classes J, K, & L.

FIRST DIVISION	SECOND DIVISION	THIRD DIVISION
1 Pipes and sewers	1 Material (stated) 2 Clay 3 Concrete (stated) 4 Ductile iron (coating/lining stated) 5 Welded steel (coating/lining stated) 6 uPVC 7 Asbestos cement 8 G.S. or G.I. 9 Polyethylene	1 Double flanged, standard m 2 S & S standard joints, (stated) m 3 S & S tyton joints, standard m 4 S & S bolted gland joints, standard m 5 Plain ended, ogee joints, standard m 6 Plain ended, with separate joints (one/pipe), standard m 7 Threaded, separate joints, (one/pipe), standard m 8 Double flanged, non-standard, length (stated) nr 9 Other, non-standard length (stated) nr 1 Long radius, 11.25° 2 Long radius, 22.5° 3 Long radius, 45° 4 Long radius, 90° 5 Short radius 11.25° 6 Short radius 22.5° 7 Short radius 45° 8 Short radius 90° 9 Duckfoot 1 Tees, equal, branch as main 2 Tees, branch down 1 dia. 3 Tees, branch down 2 dia. 4 Tees, branch down 3 dia. 5 Tees, branch down 4 dia. 6 Tees, branch down 5 dia. 7 Tees, branch down 6 dia. 8 Tees, branch down 7 dia. 9 Tees, branch down more than 7 dia., (stated) 1 Tees, equal, branch as main 2 Tees, branch down 1 dia. 3 Tees, branch down 2 dia. 4 Tees, branch down 3 dia. 5 Tees, branch down 4 dia. 6 Tees, branch down more than 4 dia. (stated) 7 Tees, hydrant, flanged branch n.b. 80 mm 8 Tees, main (stated), invert branch flanged, n.b. of branch (stated), 9 Cross or wye (stated) 1 Concentric, down 1 dia 2 Concentric, down 2 dia 3 Concentric, down 3 dia 4 Concentric, down more than 3 dia (stated) 5 Invert, down 1 dia 6 Invert, down 2 dia 7 Invert, down 3 dia 8 Invert, down more than 3 dia (stated) 1 P.e. length n.e. 1 m (stated) 2 P.e. length 1 - 2 m (stated) 3 P.e. length exc. 2 m (stated) 4 P.e. with puddle flange (length & p.f. position stated) 5 Single fl. length n.e. 1 m (stated) 6 Single fl. length 1 - 2 m (stated) 7 Single fl. length exc. 2 m (stated) 8 Single fl. with puddle flange (length & p.f. position) (stated) 9 Bellmouth
2 Fittings to ductile iron pipes (coating/lining stated) nr 3 Fittings to welded steel pipes (coating/lining stated) nr 4 Fittings in steel to uPVC pipes (coating/lining stated) nr 5 Fittings in uPVC to uPVC pipes nr 6 Fittings to asbestos cement pipes nr 7 Fittings to G.S. or G.I. pipes nr 8 Fittings to other pipes (stated) nr	- 1 Bends, double flanged 2 Bends, plain ended (A.C. & welded steel), double socket (ductile iron & uPVC), or (stated) - 3 Junctions and branches, all flanged unless (stated) - 4 Junctions and branches, main line plain ended (A.C. & welded steel), and double socket (ductile iron & uPVC), or (stated) - 5 Tapers, double flanged 6 Tapers, plain ended (A.C. & welded steel), double socket (ductile iron & uPVC), or (stated) - 7 Plain ended & single flanged pieces and bellmouths, single flanged socketed pieces, nominal lengths (stated)	

FOURTH, FIFTH & SIXTH DIVISIONS	5 PN 12		
	6 PN 16		
	7 PN 25		
	8 PN 40		
	9 PN other (stat ed)	Select from the list displayed for the pipe material that has been indicated	A number from 1 through 9 to be used if necessary to differentiate between items that would otherwise have the same BOQ number
4TH pressure class			
1 PN 0			
2 PN 3			
3 PN 6			
4 PN 10			
	5TH nominal bore list	6TH sequence no	

THIWASCO

FIRST DIVISION

Fittings to pipes (cont'd)

9 Valves, penstocks,
hydrants, meters

nr

SECOND DIVISION8 Adaptors, detachable
collars, couplings and
saddles-
9 Standard couplers & end
pieces-
1 Gate valves
2 Butterfly valves
(with cap and key unless
otherwise stated)
3 Penstocks
(with extension spindle,
headstock and handwheel
unless otherwise stated)-
4 Non-return valves-
5 Air valves-
6 Pressure control valves-
7 Hydrants-
8 Float Valves-
9 Meters**THIRD DIVISION**1 Flexible, straight coupling,
standard unless (stated)
2 Flexible, stepped coupling
(stated)
3 Flexible, anchor coupling
4 Flexible, test coupling
5 Flange adaptor, flexible
6 Flange adjustable/
removable joint
7 Detachable collar, short
unless otherwise (stated)
8 Saddle, (stated)
9 Adaptor, stepped, (stated)1 Flange-p.e. coupler in C.I
or D.I. unless (stated)
2 Union (stated)
3 Flanged socket
4 Threaded-threaded coupler
5 Threaded-p.e. coupler
6 Blank flange
7 Separate flange (stated)
8 Plug or cap (stated)
9 Other (stated)1 Flanged, non-rising spindle.
2 P.e. non-rising spindle
3 Socketed, non-rising spindle
4 Threaded, non-rising spindle
5 Flanged, rising spindle (stated)
6 P.e., rising spindle (stated)
7 Socketed, rising spindle,
(stated)
8 Single flange (butterfly &
penstock (stated)
9 Other, (stated)1 Flanged, gravity closing type
2 Flanged, counterweight
disc type
3 Flanged, surge suppressing
4 Flanged, other (stated)
5 Foot valve with strainer
6 Flap valve, single flange1 Single small orifice,
threaded with stopcock
2 Single small orifice,
flanged with stopcock
3 Single large orifice, flanged,
separate isolating valve
4 Single large orifice, flanged,
integral isolating valve
5 Double orifice, flanged,
separate isolating valve
6 Double orifice, flanged,
integral isolating valve
7. Triple action, anti-surge anti-
shock with separate isolating
valve
8. Others (stated)1 Sustaining valve (stated)
2 Reducing valve (stated)
3 Release valve (stated)
4 Level control (stated)
5 Pressure gauge1 With integral isolating valve
2 With separate isolating valve1 Equilibrium type, (stated)
2 Streamline type (stated)
3 Other (stated)1 Woltman bulk type, (stated)
2 Bulk type (stated)
3 Waste meter c/w recorder
4 Single jet, inferential with
dry dial, domestic type
5 Single jet, inferential with
wet dial, domestic type
6 Volumetric, with rotary, piston
domestic type
7 Multi-jet rotor, domestic type
8 Strainer

9 Others (stated)

**FOURTH, FIFTH &
SIXTH DIVISIONS*****4TH pressure class***

- 1 PN 0
- 2 PN 3
- 3 PN 6
- 4 PN 10
- 5 PN 12
- 6 PN 16
- 7 PN 25
- 8 PN 40
- 9 PN other
(stated)

5TH nominal bore list

Select from the
list displayed for
the pipe material
that has been
indicated

6TH sequence no

A number from 1
through 9 to be
used if
necessary to
differentiate
between items
that would
otherwise have
the same BOQ
number

NOTES

1. Items shall be deemed to include the supply of both pipes and fittings complete with all jointing materials, coatings and linings and other related materials called for on the drawings or in the specification unless such material is specifically excluded in the item description

2. The nominal bores, and in the case of uPVC pipes the nominal external diameters are given in the table below for the various types of pipe wall material.

TABLE STANDARD PIPE, SEWER AND FITTINGS DIAMETERS IN mm.

Ref. Letter	Steel / Ductile Iron	G.S. or G.I.	PVC	HDPE	Asbestos Cement	Concrete
a		10				
b		15		15		
c		20		20		
d		25		32		
e		32		40		
f	40	40	50	50	50	
g	50	50	63	63	60	
h	65	65	75	75	75	
i	80	80	90	90		
j	100	100	110	110	100	
k	150	125	160	160	150	150
l	(150)	150	180	180	175	
m	(200)		200	200	(200)	
n	200		225	225	200	225
o	(250)		250	250	(250)	
p	250		280		250	
q	300		315	315	300	300
r	350		350		350	375
s	400		400		400	
t	450				450	450
u	500				500	525
v	550					
w	600				600	600
x	700				700	675
y	800				800	750
z	>900					> 900

(NOD) =nominal outside diameter

() =non preferred sizes

CLASS J: PIPEWORK – PIPES, SEWERS AND FITTINGS - INSTALL

Includes: Distribution of pipes and fittings from storage areas to installation site or trench side, excavation of trenches, including necessary shoring, dewatering of trenches, laying of pipes and fittings in trenches, jointing, partial backfilling of trenches prior to testing of pipelines, and completion of backfilling after successful testing, testing, sterilisation, and flushing.

Excludes: Work included in classes I, K and L.

FIRST DIVISION	SECOND DIVISION	THIRD DIVISION	FOURTH DIVISION	FIFTH DIVISION
1 Method of Measurement type A in metres m	1 Other pipes and fittings, (stated) 2 Clay pipes and fittings 3 Concrete pipes and fittings, (stated) 4 Ductile iron pipes and fittings 5 Welded steel pipes and fittings 6 uPVC pipes and fittings 7 A.C. pipes and fittings 8 G.S. or G.I. pipes and fittings 9 Polyethylene pipes and fittings	1 Pipe n.b.: n.e. 100 mm 2 Pipe n.b.: exc 100 but not exc. 200 mm 3 Pipe n.b.: exc 200 but not exc. 300 mm 4 Pipe n.b.: exc 300 but not exc. 400 mm 5 Pipe n.b.: exc 400 but not exc. 500 mm 6 Pipe n.b.: exc 500 but not exc. 600 mm 7 Pipe n.b.: exc 600 but not exc. 900 mm 8 Pipe n.b.: exc 900 but not exc. 1200 mm 9 Pipe n.b.: exc 1200 (stated)	1 Not in trenches 2 In trenches, depth: n.e. 1 m 3 In trenches, depth: 1 - 1.5 m 4 In trenches, depth: 1.5 - 2 m 5 In trenches, depth: 2 - 3 m 6 In trenches, depth: 3 - 4 m 7 In trenches, depth: 4 - 6 m 8 In trenches, depth: exc. 6 m (stated) 9 On piers, number and height, (stated)	
2 Testing m	- 1 Test pressure not exc. 6 bar 2 Test pressure exc. 6 bar but not exc. 12 bar 3 Test pressure exc. 12 bar but not exc. 25 bar 4 Test pressure exc. 25 bar but not exc. 40 bar 5 Test pressure exc. 40 bar (stated)			
3 Sterilisation and flushing m	- 1 N. B: n.e. 100 mm 2 N. B: 100 - 200 mm 3 N. B: 200 - 300 mm 4 N. B: 300 - 400 mm 5 N. B: 400 - 500 mm 6 N. B: 500 - 600 mm 7 N. B: 600 - 900 mm 8 N. B: 900 - 1200 mm 9 N. B: exc. 1200 mm (stated)	-		
4 Method of Measurement type B by number nr	-	-	1 N.b: n.e. 100 mm 2 N.b.: exc 100 but not exc. 200 mm 3 N.b.: exc 200 but not exc. 300 mm 4 N.b.: exc 300 but not exc. 400 mm 5 N.b.: exc 400 but not exc. 500 mm 6 N.b.: exc 500 but not exc. 600 mm 7 N.b.: exc 600 but not exc. 900 mm 8 N.b.: exc 900 but not exc. 1200 mm 9 N.b.: exc 1200 (stated)	-
5 Method of Measurement type C by number nr	1 Pipes	1 Other pipes, (stated) 2 Clay pipes 3 Concrete pipes, (stated) 4 Ductile iron pipes 5 Welded steel pipes 6 uPVC pipes 7 A.C. pipes 8 G.S. or G.I. pipes 9 Polyethylene pipes		1 Not in trenches 2 In trenches, depth: n.e. 1 m 3 In trenches, depth: 1 - 1.5 m 4 In trenches, depth: 1.5 - 2 m 5 In trenches, depth: 2 - 3 m 6 In trenches, depth: 3 - 4 m 7 In trenches, depth: exc. 4 m (stated) 8 On piers, number and height, (stated) 9 In chambers
	2 Fittings	1 Bends (radius and joints stated) 2 Junctions & branches (type and joints stated) 3 Tapers (type and joints stated) 4 Pipe pieces and bellmouths, (length, joints and type stated) 5 Adaptors, collars, coup- lings, saddles & end pieces (stated) 6 Gate & Butterfly valves (stated) 7 Air valves (stated) 8 Meters, (type stated) 9 Others (stated)		

FIRST DIVISION

- 6 Method of Measurement
type B and type C
trench excavation m³

SECOND DIVISION

- 1 Pipe n.b. n. e. 200 mm
- 2 Pipe n.b. exc. 200 but not exc. 300 mm
- 3 Pipe n.b. exc. 300 but not exc. 600 mm
- 4 Pipe n.b. exc. 600 but not exc. 900 mm
- 5 Pipe n.b. exc. 900 mm (stated)

THIRD DIVISION

- 1 Max. depth n.e. 1 m
- 2 Max. depth 1 - 1.5 m
- 3 Max. depth 1.5 - 2 m
- 4 Max. depth 2 - 3 m
- 5 Max. depth 3 - 4 m
- 6 Max. depth 4 - 6 m
- 7 Max. depth exc. 6 m (stated)

FOURTH DIVISION**NOTES**

1. Three methods of measurement are specified herein. Methods of measurement A and B are used for new works that do not directly involve any tie-in works although they may subsequently require this. Method of measurement C is specifically reserved for tie-in work that can only be executed by shutting down a live system.

2. Unless otherwise indicated in the item description contained in the Bill of Quantities, pipes shall be measured in accordance with Method A. If used, Method B will generally be limited to intake sites, treatment works, and reservoir sites, where there are a disproportionate number of fittings involved.

3. Method A for the measurement of pipes and fittings.

- a) The unit of measurement shall be in metres.
- b) Lengths of pipelines shall be measured along their centreline and shall include lengths occupied by fittings and valves. Where pipes are built into manholes and other chambers, the lengths shall be measured from the inside surfaces of the chambers.
- c) Depths shall be measured from the Commencing Surface to the invert of the pipe.

d) All pipes shall be deemed to be in trenches unless expressly stated otherwise.

e) No separate payment shall be made for:

- i) Excavation of pipe trenches
- ii) Backfilling of pipe trenches unless trenches are expressly required to be backfilled with material other than that excavated from the trench.
- iii) Provision, cutting, laying, jointing of pipes and fittings in trenches
- iv) Temporary supports which are not expressly required to be left in the excavations
- v) Keeping trenches clear of water
- vi) Trimming of trench bottoms
- vii) Disposing of excess excavated material
- viii) Any additional protection at the time of laying if called for on the drawings or in the specification.

4. Method B for the measurement of pipes and fittings.

- a) The unit of measurement shall be by nr., with excavation and backfilling of trenches in cubic metres under first division 6.
- b) Depths shall be measured from the commencing surface to the invert of the pipe or fitting.

c) The volume of excavation & backfilling shall be calculated by multiplying together the depth of the trench and the length of the pipe or fitting in the trench & the nominal width of excavation, the excavation as stated in the Specification.

d) No separate payment shall be made for:

- i) Backfilling of trenches unless trenches are expressly required to be backfilled with material other than that excavated from the trenches
- ii) Provision, cutting, laying, and jointing of pipes and fittings.
- iii) Temporary supports which are not expressly required to be left in the excavation
- iv) Keeping trenches clear of water
- v) Trimming of trench bottoms
- vi) Any additional protection at the time of laying if called for on the drawings or in the specification.

5. Method C for the measurement of fittings, and occasionally pipes that can only be installed by closing down a live system.

- a) The unit of measurement shall be by nr., with excavation and backfilling of trenches in cubic metres under first division 6.

b) Depths shall be measured from the commencing surface to the invert of the pipe or fitting.

c) The volume of excavation & backfilling shall be calculated by multiplying together the depth of the trench and the length of the pipe or fitting in the trench & the nominal width of excavation, the excavation as stated in the Specification.

d) No separate payment shall be made for:

- i) Backfilling of trenches unless trenches are expressly required to be backfilled with material other than that excavated from the trenches
- ii) Provision, cutting, laying, and jointing of pipes and fittings, whether old or new.
- iii) Temporary supports which are not expressly required to be left in the excavation
- iv) Keeping trenches clear of water
- v) Trimming of trench bottoms
- vi) Any additional protection at the time of laying if called for on the drawings or in the specification.

Includes: Manholes and other chambers, ducts, metal culverts, crossings and reinstatement, other ancillaries as listed

exc. 1.5 m (stated)

GAUFF

FOURTH DIVISION

- 1 Nom. bore n.e. 100 mm
- 2 Nom. bore exc 100 but n.e. 200 mm
- 3 Nom. bore exc. 200 but n.e. 300 mm
- 4 Nom. bore exc.300 but n.e. 400 mm
- 5 Nom. bore exc.400 but n.e. 500 mm
- 6 Nom. bore exc. 500 but n.e. 600 mm
- 7 Nom. bore exc.600 but n.e. 900 mm
- 8 Nom. bore exc 900 but n.e. 1200 mm
- 9 Nom. bore exc. 1200 mm (stated)

FIFTH DIVISION

- 1 Depth: n.e. 1.5 m
- 2 Depth: 1.5 - 2 m
- 3 Depth: 2 - 3 m
- 4 Depth: 3 - 4 m
- 5 Depth: 4 - 5 m
- 6 Depth: 5 - 6 m
- 7 Depth: exc. 6m
(state
d)

-

-

FIRST DIVISION		SECOND DIVISION	THIRD DIVISION	FOURTH DIVISION
6	Crossings	nr	1 River, stream or canal, width 1 - 3 m	1 Overcrossing - type I
			2 River, stream or canal, width 3 - 10 m	2 Over crossing - type II
		3 River, stream or canal, width exc. 10 m (stated)	3 Pipe nom.bore 500-1000 mm	3 Undercrossing - type III
		4 Hedge crossing	4 Pipe nom.bore 1000-1500 mm	
		5 Wall crossing	5 Pipe nom.bore 1500-2000 mm	
		6 Fence crossing	6 Pipe nom.bore exc. 2000 mm (stated)	
		7 Sewer, ditch or drain crossing		
		8 Other underground service, (stated)		
		9 Railway crossing, (stated)		
7 Reinstatement		m		
		1 Breaking up and temporary reinstatement - surfaced roads	1 Pipe nom.bore n.e. 250 mm	
		2 Breaking up and temporary reinstatement of dirt roads (where specified by Engineer)	2 Pipe nom.bore 250- 500 mm	
		3 Breaking up, temporary and permanent reinstatement of surfaced roads	3 Pipe nom.bore 500-1000 mm	
		4 Breaking up, temporary and permanent re-instatement of dirt roads (where specified)	4 Pipe nom.bore 1000-1500 mm	
		5 Reinstatement of grassland	5 Pipe nom.bore 1500-2000 mm	
		6 Reinstatement of cultivated lands incl. gardens	6 Pipe nom.bore exc. 2000 mm (stated)	
		7 Reinstatement of sports fields		
8 Other pipework ancillaries				
		1 Reinstatement of field drains m		1 In class 30 precast concrete
		2 Marker posts for nr		2 In accordance with standard drawings
		3 Timber supports left in excavations m ²	1 Sluice valves	
		4 Metal supports left in excavations m ²	2 Air valves	
		5 Connection of pipes to existing manholes, and other chambers nr	3 Fire hydrants	
			4 Washouts	
			5 Water Main	
			6 Master Meter	
			7 Sewer Manhole	
			8 Other (stated)	
				1 Pipe n.b. n.e. 100 mm
				2 Pipe n.b. 100 - 200 mm
				3 Pipe n.b. 200 - 300 mm
				4 Pipe n.b. 300 - 400 mm
				5 Pipe n.b. 400 - 500 mm
				6 Pipe n.b. 600 - 900 mm
				7 Pipe n.b. 900 -1200 mm
				8 Pipe n.b. exc. 1200 mm (stated)
			1 Existing materials (stated)	
			2 Existing materials (clay)	
			3 Existing materials (concrete)	
			4 Existing materials (ductile iron)	
			5 Existing materials (welded steel)	
			6 Existing materials (uPVC)	
			7 Existing materials (A/C)	
			8 Existing materials (G.S. or G.I.)	
		6 Extension spindle with protection sleeve, length (stated)		1 Area: not exc. 0.1 m ²
				2 Area: 0.1 - 0.5 m ²
				3 Area: 0.5 - 1 m ²
				4 Area: 1 - 5 m ²
				5 Area: 5 - 15 m ²
				6 Area: exc. 15 m ² (stated)
		1 Other, (stated)	1 With grade A cover & frame	
		2 Cast iron	2 With grade B cover & frame	
		3 Rust resistant steel	3 With heavy duty cover & frame	
		4 Mild steel, plain	4 With medium duty cover & frame	
		5 Galvanised steel	5 With light duty cover & frame	
		6 HDPE valve surface box	6 With cover & frame, (stated)	
		7 HDPE hydrant surface box	7 With lockable cover and frame as per standard drawing	

NOTES

1. Type or mark numbers shall be stated in item descriptions for *manholes* and *other chambers* of which details are given elsewhere in the Contract. Item descriptions shall identify different configurations of *manholes* and *other chambers*. Separate items are not required for different arrangements of inlets and outlets or for access shafts of different heights.

2. Types and loading duties of manhole gully and catchpit covers shall be stated in item description.

3. Depths of *manholes* and *catchpits* shall be measured from the tops of covers to the tops of base slabs.

4. Separate items are not required for excavation for work in this class except as set out in class L (see notes 1-5 of class L).

5. Excavation and pipe laying for piped *French* and *rubble drains* shall be included in Class J. The nature of the filling material shall be stated in item descriptions for *filling* of *French* and *rubble drains* in this class.

6. Notes in classes I, K and L which refer to *pipe* and *pipework* shall also apply to *ducts* and *metal culverts* in this class. *Crossings, reinstatement* and *other pipework ancillaries* for ducts and metal culverts shall be itemized, described and measured as set out in this class, except that the dimension used for classification in the third division shall be the maximum nominal distance between the inside faces of the outer walls of the duct or culvert. Non-circular metal culverts shall be classified by their maximum nominal internal cross-sectional dimension. Separate items are not required for bends in cable ducts.

7. Materials and dimensions of linings to *ditches* shall be stated in item descriptions. The cross-sectional areas of *rubble drains* and *ditches* shall be measured to the Excavated Surfaces.

8. Types of surfaces shall be stated in item descriptions for *breaking up and reinstatement of roads*. Separate items are not required for removal and reinstatement of kerbs. Surfaced roads denote tarmac, concrete, paving bricks or similar surfaces. Dirt roads denote only official designated murrum roads of at least 6 m width and where specified by the Engineer or his Representative.

9. *River, stream* and *canal crossings* shall be classified by their widths between banks measured along pipe centre lines. Crossings of streams shall be measured only where their width exceeds one metre. Items for *crossings* shall include reinstatement unless otherwise stated. Where linings to rivers, streams or canals are to be broken through and reinstated the type of lining shall be stated in item descriptions for crossings. Crossings of roads and paths shall be classed as breaking up and reinstatement of roads and paths. Lengths for *breaking up and reinstatement of roads* and *footpaths* shall be measured along pipe centre lines and shall include lengths occupied by manholes and other chambers.

10. Sizes and types of *marker posts* shall be given in item descriptions or given on drawings.

11. The area measured for *supports left in excavations* shall be the area of supported surfaces for which the supports are expressly required to be left in.

CLASS L: PIPEWORK - SUPPORTS AND PROTECTION, ANCILLARIES TO LAYING AND EXCAVATION

Includes: Extras to excavation and backfilling of trenches for pipework, ducts and metal culverts, manholes and other chambers. Pipelaying in headings and thrust borings. Excavation for and provision of supports and protection to pipework, ducts and metal culverts

Excludes: Work included in classes I,J, and K.

FIRST DIVISION

1 Extras to excavation and backfilling m³

2 Special laying methods m

3 Beds m
4 Haunches m
5 Surrounds m

6 Wrapping & lagging of m

7 Concrete stools and thrust blocks, concrete class nr
(stated)

8 Other isolated pipe supports nr

SECOND DIVISION

1 In pipe trenches
2 In manholes and chambers
3 In headings
4 In thrust borings
5 In pipe jackings
6 In foundations
7 Other (stated)

--
1 Pipe laying in headings
2 Pipe laying in thrust borings
3 Pipe jacking

--
1 Sand
2 Selected granular material
3 Imported granular material
4 Mass concrete
5 Reinforced concrete

--
1 Polythene sheeting, grade (stated)
2 Material, (stated)

--
1 To horizontal bends
2 To vertical bends at crest
3 To vertical bends at trough
4 To steep slopes
5 To junctions
6 To tapers
7 To other (stated)

--
1 Height: n.e. 1 m.
2 Height: 1 - 1.5 m.
3 Height: 1.5 - 2 m.
4 Height: 2 - 3 m.
5 Height: 3 - 4 m.
6 Height: 4 - 5 m.
7 Height: 5 - 6 m.
8 Height: exc. 6 m.(stated)

THIRD DIVISION

1 Excavation of rock class I material
2 Excavation of rock class II material
3 Excavation of mass concrete
4 Excavation of reinforced concrete
5 Excavation of other artificial hard material
6 Backfilling above Final Surface with concrete
7 Backfilling above Final Surface with material other than concrete (stated)
8 Excavation of natural material below the Final Surface and backfilling with concrete
9 Excavation of natural material below the Final Surface and backfilling below the Final Surface with material other than concrete (stated)

1 Pipe n.b. n.e. 100 mm
2 Pipe n.b. 100 - 200 mm
3 Pipe n.b. 200 - 300 mm
4 Pipe n.b. 300 - 400 mm
5 Pipe n.b. 400 - 500 mm
6 Pipe n.b. 500 - 600 mm
7 Pipe n.b. 600 - 900 mm
8 Pipe n.b. 900 -1200 mm
9 Pipe n.b. exc. 1200 mm (stated)

1 Volume: n.e. 0.1 m³
2 Volume: 0.1 - 0.2 m³
3 Volume: 0.2 - 0.5 m³
4 Volume: 0.5 - 1 m³
5 Volume: 1 - 2 m³
6 Volume: 2 - 4 m³
7 Volume: 4 - 8 m³
8 Volume: exc. 8 m³ (stated)

1 Pipe n.b. n.e. 100 mm
2 Pipe n.b. 100 - 200 mm
3 Pipe n.b. 200 - 300 mm
4 Pipe n.b. 300 - 400 mm
5 Pipe n.b. 400 - 500 mm
6 Pipe n.b. 600 - 900 mm
7 Pipe n.b. 900 -1200 mm
8 Pipe n.b. exc. 1200 mm (stated)

FOURTH DIVISION

1 Pipe n.b. n.e. 100 mm
2 Pipe n.b. 100 - 200 mm
3 Pipe n.b. 200 - 300 mm
4 Pipe n.b. 300 - 400 mm
5 Pipe n.b. 400 - 500 mm
6 Pipe n.b. 500 - 600 mm
7 Pipe n.b. 600 - 900 mm
8 Pipe n.b. 900 -1200 mm
9 Pipe n.b. exc. 1200 mm (stated)

GAUFF

NOTES

1. Items shall be given in this class in addition to the items for the provision and jointing of *pipes, ducts and culverts* and for the excavation, laying and backfilling of *pipes, ducts and culverts* laid in trenches in classes I and K. Items shall be given in this class in addition to the items for *manholes* and *other chambers* in class K.

2. The volume of *extras to excavation and backfilling* for *pipes* shall be calculated by multiplying together the average depth and length of the material removed or backfilled and the nominal width is stated it shall be taken as 500 mm greater than the maximum nominal distance between the inside faces of the outer pipe walls where this distance does not exceed one metre, and as 750 mm greater than this distance where it exceeds one metre.

3. The volume of *extras to excavation and backfilling* for *manholes* and other chambers shall be calculated by multiplying the average depth of the material removed or backfilled by the maximum horizontal external cross-sectional area of the manhole or chamber.

4. Breaking up of roads and pavings shall be included in class K.

5. *Backfilling above the Final Surface* (L1 - 5-6*) shall be measured only if it is expressly required that the material excavated shall not be used for backfilling. *Excavation below the Final Surface and backfilling* (L1 - 7-8*) shall be measured only where it is expressly required.

6. *Pipe laying in headings and by thrust boring* shall be measured only where they are expressly required. Item descriptions for *pipe laying in headings* and *by thrust borings* shall identify the run of pipe or pipes laid. The type of packing shall be stated in item descriptions for *pipe laying in headings*. Thrust blocks constructed for the purposes of thrust boring only shall be classed as Temporary Works in class A.

7. Lengths of supports and protection to pipelines shall be measured along pipe centre lines including lengths occupied by fittings and valves but not including lengths occupied by manholes and chambers through which the support or protection is not continued.

8. Materials used for *beds, haunches* and *surrounds* to pipes and the depths of beds shall be stated in item descriptions. Separate items shall not be given for beds to haunched or surrounded pipes where the same material is used for beds and haunches or beds and surrounds respectively.

9. Materials used for *wrapping and lagging* of pipes shall be stated in item descriptions. Separate items are not required for wrapping and lagging of fittings and valves.

10. Principal dimensions and materials shall be stated in item descriptions for *pipe supports*. Heights of pipe supports shall be measured from the ground or other supporting surface to the invert of the highest pipe where pipes are supported from below and of the lowest pipe where pipes are supported from above. Where two or more pipes are carried by a support, the item for the support shall be classified in the third division by the aggregate bore of the pipes supported.

11. The specification of concrete shall be stated in item description for *concrete stools and thrust blocks*.

12. Work in this class associated with ducts and metal culverts shall be itemized, described and measured as set out for work associated with pipes, except that the dimension used for classification in the third division shall be the maximum nominal distance between the inside faces of the outer walls of the duct or culvert.

CLASS N: MISCELLANEOUS METALWORK

Excludes: Metal reinforcement for concrete (included in classes C, G, H and R). Metal concrete inserts (included in classes G and H). Pipework (included in classes I, J, K, and L). Structural metalwork (included in class M). Fittings and fastenings to timber (included in O). Piles (included in classes P and Q). Traffic signs (included in class R). Rail track and accessories (included in class S). Surface treatment of metalwork on site (included in class V). Fences (included in class X).

FIRST DIVISION

1	Mild steel, plain
2	Galvanized steel
3	Aluminium
4	Stainless steel
5	Other (stated)

6	Cast Iron
7	Rust resistant steel
8	Mild steel, plain
9	Other (stated)

SECOND DIVISION

1	Stairways and landing	t
2	Walkways and platforms	t

3	Ladders and step irons	m
---	------------------------	---

4	Handrails	m
5	Bridge parapets	m

6	Miscellaneous frames, dimensions, (stated)	m
---	--	---

7	Flooring, dimensions, (stated)	m ²
---	--------------------------------	----------------

8	Screens, dimensions, (stated)	m ²
---	-------------------------------	----------------

9	Plate, dimensions, (stated)	m ²
---	-----------------------------	----------------

1	Cladding	m ²
2	Welded mesh panelling	m ²
3	Duct covers	m ²
4	Tie rods	nr
5	Walings	nr

6	Bridge bearings	nr
---	-----------------	----

7	Tanks, nominal size, (stated)	nr
---	-------------------------------	----

8	Tank ancillaries	nr
---	------------------	----

9	Hand stops (stated)	m ²
---	---------------------	----------------

THIRD DIVISION

-
- | | |
|---|---------------------------------|
| 1 | Ladders, dimensions (stated) |
| 2 | Step irons, dimensions (stated) |
-

-
- | | |
|---|--|
| 1 | From angle section, painted |
| 2 | From angle section, hot dip
galvanized |
| 3 | From channel section, painted |
| 4 | From channel section, hot dip
galvanized |
| 5 | From I section, painted |
| 6 | From I section, hot dip galvanized |
| 7 | From tubular section, round, painted |
| 8 | From tubular section, round, hot dip
galvanized |
| 9 | From tubular section, rectangular,
(stated) |
-

- | | |
|---|------------------------------|
| 1 | From plain plate |
| 2 | From open grid |
| 3 | From chequer plate |
| 4 | From chequer plate, lockable |
-

- | | |
|---|------------------------------------|
| 1 | Fine, dia 5 to 10 mm., (stated) |
| 2 | Coarse, dia. 30 to 50 mm, (stated) |
-

- | | |
|---|-----------------------------------|
| 1 | With notch 53 degrees, fixed |
| 2 | With notch 53 degrees, removable |
| 3 | With notch, 90 degrees, fixed |
| 4 | With notch, 90 degrees, removable |
| 5 | Fixed, detail (stated) |
| 6 | Removable, detail (stated) |
-

-
- | | |
|---|------------------|
| 1 | Roller |
| 2 | Slide |
| 3 | Rocker |
| 4 | Cylindrical |
| 5 | Spherical |
| 6 | Plain rubber |
| 7 | Laminated rubber |
| 8 | Rubber pot |
-

- | | | | |
|---|---------|-------|---------------------|
| 1 | Volume: | n.e. | 1 m ³ |
| 2 | Volume: | 1 - | 3 m ³ |
| 3 | Volume: | 3 - | 10 m ³ |
| 4 | Volume: | 10 - | 30 m ³ |
| 5 | Volume: | 30 - | 100 m ³ |
| 6 | Volume: | 100 - | 300 m ³ |
| 7 | Volume: | 300 - | 1000 m ³ |
| 8 | Volume: | exc. | 1000 m ³ |
-

- | | |
|---|----------------------------|
| 1 | Cover description (stated) |
|---|----------------------------|
-

- | | | |
|---|----------------------------|--------|
| 1 | Roof vent assembly, diam.: | 50 mm |
| 2 | Roof vent assembly, diam.: | 80 mm |
| 3 | Roof vent assembly, diam.: | 100 mm |
| 4 | Roof vent assembly, diam.: | 150 mm |
-

NOTES

1. Item descriptions shall state the specification and thicknesses of metal used off-site surface treatments and principal dimensions of miscellaneous metalwork assemblies. Alternatively, item descriptions may identify assemblies by mark numbers related to detail shown on the Drawings or given in the Specification.

2. Masses calculated for measurement of *miscellaneous metalwork* assemblies shall include the mass of all metal components and attached pieces. Separate items are not required for the components of miscellaneous metalwork assemblies.

3. Item codes N3-38** shall be used for *miscellaneous metalwork* not listed in the classification. Generally the measurement unit for such work shall be the tonne.

4. Separate items are not required for erection and fixing of *miscellaneous metalwork* or for provision of fixings to miscellaneous metalwork.

5. The lengths of *handrails* and *bridge parapets* shall be measured along their top members. The lengths of *rectangular frames* shall be measured along their external perimeters.

6. No deductions from the masses or areas measured for *miscellaneous metalwork* shall be made for openings and holes each less than 0.5 m² in area.

CLASS O: TIMBER

Includes: Timber components and fittings Timber decking

Excludes: Formwork to concrete (included in class G). Timber piles (included in class P). Timber sleepers (included in class S). Timber fencing (included in class X). Building carpentry and joinery.

FIRST DIVISION

1	Hardwood components for general use	m
2	Hardwood components for marine use	m
3	Softwood components	m
<hr/>		
4	Hardwood decking for general use	m ²
5	Hardwood decking for marine use	m ²
6	Softwood decking	m ²
<hr/>		
7	Fittings and fastenings	nr
<hr/>		
8	Roofing	nr

SECOND DIVISION

1	X-sect. area:	n.e. 0.01 m ²
2	X-sect. area:	0.01 - 0.02 m ²
3	X-sect. area:	0.02 - 0.04 m ²
4	X-sect. area:	0.04 - 0.10 m ²
5	X-sect. area:	0.10 - 0.20 m ²
6	X-sect. area:	0.20 - 0.40 m ²
7	X-sect. area:	exc. 0.4 m ² (stated)
<hr/>		
-	1 Thickness:	25 mm
2	Thickness:	50 mm
3	Thickness:	75 mm
4	Thickness:	100 mm
5	Thickness:	125 mm
6	Thickness:	150 mm
7	Thickness:	200 mm
8	Thickness:	225 mm
9	Thickness	exc. 225 mm, (stated)
<hr/>		
-	1 Straps of dimensions, (stated)	
2	Spikes of length, diameter, (stated)	
3	Coach screws of length, diameter, (stated)	
4	Bolts of diameter, length, (stated)	
5	Plates of dimensions, (stated)	
<hr/>		
-	1 Truss assemblies, (stated)	
2	Rafters, (stated)	

THIRD DIVISION

1	Length:	n.e. 1.5 m
2	Length:	1.5 - 3 m
3	Length:	3 - 5 m
4	Length:	5 - 8 m
5	Length:	8 - 12 m
6	Length:	12 - 20 m
7	Length:	exc. 20 m (stated)
<hr/>		
1	Width	75 mm.
2	Width	100 mm.
3	Width	125 mm.
4	Width	150 mm.
5	Width	225 mm.
6	Width	250 mm.
7	Width	300 mm.
8	Width	450 mm.
9	Width,	exc. 450 mm., (stated)

NOTES

1. Timber components in buildings which may be included in civil engineering contracts need not be measured according to the procedure set down in this class

2. The nominal gross cross-sectional dimensions or thicknesses, species and any impregnation requirements or special surface finishes shall be stated in item descriptions for timber *components* and *decking*.

3. The structural use and location of timber *components* shall be stated in item descriptions for components longer than 3 metres.

4. The length of each timber *component* measured shall be its overall length with no deduction for scarfed or other joints.

5. The cross-sectional areas used for classification of timber *components* shall be their nominal gross cross-sectional areas.

6. The thickness used for classification of and stated in item descriptions for timber *decking* shall be its nominal gross thickness.

7. Separate items are not required for fixing timber *components* and *decking* or *fittings and fastenings* or for boring and cutting.

8. No deduction from the areas measured for timber *decking* shall be made for openings and holes each less than 0.5 m² in area.

GAUFF

CLASS P: PILES

Excludes:Boring for site investigation (included in class B). Ground anchors (included in class C). Walings and tie rods (included in class N). Piling ancillaries (included in class Q).

FIRST DIVISION

- 1 Bored cast in place concrete piles
- 2 Driven cast in place concrete piles

-
- 3 Preformed concrete piles
 - 4 Preformed prestressed concrete tiles
 - 5 Preformed concrete sheet piles
 - 6 Timber piles

-
- 7 Isolated steel pipes

-
- 8 Interlinked steel pipe piles

-
- 9 Interlocking steel piles
-

SECOND DIVISION

- 1 Diameter: 300 mm or 350 mm
- 2 400 mm or 450 mm
- 3 500 mm or 550 mm
- 4 600 mm or 750 mm
- 5 900 mm or 1050 mm
- 6 1200 mm or 1350 mm
- 7 1500

-
- - 1 Cross-sectional area: not exceeding
 - 2 0.025-0.05 m²
 - 3 0.05 – 0.1 m²
 - 4 0.1 – 0.15 m²
 - 5 0.15 – 0.25 m²
 - 6 0.25 – 0.5 m²
 - 7 0.5 – 1 m²
 - 8 exceeding 1 m²

-
- - 1 Mass: not exceeding 15 kg/m
 - 2 15 – 30 kg/m
 - 3 30 – 60 kg/m
 - 4 60 – 120 kg/m
 - 5 120 – 250 kg/m
 - 6 250 – 500 kg/m
 - 7 500 kg/m – 1 t/m
 - 8 exceeding 1 t/m

-
- - 1 Section modulus: not exceeding
 - 2 500 cm³/m
 - 3 500-800 cm³/m
 - 4 800-1200 cm³/m
 - 5 1200-2000 cm³/m
 - 6 2000-3000 cm³/m
 - 7 3000-4000 cm³/m
 - 8 4000-5000 cm³/m
 - 9 exceeding 5000 cm³/m
-

THIRD DIVISION

- 1 Number of piles nr
- 2 Concreted length m
- 3 Depth bored or driven to stated maximum depth m

-
- 1 Number of piles of stated length nr
 - 2 Depth driven m

-
- 1 Number of piles of stated length nr
 - 2 Depth driven m

-
- 1 Length of special piles m
 - 2 Driven area m²
 - 3 Area of piles of length: not exceeding 14 m m²
 - 4 14-24 m m²
 - 5 exceeding 24 m m²
-

MEASUREMENT RULES

- M1** Bored and driven depths shall be measured along the axes of piles from the Commencing Surface to the toe levels of bored piles, to the bottom of the casings of driven cast in place piles and to the bottom of the toes of other driven piles. The Commencing Surface adopted in the preparation of the Bill of Quantities as the surface at which boring or driving is expected to begin shall be adopted for the measurement of the completed work.
- M2** Each group of items for *cast in place concrete piles* shall comprise
- (a) an item for the *number of piles* (P1-2 * 1)
 - (b) an item for the total *concreted length* of piles (P1-2 * 2)
 - (c) an item for the total *depth bored or driven* (P1-2 * 3).
- M3** The *concreted lengths of cast in place concrete piles* shall be measured from the cut-off levels expressly required to the toe levels expressly required.
- M4** Each group of items for *preformed concrete and timber piles* shall comprise
- (a) one or more items for the *number of piles of stated length* (P3-6 * 1)
 - (b) an item for the total *depth driven* (P3-6 * 2).
- M5** Each group of items for *isolated steel piles* shall comprise
- (a) one or more items for the *number of piles of stated length* (P7 * 1)
 - (b) an item for the total *depth driven* (P7 * 2).
- M6** Each group of items for *interlocking steel piles* shall comprise
- (a) one or more items for the total length of each type of *special pile*, if any (P8 * 2)
 - (b) an item for the total *driven area* of piles (P8 * 2)
 - (c) one or more items for the total *area of piles* divided into the ranges of length given in the third division (P8 * 3-5).
- M7** The areas of *interlocking steel piles* shall be calculated by multiplying the mean undeveloped horizontal lengths of the pile walls formed (including lengths occupied by special piles) by the depths measured in accordance with rule M1 in the case of items in the case of items for the driven areas (P8 * 2) and by the lengths defined in accordance with rule D6 in the case of items for the areas of piles (P8 * 3-5).
- M8** Closure and taper piles classed as *special piles* shall be measured only where they are expressly required.

DEFINITION RULES

- D1** The maximum depth stated in item descriptions for the *depth cast in place concrete piles* shall be the depth which is not exceeded by any pile included in the item.
- D2** Piles comprising a driven permanent steel casing which is filled with concrete shall be classed as *driven cast in place concrete piles* where the piles are designed for the load to be carried on the concrete.
- D3** The lengths of *preformed concrete and timber piles* shall be the lengths expressly required to be supplied excluding extensions but including heads and shoes.
- D4** The lengths of *isolated steel piles* shall be the lengths expressly required to be supplied excluding extensions.
- D5** Piles comprising a driven permanent steel casing which is filled with concrete shall be classed as *isolated steel piles* where the piles are designed for the load to be carried on the casing. Filling such piles shall be classed as *filling hollow piles with concrete* (Q 53*)
- D6** The lengths of *interlocking steel pipes* shall be the lengths expressly required to be supplied excluding extensions.
- D7** Interlocking steel corner, junction, closure and taper piles shall be classed as *special piles*.

COVERAGE RULES

- C1** Items for piles shall be deemed to include disposal of excavated material.

ADDITIONAL DESCRIPTION RULES

- A1** Materials of which piles are composed shall be stated in item descriptions.
- A2** Preliminary piles shall be identified in item descriptions. Raked piles shall be identified in item descriptions and their inclination stated.
- A3** The structure to be supported and the Commencing Surface shall be identified in item descriptions for piles.
- A4** The diameter shall be stated in item descriptions for *cast in place concrete piles*.
- A5** Contiguous bored piles shall be identified in item descriptions.
- A6** The cross-section type and cross-sectional dimensions or diameter shall be stated in item descriptions for *preformed concrete and timber piles*.
- A7** Details of treatments and coatings shall be stated in item descriptions for the *number of piles*.
- A8** Details of driving heads and of shoes shall be stated in item descriptions for the *number of piles*.
- A9** The mass per metre and cross-sectional dimensions shall be stated in item descriptions for *isolated steel piles*.
- A10** The section reference or mass per metre and section modulus shall be stated in item descriptions for *interlocking steel piles*.
- A11** Details of treatments and coatings shall be stated in item descriptions for *area of piles*.
- A12** The type of special pile shall be stated in item descriptions for the *length of special piles*.

CLASS Q: PILING ANCILLARIES

Includes: Work ancillary to piling.

Excludes: Ground anchors (includes in class C). Piles included in class P). Walings and tie rods (included in class N).

FIRST DIVISION

1 Cast in place concrete piles

2 Cast in place concrete piles

3 Preformed concrete piles

4 Timber piles

5 Isolated steel piles

6 Interlocking steel piles

7 Obstructions

h

8 Pile tests

SECOND DIVISION

1 Pre-boring m
2 Backfilling empty bore with stated material m
2 Permanent casings each length:
not exceeding 13 m m
4. exceeding 13 m m
5 Enlarged bases nr
7 Cutting off surplus lengths m
8 Preparing heads nr

-
1 Reinforcement t

-
1 Pre-boring m
2 Jetting m
3 Filling hollow piles with concrete m
4 Number of pile extensions nr
5 Length of pile extensions, each length:
not exceeding 3 m m
6 exceeding 3 m m
7 Cutting off surplus lengths m
8 Preparing heads nr

-
1 Preboring m
2 Jetting m
3 Filling hollow piles with concrete m
4 Number of pile extensions nr
5 Length of pile extensions, each length:
not exceeding 3 m m
6 exceeding 3 m m
7 Cutting off surplus lengths m
8 Preparing heads nr

-
1 Preboring m
2 Jetting m
4 Number of pile extensions m
5 Length of pile extensions, each length:
not exceeding 3 m m
6 exceeding 3 m m
7 Cutting off surplus lengths m
8 Preparing heads nr

-

-
1 Maintained loading with various reactions
2 Constant rate of penetration
3 horizontal loading

-
4 Non-destructive integrity
5 Inclinator installations

THIRD DIVISION

- 1 Diameter: 300 mm or 350 mm
- 2 400 mm or 450 mm
- 3 500 mm or 550 mm
- 4 600 mm or 750 mm
- 5 900 mm or 1050 mm
- 6 1200 mm or 1350 mm
- 7 1500 mm

-
1. Straight bars, nominal size:
not exceeding 25
mm
 2. exceeding 25 mm
 3. Helical bars of stated nominal size

-
- 1 Cross-sectional area: not exceeding
0.025
m²
 - 2 0.025 m² - 0.05 m²
 - 3 0.05 m² - 0.1 m²
 - 4 0.1 m² - 0.15 m²
 - 5 0.15 m² - 0.25 m²
 - 6 0.25 m² - 0.5 m²
 - 7 0.5 m² - 1 m²
 - 8 stated exceeding
1
m²

-
- 1 Mass: not exceeding 15 kg/m
 - 2 15 – 30 kg/m
 - 3 30 – 60 kg/m
 - 4 60 – 120 kg/m
 - 5 120 – 250 kg/m
 - 6 250 – 500 kg/m
 - 7 500 kg/m – 1 t/m
 - 8 stated exceeding 1 t/m

-
- 1 Section modulus:
not exceeding 500 cm³/m
 - 2 500 - 800 cm³/m
 - 3 800 - 1200 cm³/m
 - 4 1200 - 2000 cm³/m
 - 5 2000 - 3000 cm³/m
 - 6 3000 - 4000 cm³/m
 - 7 4000 - 5000 cm³/m
 - 8 stated exceeding 5000 cm³/m
-

-
- 1 Test load: not exceeding 100 t
 - 2 100 – 200 t
 - 3 200 – 300 t
 - 4 300 – 400 t
 - 5 400 – 600 t
 - 6 600 – 800 t
 - 7 800 – 1000 t
 - 8 exceeding 1000 t
-

MEASUREMENT RULES

M1 Work in this class, other than *backfilling empty bore* for cast in place concrete piles, shall be measured only where it is expressly required.

M2 The lengths of *permanent casings* shall be measured from the Commencing Surface to the bottom of the casing.

M3 The mass measured for *reinforcement* shall include the mass of reinforcement in laps.

M4 The mass of steel *reinforcement* shall be taken as 0.785 kg/m per 100 mm² of cross-section (7.85 t/m³). The mass of other reinforcing materials shall be taken as stated in the Contract.

M5 Driving extended piles shall be included in the measurement of the items for driven depth in class P.

M6 Each group of items for *pile extensions* shall comprise

- (a) an item for the number of *pile extensions* (Q3-44*)
- (b) one or two items for the *length of pile extensions* divided into the ranges of length given in the second division (Q3-4 5-6*)

M7 The length of *pile extensions* measured shall not include lengths formed from material arising from cutting off surplus lengths of other piles.

M8 The length measured for *timber pile extensions* shall include lengths occupied by scarfed or other joints.

M9 Each group of items for *pile extensions* shall comprise

- (a) an item for the number of *pile extensions* (Q 5 4*)
- (b) one or two items for the *length of pile extensions* divided into the ranges of length given in the second division Q 5 5-6*).

M10 Each group of items for *pile extensions* shall comprise

- (a) an item for the number of *pile extensions* (Q 6 4 *)
- (b) one or two items for the *length of pile extensions* divided into the ranges of length given in the second division.

M11 The lengths measured for *cutting off surplus lengths* of interlocking steel piles shall be the mean undeveloped horizontal lengths to be cut (including lengths occupied by special piles).

M12 *Obstructions* shall be measured only for breaking out rock or artificial hard material encountered above the founding stratum of bored piles.

DEFINITION RULES

D1 The *diameter* used for classification in the third division shall be the diameter of the piles.

D2 The nominal size used for classification in item descriptions for *bar reinforcement* shall be the cross-sectional size defined in BS 4449.

D3 The *cross-sectional area* used for classification in the third division shall be the cross-sectional area of the piles.

D4 The *mass* used for classification in the third division shall be the mass of the piles.

D5 The *section modulus* used for classification in the third division shall be the section modulus of the piles

COVERAGE RULES

C1 Items for piling ancillaries shall be deemed to include disposal of surplus materials unless otherwise stated.

C2 Items for *permanent casings* shall be deemed to include driving heads and shoes.

C3 Items for *reinforcement* shall be deemed to include supporting reinforcement.

C4 Items for *pre-boring* shall be deemed to include grouting voids between the pile and the bore.

C5 Items for *pile extensions* shall be deemed to include the work necessary to attach the extension to the pile.

C6 Items for *filling hollow piles with concrete* shall be deemed to include removal of material from within the pile before concreting.

C4 Items for *pre-boring* shall be deemed to include grouting voids between the pile and the bore.

C5 Items for *pile extensions* shall be deemed to include the work necessary to attach the extension to the pile.

C6 Items for *filling hollow piles with concrete* shall be deemed to include removal of material from within the pile before concreting.

ADDITIONAL DESCRIPTION RULES

A1 The diameters of *enlarged bases* for bored piles shall be stated in item descriptions.

A2 Materials, thickness and details of treatments and coatings shall be stated in item descriptions for *permanent casings*. Item descriptions for *cutting off surplus lengths* which include permanent casings shall so state.

A3 Materials shall be stated in item descriptions for *reinforcement*.

A4 Details of couplers for high tensile steel reinforcement which are expressly required shall be stated in item descriptions for *reinforcement*.

A5 Item descriptions for *filling hollow piles with concrete* shall state the specification of the concrete.

A6 Materials of which *pile extensions* are composed shall be stated in item descriptions for their *length*.

A7 Item descriptions for *pile tests* shall identify those which are to preliminary piles.

A8 Item descriptions for loading tests shall state the load. Where the load is applied to raking piles item descriptions shall so state.

CLASS R: ROADS AND PAVING

Includes: Sub-base, base and surfacing of roads, runways and other paved areas. Kerbing and light duty pavements, footways and cycle tracks. Traffic signs and markings.

Excludes: Landscaping (included in class E). Drainage (included in classes I, J, K and L). Fences and gates (included in class X). Gantries and other substantial structures supporting traffic signs.

FIRST DIVISION

- 1 Sub-bases, flexible road bases and surfacing

- 2 Sub-bases, flexible road bases and surfacing

- 3 Sub-bases, flexible road bases and surfacing

- 4 Concrete pavements

- 5 Joints in concrete pavements m

SECOND DIVISION

- 1 Granular material of CBR (stated) at MDD (stated) m²
 2 Granular material (general) m²
 3 Soil-cement, ratio (stated) m²
 4 Cement bound granular material m²
 5 Lean concrete of CBR (stated) at MDD (stated) m²
 6 Hardcore m²

- 7 Geotextiles, (stated) m
 8 Allow for making up additional depth of material (stated) m³

- 1 Wet mix macadam m²
 2 Dry bound macadam m²
 3 Dense bitumen macadam m²
 4 Open texture bitumen macadam m²
 5 Dense tarmacadam m²
 6 Open texture tarmacadam m²
 7 Dense tar surfacing m²

- 1 Cold asphalt wearing course m²
 2 Rolled asphalt m²
 3 Slurry sealing m²
 4 Surface dressing m²
 5 Bituminous spray m²
 6 Removal of flexible surface m²

- 8 Regulating course of, (stated) t

- 1 Carriageway slabs, paving quality concrete (stated) m²
 2 Carriageway slabs of other strength, (stated) m²
 3 Other cast in-situ concrete slabs, strength, (stated) m²

- 4 Reinforced with steel fabric to specification m²
 5 Reinforced with other fabric (stated) m²

- 6 Reinforced with mild steel bar to specification t
 7 Reinforced with high yield steel bar, (stated) t

- 8 Waterproof membrane laid below concrete pavements m²

- 1 Longitudinal joints, (stated)
 2 Expansion joints, (stated)
 3 Contraction joints, (stated)
 4 Warping joints, (stated)
 5 Butt joints, (stated)
 6 Construction joints, (stated)

THIRD DIVISION

1	Depth:	n.e.	30 mm
2	Depth:	30 -	60 mm
3	Depth:	60 -	100 mm
4	Depth:	100 -	150 mm
5	Depth:	150 -	200 mm
6	Depth:	200 -	250 mm
7	Depth:	250 -	300 mm
8	Depth:	exc.	300 mm (stated)

1	Depth:	n.e.	30 mm
2	Depth:	30 -	60 mm
3	Depth:	60 -	100 mm
4	Depth:	100 -	150 mm
5	Depth:	150 -	200 mm
6	Depth:	200 -	250 mm
7	Depth:	250 -	300 mm
8	Depth:	exc.	300 mm (stated)

1	Depth:	n.e.	30 mm
2	Depth:	30 -	60 mm
3	Depth:	60 -	100 mm
4	Depth:	100 -	150 mm
5	Depth:	150 -	200 mm
6	Depth:	200 -	250 mm
7	Depth:	250 -	300 mm
8	Depth:	exc.	300 mm (stated)

1	Nom. mass:	n.e.	2 kg/m ²
2	Nom. mass:	2 -	3 kg/m ²
3	Nom. mass:	3 -	4 kg/m ²
4	Nom. mass:	4 -	5 kg/m ²
5	Nom. mass:	5 -	6 kg/m ²
6	Nom. mass:	6 -	7 kg/m ²
7	Nom. mass:	7 -	8 kg/m ²
8	Nom. mass:	exc.	8 kg/m ² , (stated)

1	Diameter:	6 mm
2	Diameter:	8 mm
3	Diameter:	10 mm
4	Diameter:	12 mm
5	Diameter:	14 mm
6	Diameter:	16 mm
7	Diameter:	20 mm
8	Diameter:	25 mm or greater, (stated)

1	Depth of joint:	n.e.	30 mm
2	Depth of joint:	30 -	60 mm
3	Depth of joint:	60 -	100 mm
4	Depth of joint:	100 -	150 mm
5	Depth of joint:	150 -	200 mm
6	Depth of joint:	200 -	250 mm
7	Depth of joint:	250 -	300 mm
8	Depth of joint:	exc.	300 mm, (stated)

FIRST DIVISION

6 Kerbs, channels and edgings

7 Light duty pavements m²

8 Ancillaries

SECOND DIVISION

- 1 Precast concrete kerbs to specification, bullnosed type
- 2 Precast concrete kerbs to specification, full batter type
- 3 Precast concrete kerbs to specification, half batter type
- 4 In-situ kerbs and edgings
- 5 Precast concrete channels
- 6 Precast concrete edgings
- 7 Asphalt kerbs, (stated)
- 8 Asphalt channels, (stated)

-
- 1 Granular base
 - 2 Hardcore base
 - 3 Tarmacadam
 - 4 Rolled asphalt
 - 5 Bitumen macadam
 - 6 Dense tar
 - 7 In-situ concrete, strength (stated)
 - 8 Precast concrete flags, specification (stated)

-
- 1 Traffic signs

-
- 2 Surface markings

THIRD DIVISION

- 1 Laid straight or curved to radius exc. 12 m m
- 2 Laid curved to radius n.e. 12 m m
- 3 Quadrants nr
- 4 Drops nr
- 5 Transitions nr

- 1 Depth: n.e. 30 mm
- 2 Depth: 30 - 60 mm
- 3 Depth: 60 - 100 mm
- 4 Depth: 100 - 150 mm
- 5 Depth: 150 - 200 mm
- 6 Depth: 200 - 250 mm
- 7 Depth: 250 - 300 mm
- 8 Depth: exc. 300 mm (stated)

- 1 Non-illuminated nr
- 2 Illuminated nr

- 1 Using non-reflecting road studs, (stated) nr
- 2 Using reflecting road studs, (stated) nr
- 3 Using letters and shapes, (stated) nr
- 4 Using continuous lines, (stated) m
- 5 Using intermittent lines, (stated) m

NOTES

1. Item description for all courses of paving and road making materials and pavement slabs shall identify the materials and state the depth of each course or slab.

2. Item descriptions for work in this class which is applied to surface inclined at an angle exceeding 10° to the horizontal shall so state.

3. The width of each course of material shall be measured at the top surface of the course. The area of a manhole cover or other intrusion into a surface shall not be deducted where the area of the intrusion is less than one square metre.

4. Item descriptions for *steel fabric reinforcements* to SSRN 128 shall include the type number or letter in accordance with SSRN 128. Item descriptions for other fabric reinforcement shall state the material sizes and its nominal mass per square metre. The area of additional fabric in laps shall not be measured.

5. Reinforcing bars which are not circular in cross-section shall be classified by the diameter of the circular bar given in the classification nearest in cross-sectional area to the bars measured.

6. Separate items are not required for formwork to *concrete pavement* or formwork to *joints in concrete pavements*.

7. The dimensions, spacing and nature of components shall be stated in item descriptions for *joints in concrete pavements*. Construction joints shall be measured only where they are expressly required.

8. Materials, cross-sectional dimensions and details of backings and beds shall be stated in item descriptions for *kerbs, channels and edgings*.

9. The shape and colour of aspects shall be stated in item descriptions for *reflecting road studs*.

10. The material, size and diagram number taken from *Traffic signs, regulations and general directions*, issued by the Ministry responsible for roads, shall be stated in item descriptions for *traffic signs and surface markings*.

11. Separate items are not required for supporting posts and foundations for *traffic signs*. Items for supporting gantries and other substantial structures associated with traffic signs which are constructed in concrete, structural metalwork or other materials shall be given in the appropriate classes.

12. Lengths measured for linear *surface markings* shall exclude gaps in intermittent markings.

13. The expression - 'Specified' shall mean as specified in the *Specification for road and bridge works* issued by the Ministry responsible for roads.

CLASS U: BRICKWORK, BLOCKWORK AND MASONRY

Excludes: Brickwork, blockwork and masonry in manholes and other brickwork, blockwork or masonry incidental to, pipework (included in class K).

FIRST DIVISION

- 1 Common brickwork
- 2 Facing brickwork
- 3 Engineering brickwork
- 4 Lightweight blockwork
- 5 Dense concrete blockwork
- 6 Artificial stone blockwork
- 7 Ashlar masonry
- 8 Rubble masonry

SECOND DIVISION

- 1 Composite construction, thickness not exc. 150 mm. m²
- 2 Cavity construction, thickness 150 - 250 mm. m²
- 3 Composite construction, thickness 150 - 250 mm. m²
- 4 Cavity construction, thickness 250 - 500 mm m²
- 5 Composite construction, thickness 250 - 500 mm m²
- 6 Composite construction, thickness 500 - 1000 mm. m²
- 7 Composite construction, thickness exc. 1000 mm., (stated) m³

-
- 8 Surface and other features

-
- 9 Ancillaries

THIRD DIVISION

- 1 In vertical straight walls
- 2 In vertical curved walls
- 3 In battered straight walls
- 4 In battered curved walls
- 5 As vertical facing to concrete
- 6 As battered facing to concrete
- 7 As casing to metal section
- 8 As other, (stated)

-
- 1 Copings and cills m
 - 2 Rebates and chases m
 - 3 Cornices m
 - 4 Band courses m
 - 5 Corbels m
 - 6 Pilasters m
 - 7 Plinths m
 - 8 Fair facing m²
 - 9 Columns and piers, cross-sect. dimensions (stated) m

-
- 1 Joint reinforcement using (stated) m
 - 2 Damp proof courses m
 - 3 Movement joint filled with, material, width, (stated) m
 - 4 Bond to existing work by, (stated) m²
 - 5 Concrete infill, material, thickness (stated) m²
 - 6 Fixing and ties, material, means, centres, (stated) m²
 - 7 Built in pipes and ducts, X-sect. area n.e. 0.025 m2 nr
 - 8 Built in pipes and ducts, X-sect. area 0.025 - 0.25 m2 nr
 - 9 Built in pipes and ducts, X-sect. area exc. 0.25 m2 (stated) nr

NOTES

1. Item descriptions for *brickwork* and *blockwork* shall either state the materials, nominal dimensions and types of brick or block or give equivalent references to applicable Standard specifications. The thickness of mass *brickwork* and *blockwork* shall be stated in item descriptions where it does not exceed one metre.

2. The materials and nominal thicknesses shall be stated in item descriptions for *masonry*.

3. Separate items are not required for joints, pointing, fixings or ties to *brickwork*, *blockwork* or *masonry*.

4. Item descriptions for *brickwork*, *blockwork* and *masonry* which is in cavity or composite construction shall so state. Where different bonding patterns are specified for the same material, the bonding pattern shall be stated in the item descriptions.

5. Volumes and areas measured for *brickwork*, *blockwork* and *masonry* shall include the volumes and areas of joints. No deduction or addition to the volumes and areas measured shall be made for rebates, projecting courses or other surface features each less than 0.05 m² in cross-sectional area. No deduction from areas and volumes measured shall be made for holes and openings in walls or surfaces each less than 0.25 m² in cross-sectional area. Areas shall be measured at the centre lines of brickwork, blockwork and masonry

6. Walls battered on one side shall be classed as *battered walls*.

7. Item descriptions for *surface features* shall include sufficient detail to identify special or cut bricks or blocks. The spacings of intermittent surface features shall be stated in the item descriptions. Reveals shall not be classed as surface features.

8. The materials and dimensions of *joint reinforcement* and *damp proof courses* and the mix specification of *concrete infills* shall be stated in item descriptions.

9. The area measured for *centering to arches* shall be the temporarily supported area of the intrados.

CLASS V: PAINTING

Includes: In-situ painting, and in-situ surface preparation

Excludes: Painting and other surface treatment carried out prior to delivery of components to Site and maintenance of such surfaces until completion (measured only for metalwork in classes M & N)

FIRST DIVISION

- 1 Lead, iron or zinc based primer paint
- 2 Etch primer paint
- 3 Oil paint
- 4 Alkyd gloss paint
- 5 Emulsion paint
- 6 Cement paint
- 7 Epoxy or polyurethane paint
- 8 Bituminous or coal tar paint

SECOND DIVISION

- 1 On metal other than metal sections and metal pipework
- 2 On timber
- 3 On smooth concrete
- 4 On rough concrete
- 5 On masonry
- 6 On brickwork and blockwork

- 7 On metal sections m²
- 8 On pipework m²

THIRD DIVISION

- 1 With upper surface inclined at an angle not exc. 30° to the horizontal m²
- 2 With upper surface inclined at 30° - 60° to the horizontal m²
- 3 With surface inclined at an angle exc. 60° to the horizontal m²
- 4 With soffit surfaces and lower surfaces inclined at an angle not exc. 60° to the horizontal m²
- 5 With surfaces of width not exc. 300 mm m
- 6 With surfaces of width 300 mm - 1 m m
- 7 To isolated groups of surfaces nr

NOTES

- 1. Item descriptions for work in this class shall state the materials used and either the number of coats or the film thickness.
- 2. Surfaces of width not exceeding one metre shall not be distinguished by inclination.
- 3. No deduction from areas measured for painting shall be made for holes and openings in the painted surfaces each less than 0.5 m² in area.

- 4. *Isolated groups of surfaces* may be classed as such only where the total surface area of each group does not exceed 6 m². Item descriptions for isolated groups of surfaces shall identify the work to be painted and state its location. Groups of surfaces of the same shape and dimensions may be included in one item.
- 5. In calculating the painted area of *metal sections*, the presence of connecting plates, brackets, rivets, bolts, nuts and similar projections shall be ignored.

- 6. The area measured for painting *pipework* shall be the length multiplied by the barrel girth of each length of pipework. Lengths occupied by valves and other projecting fittings shall not be deducted. Surfaces of flanges, valves and other projecting fittings shall not be measured.
- 7. Separate items are not required for preparation of surfaces before painting.

CLASS W: WATERPROOFING

Includes: Damp proofing, tanking and roofing

Excludes: Waterproofed joints (included in classes C, G, H, I, J, K, R, T, and X). Damp proof courses in brickwork, blockwork and masonry (included in class U).

FIRST DIVISION	SECOND DIVISION	THIRD DIVISION
1 Damp proofing	1 Using asphalt	1 On upper surface inclined at an angle not exc. 30° to the horizontal m ²
2 Tanking	2 Using sheet metal, material (stated)	2 On upper surface inclined at 30° - 60° to the horizontal m ²
3 Roofing	3 Using waterproof sheeting	3 On surface inclined at an angle exc. 60° to the horizontal m ²
	4 Using waterproof coating of (stated)	4 On curved surfaces of less than 10 m. radius m ²
	5 Using rendering in ordinary cement mortar	5 On domed surfaces of less than 10 m. radius m ²
	6 Using rendering in waterproof cement mortar	6 On surfaces of width not exc. 300 mm m
	7 Using rendering with proprietary mix mortar (stated)	7 On surfaces of width 300 mm. - 1 m. m
-----	-----	8 To isolated groups of surfaces nr
4 Protective layers of	-	
	1 Sand asphalt	
	2 Flexible sheeting	
	3 Sand	
	4 Sand and cement screed	
	5 Tiles	
-----	-----	-----
5 Sprayed or brushed waterproofing using (stated) m ²	-	
-----	-----	-----

NOTES

1. Item descriptions for work in this class shall state the materials used and the number and thickness of coatings or layers.
2. Separate items are not required for preparing surfaces or for joints, overlaps, mitres, angles, fillets, and built-up edges or for laying to falls and cambers.
3. Surfaces of width not exceeding one metre shall not be distinguished by inclination or curvature.
4. The areas measured for *waterproofing* shall be those of the surfaces covered. No deduction from the areas measured for *waterproofing* shall be made for holes and openings in the waterproofed surfaces each less than 0.5 m² in area.
5. Waterproofing shall be classed as to *curved* or *domed surfaces* only where the radius of curvature of the surface is less than 10 m. Waterproofing so classed shall not be distinguished by inclination.
6. *Isolated groups of surfaces* may be classed as such only where the total surface area of each group does not exceed 6 m². Item descriptions for isolated groups of surfaces shall identify the work to be waterproofed and state its location. Groups of surfaces of the same shape and dimensions may be included in one item.

CLASS X: MISCELLANEOUS WORK

Includes: Fences, gates and their foundations. Rock filled gabions. Windows and doors. Drainage to structures above ground. Underdrainage to structures. Filter media. Other items not allowed for elsewhere and as stated.

FIRST DIVISION

1	Fences	m
2	Gates and stiles	nr
3	Drainage to structures above ground	
4	Rock filled gabions	
5	Underdrainage to structures	m
6	Windows	nr
7	Doors	nr
8	Filter media	m ³
9	Other (stated)	

SECOND DIVISION

1	Timber post and rail	
2	Timber post and wire	
3	Concrete post and wire	
4	Metal post and wire	
5	Coated metal post and wire	
6	Timber close boarded	
-		
1	Timber field gates	
2	Timber wicket gates	
3	Metal field gates	
4	Metal wicket gates	
5	Stiles	
-		
1	Mild steel	
2	Cast iron	
3	Plastics	
4	Asbestos cement	
-		
1	Boxes, size, mesh and fill material (stated)	nr
2	Mattress of thickness, mesh and fill material (stated)	m ²
-		
1	Perforated clay	
2	Clay laved with gaps	
3	Perforated uPVC	
4	No fines concrete	
5	Concrete laid with gaps	
6	Perforated asbestos cement	
-		
1	Wooden frame, openable	
2	Wooden frame, deadlight	
3	Mild steel frame, openable	
4	Mild steel frame, deadlight	
5	Aluminium frame, openable	
6	Aluminium frame, deadlight	
7	Louvre, wooden frame, lockable	
8	Louvre, aluminium frame, lockable	
9	Other (stated)	
-		
1	Wood, flush, internal	
2	Wood, flush, external	
3	Wood, panel, internal	
4	Wood, panel, external	
5	Wood, matchboard, internal	
6	Wood, matchboard, external	
7	Metal, flush	
-		
1	Graded sand	
2	Graded gravel	

THIRD DIVISION

1	Height:	n.e.	1 m.
2	Height:	1 - 1.25 m.	
3	Height:	1.25 - 1.50 m.	
4	Height:	1.50 - 2 m.	
5	Height:	2 - 2.50 m.	
6	Height:	2.50 - 3 m.	
7	Height:	exc. 3 m. (stated)	
1	Width:	n.e.	1.5 m.
2	Width:	1.5 - 2 m.	
3	Width:	2 - 2.5 m.	
4	Width:	2.5 - 3 m.	
5	Width:	3 - 4 m.	
6	Width:	4 - 5 m.	
7	Width:	exc. 5 m. (stated)	
1	Gutters		m
2	Fittings to gutters		nr
3	Downpipes		m
4	Fittings to downpipes		nr
1	Diameter:		100 mm.
2	Diameter:		150 mm.
3	Diameter:		200 mm.
4	Diameter:		250 mm.
5	Diameter:	exc. 250 mm. (stated)	
1	Area:	n.e.	1 m ² .
2	Area:	1 - 2 m ² .	
3	Area:	2 - 3 m ² .	
4	Area:	3 - 4 m ² .	
5	Area:	4 - 5 m ² .	
6	Area:	exc. 5 m ² . (stated)	
1	Single leaf, standard		
2	Single leaf, stable type		
3	Double leaf, standard		
4	Double leaf, non standard (stated)		
1	Effective size 0.25 - 0.35 mm., uniformity coeff. 2.0 - 3.0 for slow sand filters.		
2	Effective size 0.55 mm., uniformity coeff. not exc. 1.5 for rapid gravity filters.		
3	Other, (stated).		
4	Particle size 2 - 5 mm., layer thickness 50 - 80 mm., ave. 65mm.		
5	Particle size 5 - 12 mm., layer thickness 50 - 80 mm., ave. 65mm.		
6	Particle size 12 - 20 mm., layer thickness 80 - 130 mm., ave. 100 mm.		
7	Particle size 20 - 38 mm., layer thickness 80 - 130 mm., ave. 100 mm.		
8	Particle size 38 - 65 mm., layer thickness 80 - 130 mm., ave. 100 mm.		
9	Other, (stated)		

NOTES

1. The types and principal dimensions of *fences, gates and stiles* and of their foundations shall be stated in item descriptions.

2. Item descriptions for *fences* which are erected on a curve of radius not exceeding 100 m or on a surface inclined at an angle exceeding 10° shall so state.

3. Heights of *fences* shall be measured from the Commencing Surface. Widths of *gates and stiles* shall be measured between the inside faces of posts.

4. Item descriptions for *drainage to structures above ground* shall state the type, principal dimensions and materials of the components.

5. *Fittings to gutters* shall include bands, angles, stop ends and outlets. *Fittings to downpipes* shall include bends, swan necks, shoes and roof outlets fixed directly to downpipes.

CLASS Y: SEWER RENOVATION AND ANCILLARY WORKS

Includes: Preparation and renovation of existing sewers and manholes and new manholes within the length of existing sewers.

Excludes: Grouting carried out from the outside of the sewer (included in class C). Supply and installation of new sewers and, new manhole and pipework ancillaries and supports and protection ancillaries to laying and excavation included in classes I, J, and K.

FIRST DIVISION	SECOND DIVISION	THIRD DIVISION
1 Preparation of existing sewers	1 Other sewer wall material (stated) 2 Clay sewers 3 RC concrete sewers 4 Cast iron sewers 5 Steel sewers 6 uPVC sewers 7 A.C. sewers 8 Unreinforced concrete sewers	5 N.b. exc. 400 - 1 N. b. n.e. 100 mm 2 N. b. exc. 100 - 200 mm 3 N. b. exc. 200 - 300 mm 4 N. b. exc. 300 - 400 mm 5 N. b. exc. 400 - 500 mm 6 N. b. exc. 500 - 600 mm 7 N. b. exc. 600 - 900 mm 8 N. b. exc. 900 - 1200 mm 9 N. b. exc. 1200 mm (stated)
2 Stabilisation of existing sewers	- 1 Other sewer wall material (stated) 2 Clay sewers 3 RC concrete sewers 4 Cast iron sewers 5 Steel sewers 6 uPVC sewers 7 A.C. sewers 8 Unreinforced concrete sewers	- 1 N. b. n.e. 100 mm 2 N. b. exc. 100 - 200 mm 3 N. b. exc. 200 - 300 mm 4 N. b. exc. 300 - 400 mm 5 N. b. exc. 400 - 500 mm 6 N. b. exc. 500 - 600 mm 7 N. b. exc. 600 - 900 mm 8 N. b. exc. 900 - 1200 mm 9 N. b. exc. 1200 mm (stated)
3 Renovation of existing sewers	- 1 Other sewer wall material (stated) 2 Clay sewers 3 RC concrete sewers 4 Cast iron sewers 5 Steel sewers 6 uPVC sewers 7 A.C. sewers 8 Unreinforced concrete sewers	- 1 N. b. n.e. 100 mm 2 N. b. exc. 100 - 200 mm 3 N. b. exc. 200 - 300 mm 4 N. b. exc. 300 - 400 mm 5 N. b. exc. 400 - 500 mm 6 N. b. exc. 500 - 600 mm 7 N. b. exc. 600 - 900 mm 8 N. b. exc. 900 - 1200 mm 9 N. b. exc. 1200 mm (stated)
3 Laterals to renovated sewers	- 1 Other sewer wall material (stated) 2 Clay sewers 3 RC concrete sewers 4 Cast iron sewers 5 Steel sewers 6 uPVC sewers 7 A.C. sewers 8 Unreinforced concrete sewers 9 Flapvalves	- 1 N. b. n.e. 100 mm 2 N. b. exc. 100 - 200 mm 3 N. b. exc. 200 - 300 mm 4 N. b. exc. 300 - 400 mm 5 N. b. exc. 400 - 500 mm 6 N. b. exc. 500 - 600 mm 7 N. b. exc. 600 - 900 mm 8 N. b. exc. 900 - 1200 mm 9 N. b. exc. 1200 mm (stated)

500 mm
6 N.b. exc. 500 –
600 mm
7 N.b. exc. 600 mm
(stated)

-

FOURTH DIVISION		1	Jointing
1	Cleaning		
m			

2	Removing intrusions		
nr			
		2	Flapvalves

3	Plugging laterals		
nr			
4	Filling laterals & other sewers, materials stated		
m³			

5	Local internal repairs		
nr			

1	Pointing, materials stated		
m²			
2	Joint sealing, material stated		
nr			

3	External grouting		

1	Sliplining		

2	In-situ jointed sewer lining		

3	Segmental lining		

4	Proprietary lining (stated)		

5	Guniting coating, thickness stated		

6	Annulus grouting materials stated		

GAUFF

FIFTH DIVISION

-
- 1 Laterals, bore n.e.
150 mm
 - 2 Laterals, profile & size
exc. 150 mm
in one or more dim-
ensions, (stated)
 - 3 Other artificial
intrusions (stated)
-

- 1 Bore n.e. 300 mm
 - 2 Profile & size exc.
300 mm in one or
more dimensions
(stated)
-

- 1 Area: n.e. 0.1 m²
 - 2 Area: 0.1 – 0.25 m²
 - 3 Area exc. 0.25 m²
(stated)
-

-
- 1 Number of holes nr
 - 2 Injection of grout,
material stated m³
-

-
- 1 Polyethylene
 - 2 Polypropylene
-

- 1 Polyethylene
 - 2 Polypropylene
 - 3 Glass reinforced
plastic
-

- 1 Glass reinforced
plastic
 - 2 Glass reinforced
concrete
 - 3 Cast gunite
 - 4 Resin concrete
-

-
- 1 Bore n.e. 150 mm
 - 2 Bore 150 to 300 mm
 - 3 Profile & size exc.
300 mm in one or
more dimensions
(stated)
-

-
- 1 Remove existing
 - 2 Replace existing
 - 3 New flap valve,
type stated
-

FIRST DIVISION

- 5 New manholes in new locations nr
- 6 New manholes replacing existing manholes nr

7 Existing man- holes
nr

- 8 Interruptions

SECOND DIVISION

- 1 Brick
- 2 Brick with back-drop
- 3 In-situ concrete
- 4 In-situ concrete with backdrop
- 5 Precast concrete
- 6 Precast concrete with backdrop
- 7 Masonry or blockwork
- 8 Masonry or block work with back-drop
- 9 Other (stated)

-
- - 1 N. b. n.e. 100 mm
 - 2 N. b. exc. 100 - 200 mm
 - 3 N. b. exc. 200 - 300 mm
 - 4 N. b. exc. 300 - 400 mm
 - 5 N. b. exc. 400 - 500 mm
 - 6 N. b. exc. 500 - 600 mm
 - 7 N. b. exc. 600 - 900 mm
 - 8 N. b. exc. 900 - 1200 mm
 - 9 N. b. exc. 1200 mm (stated)

THIRD DIVISION

- 1 N. b. n.e. 100 mm
- 2 N. b. exc. 100 - 200 mm
- 3 N. b. exc. 200 - 300 mm
- 4 N. b. exc. 300 - 400 mm
- 5 N. b. exc. 400 - 500 mm
- 6 N. b. exc. 500 - 600 mm
- 7 N. b. exc. 600 - 900 mm
- 8 N. b. exc. 900 - 1200 mm
- 9 N. b. exc. 1200 mm (stated)

-
- - 1 Depth: n.e. 1.5 m
 - 2 Depth: 1.5 - 2 m
 - 3 Depth: 2 - 3 m
 - 4 Depth: 3 - 4 m
 - 5 Depth: 4 - 5 m
 - 6 Depth: 5 - 6 m
 - 7 Depth: exc. 6m (stated)

FOURTH DIVISION

- 1 Depth: n.e. 1.5 m
- 2 Depth: 1.5 - 2 m
- 3 Depth: 2 - 3 m
- 4 Depth: 3 - 4 m
- 5 Depth: 4 - 5 m
- 6 Depth: 5 - 6 m
- 7 Depth: exc. 6m (stated)

-
- 1 Preparation of existing sewers
 - 2 Stabilisation of existing sewers
 - 3 Renovation of existing sewers
-
- 4 Work on laterals to renovated sewers
 - 5 Work on manholes

FIFTH DIVISION

-
- - 1 Abandonment
 - 2 Alteration
-

-
- - 1 Sliplining
 - 2 In-situ jointed pipe lining
 - 3 Segmental lining
 - 4 Proprietary lining, (stated)
 - 5 Guniting coating
 - 6 Annulus grouting
-
-

MEASUREMENT RULES

M1 Lengths of sewers shall be measured along their centre lines between the inside surfaces of manholes but shall exclude lengths occupied by pipes and fittings comprising backdrops to manholes.

M2 Where work is expressly required to be carried out by excavation, crossings, reinstatement and other sewer-work ancillaries shall be measured in class K and extras to excavation and backfilling shall be measured in class L.

M3 No deduction shall be made from the areas of sewer surfaces measured for pointing for openings or voids each not exceeding 0.5 m² in area.

M4 External grouting shall be measured only where grouting is expressly required to be carried out as a separate operation from annulus grouting.

M5 The volume measured for annulus grouting shall not include the volume measured for external grouting (Y 2 [1-8] [1-9].3 2).

M6 Interruptions shall be measured only where a minimum pumping capacity is expressly required and for periods of time during normal working hours wherein the flow in the sewer exceeds the installed pumping capacity and work is interrupted.

DEFINITION RULES

D1 Items shall be classed as removing intrusions where artificial intrusions into the bores of existing sewers are to be removed prior to renovation.

D2 The areas stated in item descriptions for local internal repairs shall be the finished surface areas.

D3 External grouting shall be grouting of voids outside the existing sewer from within the existing sewer other than voids grouted in the course of annulus grouting.

D4 Annulus grouting shall be grouting of the annular voids between new linings and existing sewers and of other voids grouted in the course of grouting annular voids.

D5 The depth of manholes shall be measured from the tops of covers to channel inverts or to tops of base slabs, whichever is the lower.

COVERAGE RULES

C1 Items for work which is expressly required to be carried out by excavation shall be deemed to include preparation of surfaces, disposal of excavated material, disposal of excavation, backfilling and removal of existing services.

C2 Items for cleaning shall be deemed to include making good resultant damage.

C3 Items for removing intrusions shall be deemed to include making good.

C4 Annulus grouting shall be grouting of the annular voids between new linings and existing sewers and of other voids grouted in the course of grouting annular voids.

C5 Items for pointing and sewer joint sealing shall be deemed to include preparation of joints.

C6 Items for laterals shall be deemed to include the work involved in connecting to the lining within 1 m from the inside face of the lined sewer.

C7 Items for new manholes shall be deemed to include excavation, preparation of surfaces, disposal of excavated material, upholding sides of excavation, backfilling, concrete, reinforcement, form-work, joints, finishes and reinstatement.

C8 Items for manholes shall be deemed to include metalwork, different arrangements of inlets and outlets, and access shafts of different heights and connection of sewers to manholes. Items for manholes with backdrops shall be deemed to include the sewers and fittings comprising the backdrop.

C9 Items for new manholes replacing existing manholes shall be deemed to include breaking out and disposal of existing manholes.

ADDITIONAL DESCRIPTION RULES

A1 The location of the work in each item or group of items shall be stated so that the work can be identified by reference to the Drawings.

A2 Principal dimensions, other than diameter and depth of sewers and profiles of sewers shall be identified by reference to the Drawings.

A3 Work expressly required to be carried out manually or by remotely controlled methods shall each be so stated in item descriptions.

A4 Item descriptions for work which is expressly required to be carried out by excavation shall so state and (except for manholes) shall state the maximum depth of excavation in stages of 1 m measured to the invert of the sewer.

A5 Item descriptions for preparation, stabilisation, renovation and laterals shall state the material forming of the existing sewer.

A6 Item descriptions for removing intrusions shall state the materials forming the intrusions.

A7 Where external grouting is carried out through sewer joints, descriptions of items for the number of holes shall so state.

A8 Item descriptions for slip-lining, in situ jointed pipe lining, segmental lining and stated proprietary lining shall state the type lining, its minimum finished internal size and its thickness or grade.

A9 Item descriptions for in situ jointed sewer lining and segmental lining shall state the offset where the lining

is curved to an offset which exceeds 35 mm per metre.


A10 Item descriptions for jointing laterals shall state the type of lining to which the laterals are to be connected and identify those laterals which are to be reggraded.

A11 Type or mark numbers shall be stated in item descriptions for manholes of which details are given elsewhere in the Contract. Item descriptions shall identify different configurations of manholes.

A12 Types and loading duties of covers shall be stated in item descriptions for new manholes.


A13 Item descriptions for existing manholes shall state details of the work required.


SECTION VII- BILLS OF QUANTITIES

 Preliminary and General					1
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE KES	AMOUNT KES
	All rates are inclusive of all overheads and applicable taxes and duties				
1-A	GENERAL ITEMS				
1-A1	CONTRACTUAL REQUIREMENTS				
1-A11	Performance Security	Sum	1		
1-A121	Contractor's all risk insurance (CAR)	Sum	1		
1-A2	SPECIFIED REQUIREMENTS				
1-A24	New equipment for Use by Engineers Staff				
	Provide and maintain Contractor owned RTK survey equipment as specified in the specifications during contract period for exclusive use of the Engineer.				
1-A249.2	Contractor retains ownership of equipment.	month	4		
1-A249.6	Contractor's overheads & profit for items A249.2	%	0		
1-A25	Attendance upon Contract Administrators				
1-1.A252	Chainmen Provide (1 No.)	month	4		
	<u>By Third Party Inspection (man-made other than pipes)</u>				
1-A264.2	Concrete crush test: 150 mm moulds cubes in sets of 3 samples	nr	1		
1-A264.3	Steel Reinforcement: tensile strength test	nr	1		
	<u>By Third Party Inspection (pipes)</u>				
1-A266.6	HDPE Pipes & Fittings	nr	1		
	Testing of Works				
1-A277	Test Run of Works 2 weeks prior & 2 weeks after substantial completion	Sum	1		
	Signboards				
1-A279	Provide project signboard as detailed in Drawing No.: THIWASCO/SD/1.0	nr	1		
TOTAL CARRIED FORWARD TO BILL COLLECTION SHEET					

THIWASCO
Bills of Quantities

FY 2023/2024 Borehole Equipping, Construction Of Elevated
Steel Tank Pipeline In Gatuanyaga - Munyu


	Preliminary and General				1
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE KES	AMOUNT KES
1-A381	METHOD RELATED CHARGES The Contractor to allow a lump sum amount to cater for his method related costs including overheads & profits by considering the following site conditions: (i) The pipe lines will be laid in areas with numerous active existing services, both on the surface and buried; and along Roads in Commercial and Residential areas. (ii) The works are to be carried out in congested Built-up areas with limited working space and limited access for Mechanical Equipment. The area is predominantly rocky. (iii) The pipelines will be constructed mainly along road reserves. Execution of Works in such conditions are deemed to be included in the Contractor's Rates.	Sum	1		
1-A382	<u>Contractor's Camp and Storage Yard:</u> Allow for any costs, overheads and profit for establishment of the Contractor's Camp(s), Offices, Storage Yard and other facilities including mobilization, demobilization and removal on Completion. Include for all equipment, temporary measures, machines, tools, materials, facilities for workers, water and electricity supply etc. all as specified for execution of the Works, for the entire Contract Period	Sum	1		
1-A383	<u>Setting Out of the Works:</u> To be done in accordance with Specifications. The Work will entails establishment of Level Datum, setting out of the Works in accordance with Specifications, staking out of the construction wayleave along all pipeline routes, Topographical Survey, preparation of updated Layout Plans (with Contours at 1m interval), submission of plans & pipeline profiles and Setting Out of proposed manholes and pipelines	m	7,600		
1-A384	Provisional Sum of KES 200000 for any payments for services by roads authorities, County Government, NEMA etc and any other that have any statutory jurisdiction over the works. Rate to include sourcing road cutting permits and reinstatement to standard, permits to work on road verges and tree cutting permits as may be required.	Sum	1		
1-A387	Provide "As Built drawings" in AutoCAD and 5nr A3 hard copies and Operation and maintenance manuals for all plant, and equipment installed or constructed and rehabilitated. Include general layouts, pipeline profiles, chamber plans, sections & reinforcement detailing	Sum	1		
TOTAL CARRIED FORWARD TO BILL COLLECTION SHEET					


	Preliminary and General				1
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE KES	AMOUNT KES
<div style="background-color: #4a7ebb; color: white; padding: 10px; margin: 10px auto; width: 80%; border-radius: 10px;">COLLECTION SHEET</div>					
PAGE NO.					
1					
2					
TOTAL CARRIED TO SUMMARY SHEET					-

THIWASCO
Bills of Quantities

FY 2023/2024

Borehole Equipping, Construction Of Elevated
Steel Tank Pipeline In Gatuanyaga - Munyu


	Equipping Magana Primary School Borehole in Gatuanyaga - Munyu				2
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE KES	AMOUNT KES
1	All rates are inclusive of all overheads and applicable taxes and duties SITE WORKS				
	General Clearance				
1.1	Clearance of grassland/open bush and thicket locally disposed off as directed.	m2	50		
	Fencing				
1.2	Precast concrete fencing post and chain link 3.0 m high above ground level as per Drawings No.:	m	50		
2	EQUIPING OF BOREHOLES				
2.1	Mobilization, Shifting, Setting Up & Demobilization				
2.11	Mobilization and demobilization of and test pumping unit to and from site.	nr	1		
2.2	Testing of Works				
2.21	Pressure testing of all pipework	Sum	1		
2.22	Cleaning & Sterilization of Tanks & Pipework	Sum	1		
2.4	Test Pumping				
2.41	Constant discharge test (48 hours per test well)	nr	1		
2.42	Recovery test per borehole (10 hours per test well)	nr	1		
2.5	PIPEWORK				
	Supply, install and test pipes & fittings. Allow for cut & weld on site modifications to suit site specific conditions Contractors rate to allow for testing and commissioning				
	Pump delivery & tank inlet pipework				
	Allow for DN 100, PN 10 steel pipes, gate valve, smart ready dry dial meter, non-return valve, "Y" strainer, sampling tap, masonry walled chambers, float valve complete with all sundry fittings from borehole pump to elevated tank. Fittings & Chambers to be as per drawing No.: THIWASCO/BH/1.0, and drawing No.: THIWASCO/SD/2.0				
2.51		Sum	1		
	Tank outlet pipework				
	Allow for DN 100, PN 10 steel pipes, gate valve and valve chamber complete with all sundry fittings. Fittings & Chambers to be as per standard drawing No.: THIWASCO/SD/3.0				
2.52		Sum	1		
	Tank scour pipework				
	Allow for DN 100, PN 10 steel pipes, gate valve and valve chamber complete with all sundry fittings. Fittings & Chambers to be as per standard drawing No.: THIWASCO/SD/3.0				
2.53		Sum	1		
TOTAL CARRIED FORWARD TO BILL COLLECTION SHEET					

	Equipping Magana Primary School Borehole in Gatuanyaga - Munyu				2
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE KES	AMOUNT KES
3.6	<u>ELECTROMECHANICAL</u>				
	<u>KPLC power Supply</u>				
3.61	Apply and follow up with KPLC for grid power supply. Size of power applied for shall be 1.4 times the power rating of the pumping system motor.	sum	1		
	<u>Grid Tied-Solar Power System</u>				
3.62	Design, supply, install, test and commission grid tied solar pumping system capable of supplying 1.4 times the power rating of the pumping system motor. The solar powered pumping system shall be complete with ; Appropriately rated monocrystalline solar modules, appropriately rated hybrid inverter/controller to allow for synchronisation with grid, eathing to KPLC requirements.	sum	1		
3.63	Ground mounted steel solar support structure	Sum	1		
	<u>Power Transmission Cabling</u>				
3.64	Supply and install all cabling required according to IEC 60364-5-52, calbes installed below ground to be amoured, appropriately rated to suit pump & motor. From Solar PV to Control Panel & pump. Contractor's rate to include NFC fuses, shrink joints, trenching, ducting and cable laying and accessories.	Sum	1		
	<u>Pumps</u>				
3.65	Supply and install motor-pump set for borehole, including all assesories complete and ready to operate Pump set. 'Motor with built-in temperature sensor, dry run protection. Allow for determining safe yield. Pump rating to suit safe yield and delivery head to 20 m high elevated tank. Minimum flow 20 m3/hr at 110 m head	nr	1		
3.66	Allow for installation of airline pipe	Sum	1		
	<u>Control Panel</u>				
4	Design, supply,install, test and commission approved control panel with direct online starter with Grundfos MP 204 (or equivalent) controlller complete with communication interface unit, hours counter, hours timer to allow for recharge. The system shall be integrable with SCADA and shall allow for manual and automacti control of the pumping system.	Sum	1		
	<u>REHABILITATION OF MASONRY STRUCTURE</u>				
	<u>Paint</u>				
4.1	Repair damaged plaster, prepare and apply 3 coats of grade A' Plastic Emulsion Paint on all plastered surfaces.	m ²	37.50		
	<u>Coloured screed</u>				
4.2	25 mm thick coloured cement and sand (1:5) screed steel trowelled hard and smooth.	m ²	12.50		
	<u>Replace Damaged Door</u>				
4.3	Supply & install single leaf metalic door c/w frame, iron mongery and paint	nr	1.00		
TOTAL CARRIED FORWARD TO BILL COLLECTION SHEET					

THIWASCO
Bills of Quantities

FY 2023/2024

Borehole Equipping, Construction Of Elevated
Steel Tank Pipeline In Gatuanyaga - Munyu

	Equipping Magana Primary School Borehole in Gatuanyaga - Munyu				2
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE KES	AMOUNT KES
4.4	<u>Replace Damaged Window</u> Supply & fix purpose made steel casement window fabricated from standard sections complete with frames, mullions and transoms side hang casement and fixed light including all necessary locking and hanging devices, including mosquito gauze, once shop primed with red lead oxide primer before delivery to site c/w glazing.	nr	2.00		
4.5	<u>Replace Damaged Roofing</u> Allow for all materials for providing and placing reinforced concrete and installation of permanent ventilation as Per Drawing No.: THIWASCO/BH/1.0	Sum	1.00		
4.6	<u>Small Power & Lighting</u> Supply & install Small Power & Lighting for pump house Contractor's rate to allow for minor items such as saddles, clips & small lengths of cables, etc. All luminaries to conform to IP54. Voltage: 230 V. Actual installation positions as directed by the Engineer. To include all switches sockets outlets light fittings columns lanterns Internal lighting and small power	sum	1.00		
4.7	External solar flood light IP 65, 200 W mounted on pump house roof.	nr	2		
TOTAL CARRIED FORWARD TO BILL COLLECTION SHEET					





COLLECTION SHEET


THIWASCO
Bills of Quantities

FY 2023/2024

Borehole Equipping, Construction Of Elevated
Steel Tank Pipeline In Gatwanyaga - Munyu

 Construction of 50 m3 Elevated Tank in Gatwanyaga - Munyu					3
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE (KShs.)	AMOUNT (KShs.)
	All rates are inclusive of all overheads and applicable taxes and duties				
1	<u>GENERAL CLEARANCE</u>				
1.1	Grassland	m ²	100.00		
2	<u>EARTHWORKS</u>				
	<u>Excavation for Foundations</u>				
2.1	Top soil stripping	m ³	7.00		
2.2	Below ground level in loose weathered material	m ³	31.00		
2.3	Below ground level in weathered rock	m ³	51.00		
2.4	Below ground level in rock	m ³	11.00		
	<u>Filling and Compaction</u>				
2.5	Compacted granular fill. Using excavated material	m ³	16.00		
2.6	Hardcore. Using imported material	m ³	11.00		
3	<u>DESIGNED MIX FOR ORDINARY</u>				
	<u>STRUCTURAL CONCRETE SEVERE</u>				
	<u>EXPOSURE USING ORDINARY PORTLAND</u>				
	<u>CEMENT</u>				
	Supply all materials and construct the reinforced concrete foundation for the elevated pressed steel tank 50 m3 as specified and shown in the Drawing No.: THIWASCO/ELVTANK/1.0 Include for shuttering and excavation works				
3.1	Provide & Place Concrete Grade: 15 as blinding Using 20 mm aggregate	m ³	3.00		
3.2	Provide & Place Reinforced Concrete Grade: 25 Using 20 mm aggregate	m ³	18.50		
	<u>CONCRETE ANCILLARIES</u>				
	<u>FORMWORK; FAIR FINISH</u>				
	<u>Plane Vertical</u>				
3.3	Sides of base; width >0.2 ≤0.4 m.	m ²	36.00		
	<u>REINFORCEMENT</u>				
	<u>High yield steel bars</u>				
3.4	In assorted diameters: 8 mm, 10 mm, 12 mm, 16 mm	t	1.60		
4	<u>ELEVATED STEEL TANK</u>				
	Supply and erect a 50 m3 Elevated Pressed Steel tank on 20.0 m high tower. Panels configuration to be of 1.22 m square. Complete with all pipework (inlet, outlet, overflow, washout and other fittings) as specified and shown in Drawing. Submit Structural Design calculations documentation and shop drawings for approval prior to fabrication. Tower to be painted with one coat each of zinc phosphate primer and silver aluminium.				
4.1	Drawing No. THIWASCO/ELVTANK/1.0	nr	1.00		
TOTAL CARRIED FORWARD TO BILL COLLECTION SHEET					


	Construction of 50 m3 Elevated Tank in Gatunyaga - Munyu				3
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE (KShs.)	AMOUNT (KShs.)
4.2	Water level Indicator. Provide and install Tank level indicator.	nr	1.00		
	Testing of Works Water Retaining Structures				
4.3	Allow for water tightness testing of Elevated Steel Tank	nr	1.00		
5	MISCELLANEOUS The contractor is to insert hereunder a lump sum rate without providing additional descriptions hereunder for works which he considers necessary and have been omitted from the Bill of Quantities, and for which he desires to enter a separate lump sum charge. If no separate charge is entered here-under, then the rates in the Bill of Quantities are deemed to include all expenses and obligations for supplying, installing, testing and commissioning of these works.				
5.1		Sum	1.00		
TOTAL CARRIED FORWARD TO BILL COLLECTION SHEET					


		Supply and Installation of Pipeline in Gatwanyaga - Munyu			4
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT (KES)
	All rates are inclusive of all overheads and applicable taxes and duties				
2-D	DEMOLITION & SITE CLEARANCE				
	Removal from site and disposed to County Government of Kiambu (CGK) dump site				
2-D2	REMOVAL OF TREES AND STUMPS				
	<u>Removal from site and disposed</u>				
2-D212	Trees of girth: 500 mm - 1 m.,	nr	1.00		
2-D272	Stumps of diameter: 500 mm - 1m.,	nr	1.00		
2-D5	CLEARANCE OF PIPELINE WAYLEAVES, DISPOSAL AS DIRECTED				
	<u>Pipeline and access track</u>				
2-D512	Nominal bore: not exceeding 100 mm,	m	800.00		
2-I	PIPEWORK - PIPES & FITTINGS - SUPPLY OF				
2-I1	PIPES				
2-I16	<u>Supply of HDPE pipes</u>				
2-I166	<u>Plain ended electrofusion joints, standard pipe lengths</u>				
2-I195.4i	OD 90, PN 10	m	800.00		
	<u>Supply of PPR Consumer Pipes</u>				
2-I195.4c	Polypropylene pipe n.b. OD 20	m	50.00		
	<u>Two band saddle clamp stainless steel tapping sleeves c/w female threaded outlet</u>				
2-6A-I488.4i	OD 90 - Outlet OD 20	nr	5.00		
2-6A-I488.4j	OD 110 - Outlet OD 90	nr	1.00		
2-I3	FITTINGS TO HDPE PIPES				
2-I32	<u>Bends Plain Ended, butt welded joints in angles</u>				
2-I321	<u>Bends of varying curvature from 7 degrees to 90 degrees</u>				
2-I828.4i	OD 90, PN 10.	nr	5.00		
	<u>Junctions and Branches.</u>				
	<u>Tees, branch down as stated</u>				
2-I832.4j	OD 110/90, PN 10.	nr	1.00		
	<u>Main Plain ended, flanged invert level branch.</u>				
2-I848.4i	OD 90/90, PN 10.	nr	1.00		
	<u>Adaptors, detachable collars couplings & saddles</u>				
	<u>Flexible straight & stepped coupling.</u>				
2-I381.6i	DN 90, PN 16.	nr	6		
2-I9	VALVES, PENSTOCKS, HYDRANTS & METERS				
	<u>Gate valves to SSRN 226</u>				
2-I911.6d	DN 25, PN 10.	nr	2.00		
2-I911.6i	DN, 80, PN 10.	nr	2.00		
	<u>Non-return valves, double flanged</u>				
2-I941.6j	DN 100, PN 10.	nr	1.00		
	<u>Flap valves, flanged</u>				
2-I941.6i(ii)	DN, 80, PN 10.	nr	1.00		
	<u>Tripple function Anti-Surge Air Valves, flanged.</u>				
2-I959.6d	DN 25, PN 10.	nr	2.00		
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THIWASCO
Bills of Quantities

FY 2023/2024

Borehole Equipping, Construction Of Elevated
Steel Tank Pipeline In Gatunyaga - Munyu


	Supply and Installation of Pipeline in Gatunyaga - Munyu				4
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT (KES)
2-I992.6j	<u>Water meters, smart ready ultrasonic</u> DN 75, PN 10.	nr	1.00		
2-J	PIPEWORK - PIPES, SEWERS & FITTINGS - INSTALL				
2-J1	METHOD OF MEASUREMENT TYPE A IN METERS: HDPE Pipes Rates for installation of pipelines include: transportation of pipes from storage, stripping of top soil, excavation of trenches in loose soil, weathered rock and in hard rock as per Drawing No.: THIWASCO/SD/5.0, laying of pipes in trenches, jointing of pipes and backfilling of pipe trenches in compacted layers				
2-J161.2	Pipe n.b: n.e. 100 mm trenches depth n.e. 1 m.	m	800.00		
2-J2	TESTING <u>Test pressure exc.6 bar but not exc. 15 bar.</u>				
2-J211	Pipe n.b: n.e. 100 mm	m	800.00		
2-J3	STERILISATION AND FLUSHING				
2-J31	Pipe n.b.: n.e 100 mm.	m	800.00		
2-J4	METHOD OF MEASUREMENT TYPE B BY NUMBER: Fittings <u>11.25°, 22.5°, 45°, 90° Long radius Plain Ended bends</u>				
2-J421.12	Bend n.b: n.e. 100 mm trenches depth n.e. 1 m.	nr	5.00		
2-J422.12	<u>Junctions and Branches</u> Tee n.b: n.e. 100 mm trenches depth n.e. 1 m.	nr	2.00		
2-J426.11	<u>Gate, butterfly valves, penstocks, non return/flap valves</u> Pipe n.b: n.e. 100 mm Not in trenches, rate to include installation with extension spindle and valve surface box as per Drawing Number: THIWASCO_SD_11.0	nr	1.00		
2-J427.11	<u>Air valves</u> Pipe n.b: n.e. 100 mm Not in trenches/ In precast concrete chambers as per Drawing No.: THIWASCO/SD/2.0 including all fittings.	nr	2.00		
2-J428.11	<u>Meters</u> Pipe n.b: n.e. 100 mm Not in trenches/ In chambers as per Drawing No.: THIWASCO/SD/3.0 including all fittings.	nr	1.00		
2-K	PIPEWORK - MANHOLE & PIPEWORK ANCILLARIES				
2-K1	MANHOLES AND OTHER CHAMBERS IN ACCORDANCE WITH STANDARD DRAWINGS <u>In -situ concrete Valve chamber as per Drawing No.: THIWASCO/SD/10</u>				
2-K131.11	Pipe Nom. Bore n.e. 100 mm. Depth n.e. 1.5 m	nr	1.00		
2-K136.12	<u>In -situ concrete Washout valve chamber</u> <u>As per Drawing No.: THIWASCO/SD/13.0</u> Pipe n.b: n.e exc. 100 mm depth 1.5 - 2 m.	nr	1.00		
PAGE TOTAL CARRIED FORWARD TO SECTION COLLECTION SHEET					


		Supply and Installation of Pipeline in Gatuaryaga - Munyu			4
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT (KES)
2-K139.12	<u>In -situ concrete outfall structure</u> <u>As per Drawing No.: THIWASCO/SD/13.0</u> Pipe n.b: n.e exc. 100 mm depth 1.5 - 2 m.	nr	1.00		
2-K151.11	<u>Precast concrete Valve chamber</u> <u>As per Drawing No.: THIWASCO/SD/2.0</u> Pipe Nom. Bore n.e. 100 mm. Depth n.e. 1.5 m	nr	2.00		
2-K2	CONCRETE MANHOLE COVERS				
2-K253	<u>Precast concrete cover</u> Area: 0.5 - 1 m ² as per Drawings	nr	3.00		
2-K6	CROSSINGS				
2-K7	REINSTATEMENT Temporary breaking up and permanent reinstatement of surfaced roads, pipe nominal bore not exceeding. 250 mm.	m	10.00		
2-K8	OTHER PIPEWORK ANCILLARIES				
2-K821.2	<u>Marker Posts for valves</u> in accordance with general drawings.	nr	3.00		
2-K822.2	<u>Marker Posts for Air Valves</u> in accordance with general drawings.	nr	2.00		
2-K824.2	<u>Marker Posts for Washouts</u> in accordance with general drawings.	nr	1.00		
2-K825.2	<u>Marker Posts for Pipelines</u> in accordance with general drawings.	nr	4.00		
2-L	PIPEWORK-SUPPORTS AND PROTECTION				
2-L1	ANCILLARIES TO LAYING AND EXCAVATION EXTRAS TO EXCAVATION AND BACKFILLING <u>In pipe trenches excavation not covered under installation of new pipelines</u>				
2-L111	of hard rock class I material.	m ³	54.00		
2-L112	of altered and weathered rock class II material.	m ³	81.00		
2-L117	with class S2 material.	m ³	97.20		
2-L3	BEDS				
2-L323	<u>Bedding Material</u> In pipe trenches lower bedding as per Drawing No.: THIWASCO/SD/5.0 with blended imported and screened class S2 material.	m ³	54.00		
2-L5	SURROUNDS				
2-L521	<u>Surround Material</u> In pipe trenches Selected granular material as per Drawing No.: THIWASCO/SD/5.0 with blended imported and screened Pipe n.b. n.e. 100 mm	m ³	108.00		
2-L7	CONCRETE STOOLS AND THRUST BLOCKS CONCRETE CLASS 25 Asp per Standard Drawings <u>To bends. Volume: 0.5 - 2 m³, nom.</u>	nr	5.00		
2-L714.1	Pipe n.b. n.e. 100 mm	nr			
2-L725.1	<u>To junctions/tees. Volume: 0.5 - 2 m³, nom.</u> Pipe n.b. n.e. 100 mm	nr	2.00		
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THIWASCO
Bills of Quantities

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Borehole Equipping, Construction Of Elevated
Steel Tank Pipeline In Gatunyaga - Munyu

	Supply and Installation of Pipeline in Gatunyaga - Munyu				4
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT (KES)
2-L726.1	Valve & Taper stools. Volume 0.1-0.5 m³ Pipe n.b. n.e. 100 mm	nr	1.00		
2-X	MISCELLANEOUS				
2-X9	OTHER				
2-X9.1	Pigmented low density polyethylene and Aluminium foil in a bright colour continuously labelled "DANGER HDPE PIPE" in English and Swahili. For road crossings.	m	30.00		
	<u>Tee Keys for valve operation</u>				
2-X9.2	Provide Tee keys for the operation of Sluice valves. Length = 600 - 3000mm c/w tapered handle tip for surface box opening. Keys to suit extended spindle top provided.	nr	1.00		
2-X9.3	<u>Chamber cover lifting apparatus</u> As per General Drawings.	nr	1.00		
2-X9.4	<u>Supply Denso paste/tape</u> For all fittings	Sum	1.00		
	Consumer connections				
2-X9.5	For connection of existing consumers Contractor's rate to include supply and installation of compression fittings as per Standard Drawing including 90° Male HDPE Bend OD 20, 90° HDPE Bend OD 20, All Flanged Tee HDPE OD 20, HDPE - BPT adaptor (OD 20 - OD 20), Universal connector OD 20 and transfer of consumer meter connection from old pipeline to new pipeline	nr	5.00		
PAGE TOTAL CARRIED FORWARD TO SECTION COLLECTION SHEET					

	Supply and Installation of Pipeline in Gatuanyaga - Munyu				4
ITEM No.	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT (KES)
<div>COLLECTION SHEET</div> <div>PAGE NO.</div> <div>1</div> <div>2</div> <div>3</div> <div>4</div>					
TOTAL CARRIED TO GRAND SUMMARY					-

PART III - CONDITIONS OF CONTRACT AND CONTRACT FORMS

SECTION VIII - GENERAL CONDITIONS OF CONTRACT

These General Conditions of Contract (GCC), read in conjunction with the Special Conditions of Contract (SCC) and other documents listed therein, should be a complete document expressing fairly the rights and obligations of both parties.

These General Conditions of Contract have been developed on the basis of considerable international experience in the drafting and management of contracts, bearing in mind a trend in the construction industry towards simpler, more straightforward language.

The GCC can be used for both smaller admeasurement contracts and lump sum contracts.

General Conditions of Contract

A. General

1. Definitions

1.1 Bold face type is used to identify defined terms.

- a) **The Accepted Contract Amount** means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects.
- b) **The Activity Schedule** is a schedule of the activities comprising the construction, installation, testing, and commissioning of the Works in a lump sum contract. It includes a lump sum price for each activity, which is used for valuations and for assessing the effects of Variations and Compensation Events.
- c) **The Adjudicator** is the person appointed jointly by the Procuring Entity and the Contractor to resolve disputes in the first instance, as provided for in GCC 23.
- d) **Bill of Quantities** means the priced and completed Bill of Quantities forming part of the Bid.
- e) **Compensation Events** are those defined in GCC Clause 42 hereunder.
- f) **The Completion Date** is the date of completion of the Works as certified by the Project Manager, in accordance with GCC Sub-Clause 53.1.
- g) **The Contract** is the Contract between the Procuring Entity and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in GCC Sub-Clause 2.3 below.
- h) **The Contractor** is the party whose Bid to carry out the Works has been accepted by the Procuring Entity.
- i) **The Contractor's Bid** is the completed bidding document submitted by the Contractor to the Procuring Entity.
- j) **The Contract Price** is the Accepted Contract Amount stated in the Letter of Acceptance and thereafter as adjusted in accordance with the Contract.
- k) **Days** are calendar days; months are calendar months.
- l) **Day works** are varied work inputs subject to payment on a time basis for the Contractor's employees and Equipment, in addition to payments for associated Materials and Plant.
- m) **A Defect** is any part of the Works not completed in accordance with the Contract.
- n) **The Defects Liability Certificate** is the certificate issued by Project Manager upon correction of defects by the Contractor.
- o) **The Defects Liability Period** is the period **named in the SCC** pursuant to Sub-Clause 34.1 and calculated from the Completion Date.
- p) **Drawings** means the drawings of the Works, as included in the Contract, and any additional and modified drawings issued by (or on behalf of) the Procuring Entity in accordance with the Contract, include calculations and other information provided or approved by the Project Manager for the execution of the Contract.
- q) **The Procuring Entity** is the party who employs the Contractor to carry out the Works, **as specified in the SCC**, who is also the Procuring Entity.
- r) **Equipment** is the Contractor's machinery and vehicles brought temporarily to the Site to construct the

- s) **“In writing” or “written”** means hand-written, type-written, printed or electronically made, and resulting in a permanent record;
- t) The Initial Contract Price is the Contract Price listed in the Procuring Entity's Letter of Acceptance.
- u) **The Intended Completion Date** is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is **specified in the SCC**. The Intended Completion Date may be revised only by the Project Manager by issuing an extension of time or an acceleration order.
- v) **Materials** are all supplies, including consumables, used by the Contractor for incorporation in the Works.
- w) **Plant** is any integral part of the Works that shall have a mechanical, electrical, chemical, or biological function.
- x) **The Project Manager** is the person **named in the SCC** (or any other competent person appointed by the Procuring Entity and notified to the Contractor, to act in replacement of the Project Manager) who is responsible for supervising the execution of the Works and administering the Contract.
- y) **SCC** means Special Conditions of Contract.
- z) **The Site** is the area of the works as **defined as such in the SCC**.
- aa) **Site Investigation Reports** are those that were included in the bidding document and are factual and interpretative reports about the surface and subsurface conditions at the Site.
- bb) **Specification** means the Specification of the Works included in the Contract and any modification or addition made or approved by the Project Manager.
- cc) **The Start Date** is **given in the SCC**. It is the latest date when the Contractor shall commence execution of the Works. It does not necessarily coincide with any of the Site Possession Dates.
- dd) **A Subcontractor** is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract, which includes work on the Site.
- ee) **Temporary Works** are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.
- ff) **A Variation** is an instruction given by the Project Manager which varies the Works.
- gg) **The Works** are what the Contract requires the Contractor to construct, install, and turn over to the Procuring Entity, **as defined in the SCC**.

2 Interpretation

- 21 In interpreting these GCC, words indicating one gender include all genders. Words indicating the singular also include the plural and words indicating the plural also include the singular. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Project Manager shall provide instructions clarifying queries about these GCC.
- 22 If sectional completion is specified in the SCC, references in the GCC to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).
- 23 The documents forming the Contract shall be interpreted in the following order of priority:
 - a) Agreement,
 - b) Letter of Acceptance,
 - c) Contractor's Bid,
 - d) Special Conditions of Contract,
 - e) General Conditions of Contract, including Appendices,
 - f) Specifications,
 - g) Drawings,
 - h) Bill of Quantities⁶, and
 - i) any other document **listed in the SCC** as forming part of the Contract.

⁶*In lump sum contracts, delete “Bill of Quantities” and replace with “Activity Schedule.”*

3. Language and Law

- 3.1 The language of the Contract is English Language and the law governing the Contract are the Laws of Kenya.
- 3.2 Throughout the execution of the Contract, the Contractor shall comply with the import of goods and services prohibitions in the Procuring Entity's Country when
 - a) as a matter of law or official regulations, Kenya prohibits commercial relations with that country; or
 - b) by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, Kenya prohibits any import of goods from that country or any payments to any country, person, or entity in that country.

4. Project Manager's Decisions

- 4.1 Except where otherwise specifically stated, the Project Manager shall decide contractual matters between the Procuring Entity and the Contractor in the role representing the Procuring Entity.

5. Delegation

- 5.1 Otherwise **specified in the SCC**, the Project Manager may delegate any of his duties and responsibilities to other people, except to the Adjudicator, after notifying the Contractor, and may revoke any delegation after notifying the Contractor.

6. Communications

- 6.1 Communications between parties that are referred to in the Conditions shall be effective only when in writing. A notice shall be effective only when it is delivered.

7. Subcontracting

- 7.1 The Contractor may subcontract with the approval of the Project Manager, but may not assign the Contract without the approval of the Procuring Entity in writing. Subcontracting shall not alter the Contractor's obligations.

8. Other Contractors

- 8.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Procuring Entity between the dates given in the Schedule of Other Contractors, as **referred to in the SCC**. The Contractor shall also provide facilities and services for them as described in the Schedule. The Procuring Entity may modify the Schedule of Other Contractors, and shall notify the Contractor of any such modification.

9. Personnel and Equipment

- 9.1 The Contractor shall employ the key personnel and use the equipment identified in its Bid, to carry out the Works or other personnel and equipment approved by the Project Manager. The Project Manager shall approve any proposed replacement of key personnel and equipment only if their relevant qualifications or characteristics are substantially equal to or better than those proposed in the Bid.
- 9.2 If the Project Manager asks the Contractor to remove a person who is a member of the Contractor's staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract.
- 9.3 If the Procuring Entity, Project Manager or Contractor determines, that any employee of the Contractor be determined to have engaged in Fraud and Corruption during the execution of the Works, then that employee shall be removed in accordance with Clause 9.2 above.

10. Procuring Entity's and Contractor's Risks

- 10.1 The Procuring Entity carries the risks which this Contract states are Procuring Entity's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.

11. Procuring Entity's Risks

11.1 From the Start Date until the Defects Liability Certificate has been issued, the following are Procuring Entity's risks:

- a) The risk of personal injury, death, or loss of or damage to property (excluding the Works, Plant, Materials, and Equipment), which are due to
 - i) use or occupation of the Site by the Works or for the purpose of the Works, which is the unavoidable result of the Works or
 - ii) negligence, breach of statutory duty, or interference with any legal right by the Procuring Entity or by any person employed by or contracted to him except the Contractor.
- b) The risk of damage to the Works, Plant, Materials, and Equipment to the extent that it is due to a fault of the Procuring Entity or in the Procuring Entity's design, or due to war or radioactive contamination directly affecting the country where the Works are to be executed.

11.2 From the Completion Date until the Defects Liability Certificate has been issued, the risk of loss of or damage to the Works, Plant, and Materials is a Procuring Entity's risk except loss or damage due to

- aa) a Defect which existed on the Completion Date,
- bb) an event occurring before the Completion Date, which was not itself a Procuring Entity's risk, or
- cc) the activities of the Contractor on the Site after the Completion Date.

12. Contractor's Risks

12.1 From the Starting Date until the Defects Liability Certificate has been issued, the risks of personal injury, death, and loss of or damage to property (including, without limitation, the Works, Plant, Materials, and Equipment) which are not Procuring Entity's risks are Contractor's risks.

13. Insurance

13.1 The Contractor shall provide, in the joint names of the Procuring Entity and the Contractor, insurance cover from the Start Date to the end of the Defects Liability Period, in the amounts and deductibles **stated in the SCC** for the following events which are due to the Contractor's risks:

- a) loss of or damage to the Works, Plant, and Materials;
- b) loss of or damage to Equipment;
- c) loss of or damage to property (except the Works, Plant, Materials, and Equipment) in connection with the Contract; and
- d) personal injury or death.

13.2 Policies and certificates for insurance shall be delivered by the Contractor to the Project Manager for the Project Manager's approval before the Start Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

13.3 If the Contractor does not provide any of the policies and certificates required, the Procuring Entity may effect the insurance which the Contractor should have provided and recover the premiums the Procuring Entity has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.

13.4 Alterations to the terms of an insurance shall not be made without the approval of the Project Manager.

13.5 Both parties shall comply with any conditions of the insurance policies.

14. Site Data

14.1 The Contractor shall be deemed to have examined any Site Data **referred to in the SCC**, supplemented by any information available to the Contractor.

15. Contractor to Construct the Works

15.1 The Contractor shall construct and install the Works in accordance with the Specifications and Drawings.

16. The Works to Be Completed by the Intended Completion Date

16.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Program submitted by the Contractor, as updated with the approval of the Project Manager, and complete them by the Intended Completion Date.

17. Approval by the Project Manager

17.1 The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Project Manager, for his approval.

17.2 The Contractor shall be responsible for design of Temporary Works.

17.3 The Project Manager's approval shall not alter the Contractor's responsibility for design of the Temporary Works.

17.4 The Contractor shall obtain approval of third parties to the design of the Temporary Works, where required.

17.5 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Project Manager before this use.

18. Safety

18.1 The Contractor shall be responsible for the safety of all activities on the Site.

19. Discoveries

19.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site shall be the property of the Procuring Entity. The Contractor shall notify the Project Manager of such discoveries and carry out the Project Manager's instructions for dealing with them.

20. Possession of the Site

20.1 The Procuring Entity shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date **stated in the SCC**, the Procuring Entity shall be deemed to have delayed the start of the relevant activities, and this shall be a Compensation Event.

21. Access to the Site

21.1 The Contractor shall allow the Project Manager and any person authorized by the Project Manager access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.

22. Instructions, Inspections and Audits

22.1 The Contractor shall carry out all instructions of the Project Manager which comply with the applicable laws where the Site is located.

22.2 The Contractor shall keep, and shall make all reasonable efforts to cause its Subcontractors and sub-consultants to keep, accurate and systematic accounts and records in respect of the Works in such form and details as will clearly identify relevant time changes and costs.

22.3 The Contractor shall permit and shall cause its subcontractors and sub-consultants to permit, the Procuring Entity and/or persons appointed by the Public Procurement Regulatory Authority to inspect the Site and/or the accounts and records relating to the procurement process, selection and/or contract execution, and to have such accounts and records audited by auditors appointed by the Public Procurement Regulatory Authority. The Contractor's and its Subcontractors' and sub-consultants' attention is drawn to Sub-Clause 25.1 (Fraud and Corruption) which provides, inter alia, that acts intended to materially impede the exercise of the Public Procurement Regulatory Authority's inspection and audit rights constitute a prohibited practice subject to contract termination (as well as to a determination of ineligibility pursuant to the Public Procurement Regulatory Authority's prevailing sanctions procedures).

23 Appointment of the Adjudicator

- 23.1 The Adjudicator shall be appointed jointly by the Procuring Entity and the Contractor, at the time of the Procuring Entity's issuance of the Letter of Acceptance. If, in the Letter of Acceptance, the Procuring Entity does not agree on the appointment of the Adjudicator, the Procuring Entity will request the Appointing Authority designated in the SCC, to appoint the Adjudicator within 14 days of receipt of such request.
- 23.2 Should the Adjudicator resign or die, or should the Procuring Entity and the Contractor agree that the Adjudicator is not functioning in accordance with the provisions of the Contract, a new Adjudicator shall be jointly appointed by the Procuring Entity and the Contractor. In case of disagreement between the Procuring Entity and the Contractor, within 30 days, the Adjudicator shall be designated by the Appointing Authority designated in the SCC at the request of either party, within 14 days of receipt of such request.

24 Settlement of Claims and Disputes**24.1 Contractor's Claims**

- 24.1.1 If the Contractor considers itself to be entitled to any extension of the Time for Completion and/or any additional payment, under any Clause of these Conditions or otherwise in connection with the Contract, the Contractor shall give Notice to the Project Manager, describing the event or circumstance giving rise to the claim. The notice shall be given as soon as practicable, and not later than 30 days after the Contractor became aware, or should have become aware, of the event or circumstance.
- 24.1.2 If the Contractor fails to give notice of a claim within such period of 30 days, the Time for Completion shall not be extended, the Contractor shall not be entitled to additional payment, and the Procuring Entity shall be discharged from all liability in connection with the claim. Otherwise, the following provisions of this Sub- Clause shall apply.
- 24.1.3 The Contractor shall also submit any other notices which are required by the Contract, and supporting particulars for the claim, all as relevant to such event or circumstance.
- 24.1.4 The Contractor shall keep such contemporary records as may be necessary to substantiate any claim, either on the Site or at another location acceptable to the Project Manager. Without admitting the Procuring Entity's liability, the Project Manager may, after receiving any notice under this Sub-Clause, monitor the record- keeping and/or instruct the Contractor to keep further contemporary records. The Contractor shall permit the Project Manager to inspect all these records, and shall (if instructed) submit copies to the Project Manager.
- 24.1.5 Within 42 days after the Contractor became aware (or should have become aware) of the event or circumstance giving rise to the claim, or within such other period as may be proposed by the Contractor and approved by the Project Manager, the Contractor shall send to the Project Manager a fully detailed claim which includes full supporting particulars of the basis of the claim and of the extension of time and/or additional payment claimed. If the event or circumstance giving rise to the claim has a continuing effect:
- a) this fully detailed claim shall be considered as interim;
 - b) the Contractor shall send further interim claims at monthly intervals, giving the accumulated delay and/or amount claimed, and such further particulars as the Project Manager may reasonably require; and
 - c) the Contractor shall send a final claim within 30 days after the end of the effects resulting from the event or circumstance, or within such other period as may be proposed by the Contractor and approved by the Project Manager.
- 24.1.6 Within 42 days after receiving a Notice of a claim or any further particulars supporting a previous claim, or within such other period as may be proposed by the Project Manager and approved by the Contractor, the Project Manager shall respond with approval, or with disapproval and detailed comments. He may also request any necessary further particulars, but shall nevertheless give his response on the principles of the claim within the above defined time period.
- 24.1.7 Within the above defined period of 42 days, the Project Manager shall proceed in accordance with Sub-Clause
- 24.1.8 [Determinations] to agree or determine (i) the extension (if any) of the Time for Completion (before or

after its expiry) in accordance with Sub-Clause 8.4 [Extension of Time for Completion], and/or (ii) the additional payment (if any) to which the Contractor is entitled under the Contract.

24.1.9 Each Payment Certificate shall include such additional payment for any claim as has been reasonably substantiated as due under the relevant provision of the Contract. Unless and until the particulars supplied are sufficient to substantiate the whole of the claim, the Contractor shall only be entitled to payment for such part of the claim as he has been able to substantiate.

24.1.10 If the Project Manager does not respond within the timeframe defined in this Clause, either Party may consider that the claim is rejected by the Project Manager and any of the Parties may refer to Arbitration in accordance with Sub-Clause 24.4 [Arbitration].

24.1.11 The requirements of this Sub-Clause are in addition to those of any other Sub-Clause which may apply to a claim. If the Contractor fails to comply with this or another Sub-Clause in relation to any claim, any extension of time and/or additional payment shall take account of the extent (if any) to which the failure has prevented or prejudiced proper investigation of the claim, unless the claim is excluded under the second paragraph of this Sub-Clause 24.3.

242 Amicable Settlement

24.1.1 Where a notice of a claim has been given, both Parties shall attempt to settle the dispute amicably before the commencement of arbitration. However, unless both Parties agree otherwise, the Party giving a notice of a claim in accordance with Sub-Clause 24.1 above should move to commence arbitration after the fifty-sixth day from the day on which a notice of a claim was given, even if no attempt at an amicable settlement has been made.

243 Matters that may be referred to arbitration

24.3.1 Notwithstanding anything stated herein the following matters may be referred to arbitration before the practical completion of the Works or abandonment of the Works or termination of the Contract by either party:

- a) The appointment of a replacement Project Manager upon the said person ceasing to act.
- b) Whether or not the issue of an instruction by the Project Manager is empowered by these Conditions.
- c) Whether or not a certificate has been improperly withheld or is not in accordance with these Conditions.
- e) Any dispute arising in respect of war risks or war damage.
- f) All other matters shall only be referred to arbitration after the completion or alleged completion of the Works or termination or alleged termination of the Contract, unless the Procuring Entity and the Contractor agree otherwise in writing.

244 Arbitration

24.4.1 Any claim or dispute between the Parties arising out of or in connection with the Contract not settled amicably in accordance with Sub-Clause 24.3 shall be finally settled by arbitration.

24.4.2 No arbitration proceedings shall be commenced on any claim or dispute where notice of a claim or dispute has not been given by the applying party within ninety days of the occurrence or discovery of the matter or issue giving rise to the dispute.

24.4.3 Notwithstanding the issue of a notice as stated above, the arbitration of such a claim or dispute shall not commence unless an attempt has in the first instance been made by the parties to settle such claim or dispute amicably with or without the assistance of third parties. Proof of such attempt shall be required.

24.4.4 The Arbitrator shall, without prejudice to the generality of his powers, have powers to direct such measurements, computations, tests or valuations as may in his opinion be desirable in order to determine the rights of the parties and assess and award any sums which ought to have been the subject of or included in any certificate.

24.4.5 The Arbitrator shall, without prejudice to the generality of his powers, have powers to open up, review and revise any certificate, opinion, decision, requirement or notice and to determine all matters in dispute which shall be submitted to him in the same manner as if no such certificate, opinion, decision requirement or notice had been given.

24.4.6 The arbitrators shall have full power to open up, review and revise any certificate, determination, instruction, opinion or valuation of the Project Manager, relevant to the dispute. Nothing shall disqualify representatives of the Parties and the Project Manager from being called as a witness and giving evidence

before the arbitrators on any matter whatsoever relevant to the dispute.

- 24.4.7 Neither Party shall be limited in the proceedings before the arbitrators to the evidence, or to the reasons for dissatisfaction given in its Notice of Dissatisfaction.
- 24.4.8 Arbitration may be commenced prior to or after completion of the Works. The obligations of the Parties, and the Project Manager shall not be altered by reason of any arbitration being conducted during the progress of the Works.
- 24.4.9 The terms of the remuneration of each or all the members of Arbitration shall be mutually agreed upon by the Parties when agreeing the terms of appointment. Each Party shall be responsible for paying one-half of this remuneration.

245 Arbitration with National Contractors

- 24.5.1 If the Contract is with national contractors, arbitration proceedings will be conducted in accordance with the Arbitration Laws of Kenya. In case of any claim or dispute, such claim or dispute shall be notified in writing by either party to the other with a request to submit it to arbitration and to concur in the appointment of an Arbitrator within thirty days of the notice. The dispute shall be referred to the arbitration and final decision of a person to be agreed between the parties. Failing agreement to concur in the appointment of an Arbitrator, the Arbitrator shall be appointed, on the request of the applying party, by the Chairman or Vice Chairman of any of the following professional institutions;
- i) Architectural Association of Kenya
 - ii) Institute of Quantity Surveyors of Kenya
 - iii) Association of Consulting Engineers of Kenya
 - iv) Chartered Institute of Arbitrators (Kenya Branch)
 - v) Institution of Engineers of Kenya

- 24.5.2 The institution written to first by the aggrieved party shall take precedence over all other institutions.

246 Alternative Arbitration Proceedings

- 24.6.1 Alternatively, the Parties may refer the matter to the Nairobi Centre for International Arbitration (NCIA) which offers a neutral venue for the conduct of national and international arbitration with commitment to providing institutional support to the arbitral process.

247 Failure to Comply with Arbitrator's Decision

- 24.7.1 The award of such Arbitrator shall be final and binding upon the parties.
- 24.7.2 In the event that a Party fails to comply with a final and binding Arbitrator's decision, then the other Party may, without prejudice to any other rights it may have, refer the matter to a competent court of law.

248 Contract operations to continue

- 24.8.1 Notwithstanding any reference to arbitration herein,
- a) the parties shall continue to perform their respective obligations under the Contract unless they otherwise agree; and
 - b) the Procuring Entity shall pay the Contractor any monies due the Contractor.

25. Fraud and Corruption

- 25.1 The Government requires compliance with the country's Anti-Corruption laws and its prevailing sanctions policies and procedures as set forth in the Constitution of Kenya and its Statutes.
- 25.2 The Procuring Entity requires the Contractor to disclose any commissions or fees that may have been paid or are to be paid to agents or any other party with respect to the bidding process or execution of the Contract. The information disclosed must include at least the name and address of the agent or other party, the amount and currency, and the purpose of the commission, gratuity or fee.

B. Time Control

26. Program

- 26.1 Within the time stated in the SCC, after the date of the Letter of Acceptance, the Contractor shall submit to the Project Manager for approval a Program showing the general methods, arrangements, order, and timing

for all the activities in the Works. In the case of a lump sum contract, the activities in the Program shall be consistent with those in the Activity Schedule.

262 An update of the Program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities.

263 The Contractor shall submit to the Project Manager for approval an updated Program at intervals no longer than the period stated in the SCC. If the Contractor does not submit an updated Program within this period, the Project Manager may withhold the amount stated in the SCC from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program has been submitted. In the case of a lump sum contract, the Contractor shall provide an updated Activity Schedule within 14 days of being instructed to by the Project Manager.

264 The Project Manager's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Project Manager again at any time. A revised Program shall show the effect of Variations and Compensation Events.

27. Extension of the Intended Completion Date

27.1 The Project Manager shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining work, which would cause the Contractor to incur additional cost.

27.2 The Project Manager shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Project Manager for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

28. Acceleration

28.1 When the Procuring Entity wants the Contractor to finish before the Intended Completion Date, the Project Manager shall obtain priced proposals for achieving the necessary acceleration from the Contractor. If the Procuring Entity accepts these proposals, the Intended Completion Date shall be adjusted accordingly and confirmed by both the Procuring Entity and the Contractor.

28.2 If the Contractor's priced proposals for an acceleration are accepted by the Procuring Entity, they are incorporated in the Contract Price and treated as a Variation.

29. Delays Ordered by the Project Manager

29.1 The Project Manager may instruct the Contractor to delay the start or progress of any activity within the Works.

30. Management Meetings

30.1 Either the Project Manager or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.

30.2 The Project Manager shall record the business of management meetings and provide copies of the record to those attending the meeting and to the Procuring Entity. The responsibility of the parties for actions to be taken shall be decided by the Project Manager either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

31. Early Warning

31.1 The Contractor shall warn the Project Manager at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price, or delay the execution of the Works. The Project Manager may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate

- 31.2 The Contractor shall cooperate with the Project Manager in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Project Manager.

C. Quality Control

32. Identifying Defects

- 32.1 The Project Manager shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Project Manager may instruct the Contractor to search for a Defect and to uncover and test any work that the Project Manager considers may have a Defect.

33. Tests

- 33.1 If the Project Manager instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect, the test shall be a Compensation Event.

34. Correction of Defects

- 34.1 The Project Manager shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion, and is defined in the SCC. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.
- 34.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Project Manager's notice.

35. Uncorrected Defects

- 35.1 If the Contractor has not corrected a Defect within the time specified in the Project Manager's notice, the Project Manager shall assess the cost of having the Defect corrected, and the Contractor shall pay this amount.

D. Cost Control

36. Contract Price⁷

- 36.1 The Bill of Quantities shall contain priced items for the Works to be performed by the Contractor. The Bill of Quantities is used to calculate the Contract Price. The Contractor will be paid for the quantity of the work accomplished at the rate in the Bill of Quantities for each item.

37. Changes in the Contract Price⁸

- 37.1 If the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item by more than 25 percent, provided the change exceeds 1 percent of the Initial Contract Price, the Project Manager shall adjust the rate to allow for the change. The Project Manager shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than 15 percent, except with the prior approval of the Procuring Entity.
- 37.2 If requested by the Project Manager, the Contractor shall provide the Project Manager with a detailed cost breakdown of any rate in the Bill of Quantities.

38. Variations

- 38.1 All Variations shall be included in updated Programs⁹ produced by the Contractor.
- 38.2 The Contractor shall provide the Project Manager with a quotation for carrying out the Variation when requested to do so by the Project Manager. The Project Manager shall assess the quotation, which shall be given within seven (7) days of the request or within any longer period stated by the Project Manager and before the Variation is ordered.
- 38.3 If the Contractor's quotation is unreasonable, the Project Manager may order the Variation and make a

change to the Contract Price, which shall be based on the Project Manager's own forecast of the effects of the Variation on the Contractor's costs.

384 If the Project Manager decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a Compensation Event.

⁷In lump sum contracts, replace GCC Sub-Clauses 36.1 as follows:

36.1 The Contractor shall provide updated Activity Schedules within 14 days of being instructed to by the Project Manager. The Activity Schedule shall contain the priced activities for the Works to be performed by the Contractor. The Activity Schedule is used to monitor and control the performance of activities on which basis the Contractor will be paid. If payment for materials on site shall be made separately, the Contractor shall show delivery of Materials to the Site separately on the Activity Schedule.

⁸In lump sum contracts, replace entire GCC Clause 37 with new GCC Sub-Clause 37.1, as follows:

The Activity Schedule shall be amended by the Contractor to accommodate changes of Program or method of working made at the Contractor's own discretion. Prices in the Activity Schedule shall not be altered when the Contractor makes such changes to the Activity Schedule.

⁹In lump sum contracts, add "and Activity Schedules" after "Programs." ¹⁰In lump sum contracts, delete this paragraph.

385 The Contractor shall not be entitled to additional payment for costs that could have been avoided by giving early warning

386 If the work in the Variation corresponds to an item description in the Bill of Quantities and if, in the opinion of the Project Manager, the quantity of work above the limit stated in Sub-Clause 39.1 or the timing of its execution do not cause the cost per unit of quantity to change, the rate in the Bill of Quantities shall be used to calculate the value of the Variation. If the cost per unit of quantity changes, or if the nature or timing of the work in the Variation does not correspond with items in the Bill of Quantities, the quotation by the Contractor shall be in the form of new rates for the relevant items of work

387 Value Engineering: The Contractor may prepare, at its own cost, a value engineering proposal at any time during the performance of the contract. The value engineering proposal shall, at a minimum, include the following;

- a) the proposed change(s), and a description of the difference to the existing contract requirements;
- b) a full cost/benefit analysis of the proposed change(s) including a description and estimate of costs (including life cycle costs) the Procuring Entity may incur in implementing the value engineering proposal; and
- c) a description of any effect(s) of the change on performance/functionality.

388 The Procuring Entity may accept the value engineering proposal if the proposal demonstrates benefits that:

- a) accelerate the contract completion period; or
- b) reduce the Contract Price or the life cycle costs to the Procuring Entity; or
- c) improve the quality, efficiency, safety or sustainability of the Facilities; or
- d) yield any other benefits to the Procuring Entity, without compromising the functionality of the Works.

389 If the value engineering proposal is approved by the Procuring Entity and results in:

- a) a reduction of the Contract Price; the amount to be paid to the Contractor shall be the **percentage specified in the SCC** of the reduction in the Contract Price; or
- b) an increase in the Contract Price; but results in a reduction in life cycle costs due to any benefit described in (a) to (d) above, the amount to be paid to the Contractor shall be the full increase in the Contract Price.

39. Cash Flow Forecasts

39.1 When the Program¹¹, is updated, the Contractor shall provide the Project Manager with an updated cash flow forecast. The cash flow forecast shall include different currencies, as defined in the Contract, converted as necessary using the Contract exchange rates.

40. Payment Certificates

40.1 The Contractor shall submit to the Project Manager monthly statements of the estimated value of the work executed less the cumulative amount certified previously.

- 402 The Project Manager shall check the Contractor's monthly statement and certify the amount to be paid to the Contractor.
- 403 The value of work executed shall be determined by the Project Manager.
- 404 The value of work executed shall comprise the value of the quantities of work in the Bill of Quantities that have been completed¹².
- 405 The value of work executed shall include the valuation of Variations and Compensation Events.
- 406 The Project Manager may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.
- 407 Where the contract price is different from the corrected tender price, in order to ensure the contractor is not paid less or more relative to the contract price (which would be the tender price), payment valuation certificates and variation orders on omissions and additions valued based on rates in the Bill of Quantities or schedule of rates in the Tender, will be adjusted by a plus or minus percentage. The percentage already worked out during tender evaluation is worked out as follows: $(\text{corrected tender price} - \text{tender price}) / \text{tender price} \times 100$.

41. Payments

- 41.1 Payments shall be adjusted for deductions for advance payments and retention. The Procuring Entity shall pay the Contractor the amounts certified by the Project Manager within 30 days of the date of each certificate. If the Procuring Entity makes a late payment, the Contractor shall be paid interest on the late payment in the next payment. Interest shall be calculated from the date by which the payment should have been made up to the date when the late payment is made at the prevailing rate of interest for commercial borrowing for each of the currencies in which payments are made.
- 41.2 If an amount certified is increased in a later certificate or as a result of an award by the Adjudicator or an Arbitrator, the Contractor shall be paid interest upon the delayed payment as set out in this clause. Interest shall be calculated from the date upon which the increased amount would have been certified in the absence of dispute.
- 41.3 Unless otherwise stated, all payments and deductions shall be paid or charged in the proportions of currencies comprising the Contract Price.
- 41.4 Items of the Works for which no rate or price has been entered in shall not be paid for by the Procuring Entity and shall be deemed covered by other rates and prices in the Contract.

42. Compensation Events

- 42.1 The following shall be Compensation Events:
- d) The Procuring Entity does not give access to a part of the Site by the Site Possession Date pursuant to GCC Sub-Clause 20.1.
 - e) The Procuring Entity modifies the Schedule of Other Contractors in a way that affects the work of the Contractor under the Contract.
 - f) The Project Manager orders a delay or does not issue Drawings, Specifications, or instructions required for execution of the Works on time.
 - g) The Project Manager instructs the Contractor to uncover or to carry out additional tests upon work, which is then found to have no Defects.
 - h) The Project Manager unreasonably does not approve a subcontract to be let.
 - i) Ground conditions are substantially more adverse than could reasonably have been assumed before issuance of the Letter of Acceptance from the information issued to bidders (including the Site Investigation Reports), from information available publicly and from a visual inspection of the Site.
 - j) The Project Manager gives an instruction for dealing with an unforeseen condition, caused by the Procuring Entity, or additional work required for safety or other reasons.
 - k) Other contractors, public authorities, utilities, or the Procuring Entity does not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor.
 - l) The advance payment is delayed.
 - m) The effects on the Contractor of any of the Procuring Entity's Risks.

n) The Project Manager unreasonably delays issuing a Certificate of Completion.

422 If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date shall be extended. The Project Manager shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

423 As soon as information demonstrating the effect of each Compensation Event upon the Contractor's forecast cost has been provided by the Contractor, it shall be assessed by the Project Manager, and the Contract Price shall be adjusted accordingly. If the Contractor's forecast is deemed unreasonable, the Project Manager shall adjust the Contract Price based on the Project Manager's own forecast. The Project Manager shall assume that the Contractor shall react competently and promptly to the event.

¹¹In lump sum contracts, add "or Activity Schedule" after "Program."

¹²In lump sum contracts, replace this paragraph with the following: "The value of work executed shall comprise the value of completed activities in the Activity Schedule."

424 The Contractor shall not be entitled to compensation to the extent that the Procuring Entity's interests are adversely affected by the Contractor's not having given early warning or not having cooperated with the Project Manager.

43. Tax

43.1 The Project Manager shall adjust the Contract Price if taxes, duties, and other levies are changed between the date 30 days before the submission of bids for the Contract and the date of the last Completion certificate. The adjustment shall be the change in the amount of tax payable by the Contractor, provided such changes are not already reflected in the Contract Price or are a result of GCC Clause 44.

44. Currency of Payment

44.1 All payments under the contract shall be made in Kenya Shillings

45. Price Adjustment

45.1 Prices shall be adjusted for fluctuations in the cost of inputs only if **provided for in the SCC**. If so provided, the amounts certified in each payment certificate, before deducting for Advance Payment, shall be adjusted by applying the respective price adjustment factor to the payment amounts due in each currency. A separate formula of the type specified below applies:

$$P = A + B \text{ Im/Io}$$

where:

the Contract Price payable.

P is the adjustment factor for the portion of

A and B are coefficients¹³ **specified in the SCC**, representing the non-adjustable and adjustable portions, respectively, of the Contract Price payable and Im is the index prevailing at the end of the month being invoiced and IOC is the index prevailing 30 days before Bid opening for inputs payable.

45.2 If the value of the index is changed after it has been used in a calculation, the calculation shall be corrected and an adjustment made in the next payment certificate. The index value shall be deemed to take account of all changes in cost due to fluctuations in costs.

46. Retention

46.1 The Procuring Entity shall retain from each payment due to the Contractor the proportion stated in the **SCC** until Completion of the whole of the Works.

46.2 Upon the issue of a Certificate of Completion of the Works by the Project Manager, in accordance with GCC 53.1, half the total amount retained shall be repaid to the Contractor and half when the Defects Liability Period has passed and the Project Manager has certified that all Defects notified by the Project Manager to the Contractor before the end of this period have been corrected. The Contractor may substitute retention money

47. Liquidated Damages

- 47.1 The Contractor shall pay liquidated damages to the Procuring Entity at the rate per day stated in the SCC for each day that the Completion Date is later than the Intended Completion Date. The total amount of liquidated damages shall not exceed the amount defined in the SCC. The Procuring Entity may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not affect the Contractor's liabilities.
- 47.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Project Manager shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate. The Contractor shall be paid interest on the overpayment, calculated from the date of payment to the date of repayment, at the rates specified in GCC Sub-Clause 41.1.

48. Bonus

- 48.1 The Contractor shall be paid a Bonus calculated at the rate per calendar day **stated in the SCC** for each day (less any days for which the Contractor is paid for acceleration) that the Completion is earlier than the Intended Completion Date. The Project Manager shall certify that the Works are complete, although they may not be due to be complete.

49. Advance Payment

- 49.1 The Procuring Entity shall make advance payment to the Contractor of the amounts stated in the SCC by the date stated in the SCC, against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a bank acceptable to the Procuring Entity in amounts and currencies equal to the advance payment. The Guarantee shall remain effective until the advance payment has been repaid, but the amount of the Guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest shall not be charged on the advance payment.
- 49.2 The Contractor is to use the advance payment only to pay for Equipment, Plant, Materials, and mobilization expenses required specifically for execution of the Contract. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the Project Manager.
- 49.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuations of work done, Variations, price adjustments, Compensation Events, Bonuses, or Liquidated Damages.

50. Securities

- 50.1 The Performance Security shall be provided to the Procuring Entity no later than the date specified in the Letter of Acceptance and shall be issued in an amount **specified in the SCC**, by a bank or surety acceptable to the Procuring Entity, and denominated in the types and proportions of the currencies in which the Contract Price is payable. The Performance Security shall be valid until a date 28 day from the date of issue of the Certificate of Completion in the case of a Bank Guarantee, and until one year from the date of issue of the Completion Certificate in the case of a Performance Bond.

51. Dayworks

- 51.1 If applicable, the Dayworks rates in the Contractor's Bid shall be used only when the Project Manager has given written instructions in advance for additional work to be paid for in that way.
- 51.2 All work to be paid for as Dayworks shall be recorded by the Contractor on forms approved by the Project Manager. Each completed form shall be verified and signed by the Project Manager within two days of the work being done.
- 51.3 The Contractor shall be paid for Dayworks subject to obtaining signed Dayworks forms.

52. Cost of Repairs

- 52.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.

E. Finishing the Contract

53. Completion

53.1 The Contractor shall request the Project Manager to issue a Certificate of Completion of the Works, and the Project Manager shall do so upon deciding that the whole of the Works is completed.

54. Taking Over

54.1 The Procuring Entity shall take over the Site and the Works within seven days of the Project Manager's issuing a certificate of Completion.

55. Final Account

55.1 The Contractor shall supply the Project Manager with a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Project Manager shall issue a Defects Liability Certificate and certify any final payment that is due to the Contractor within 56 days of receiving the Contractor's account if it is correct and complete. If it is not, the Project Manager shall issue within 56 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Project Manager shall decide on the amount payable to the Contractor and issue a payment certificate.

⁻¹³*The sum of the two coefficients A and B should be 1 (one) in the formula for each currency. Normally, both coefficients shall be the same in the formulae for all currencies, since coefficient A, for the non-adjustable portion of the payments, is a very approximate figure (usually 0.15) to take account of fixed cost elements or other non-adjustable components. The sum of the adjustments for each currency are added to the Contract Price.*

56. Operating and Maintenance Manuals

56.1 If "as built" Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates stated in the SCC.

56.2 If the Contractor does not supply the Drawings and/or manuals by the dates stated in the SCC pursuant to GCC Sub-Clause 56.1, or they do not receive the Project Manager's approval, the Project Manager shall withhold the amount **stated in the SCC** from payments due to the Contractor.

57. Termination

57.1 The Procuring Entity or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.

57.2 Fundamental breaches of Contract shall include, but shall not be limited to, the following:

- a) the Contractor stops work for 30 days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Project Manager;
- b) the Project Manager instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within 30 days;
- c) the Procuring Entity or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;
- d) a payment certified by the Project Manager is not paid by the Procuring Entity to the Contractor within 84 days of the date of the Project Manager's certificate;
- e) the Project Manager gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Project Manager;
- f) the Contractor does not maintain a Security, which is required;
- g) the Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid, as **defined in the SCC**; or
- h) if the Contractor, in the judgment of the Procuring Entity has engaged in Fraud and Corruption, as defined in paragraph 2.2 a of the Appendix A to the GCC, in competing for or in executing the Contract, then the Procuring Entity may, after giving fourteen (14) days written notice to the Contractor, terminate the Contract and expel him from the Site.

57.3 Notwithstanding the above, the Procuring Entity may terminate the Contract for convenience.

57.4 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.

57.5 When either party to the Contract gives notice of a breach of Contract to the Project Manager for a cause other than those listed under GCC Sub-Clause 56.2 above, the Project Manager shall decide whether the breach is fundamental or not.

58. Payment upon Termination

58.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Project Manager shall issue a certificate for the value of the work done and Materials ordered less advance payments received up to the date of the issue of the certificate and less the percentage to apply to the value of the work not completed, as specified in the SCC. Additional Liquidated Damages shall not apply. If the total amount due to the Procuring Entity exceeds any payment due to the Contractor, the difference shall be a debt payable to the Procuring Entity.

58.2 If the Contract is terminated for the Procuring Entity's convenience or because of a fundamental breach of Contract by the Procuring Entity, the Project Manager shall issue a certificate for the value of the work done, Materials ordered, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works, and less advance payments received up to the date of the certificate.

59. Property

59.1 All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Procuring Entity if the Contract is terminated because of the Contractor's default.

60. Release from Performance

60.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Procuring Entity or the Contractor, the Project Manager shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which a commitment was made.

SECTION IX - SPECIAL CONDITIONS OF CONTRACT

Number of GC Clause	Amendments of, and Supplements to, Clauses in the General Conditions of Contract
A. General	
GCC 1.1 (q)	The Procuring Entity is: Thika Water and Sewerage Company Ltd of P.O. Box 6103-01000, Thika
GCC 1.1 (u)	The Intended Completion Date for the whole of the Works shall be: 3 months after contract signature
GCC 1.1 (x)	The Engineer is:
GCC 1.1 (z)	The Site is located at Thika Water Treatment works
GCC 1.1 (cc)	The Start Date shall be: 14 days after contract signature
GCC 1.1 (gg)	The Works consist of: Borehole Equipping & Construction of Elevated Steel tank at Magana Primary School
GCC 2.2	Sectional Completions are: Not Applicable
GCC 5.1	The Engineer may delegate any of his duties and responsibilities.
GCC 8.1	Schedule of other contractors: Not Appropriate
GCC 9.1	<p>Key Personnel GCC 9.1 is replaced with the following: 9.1 Key Personnel are the Contractor's personnel named in this GCC 9.1 of the Special Conditions of Contract. The Contractor shall employ the Key Personnel and use the equipment identified in its Bid, to carry out the Works or other personnel and equipment approved by the Engineer. The Engineer shall approve any proposed replacement of Key Personnel and equipment only if their relevant qualifications or characteristics are substantially equal to or better than those proposed in the Bid.</p> <p>[insert the name/s of each Key Personnel agreed by the Procuring Entity prior to Contract signature.]</p>
GCC 13.1	The minimum insurance amounts and deductibles shall be: as indicated in the BOQs
GCC 20.1	The Site Possession Date(s) shall be: as will be agreed during commencement meeting
GCC 23.1 & GCC 23.2	Appointing Authority for the Adjudicator: NCIA
	Hourly rate and types of reimbursable expenses to be paid to the Adjudicator: As it shall be agreed upon by both parties

Number of GC Clause	Amendments of, and Supplements to, Clauses in the General Conditions of Contract
B. Time Control	
GCC 26.1	The Contractor shall submit for approval a Program for the Works within fourteen (14) days from the date of the Letter of Acceptance.
GCC 26.3	The period between Program updates is Thirty (30) days.

C. Quality Control

GCC 34.1	The Defects Liability Period is: [365] days.
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D. Cost Control

GCC 38.9	If the value engineering proposal is approved by the Procuring Entity the amount to be paid to the Contractor shall be <u>10</u> % of the reduction in the Contract Price.
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GCC 44.1	The currency of the Procuring Entity's Country is: Kenya Shillings
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GCC 45.1	The Contract is not subject to price adjustment in accordance with GCC Clause 45, and the following information regarding coefficients does not apply.
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GCC 46.1	The proportion of payments retained is: 5%
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GCC 47.1	The liquidated damages for the whole of the Works are 0.1% per day. The maximum amount of liquidated damages for the whole of the Works is 10% of the final Contract Price.
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GCC 49.1	The Advance Payments shall be: Not Applicable
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GCC 50.1	<p>The Performance Security amount is</p> <p>(a) Performance Security – Bank Guarantee: in the amount(s) of 10% percent of the Accepted Contract Amount and in the same currency(ies) of the Accepted Contract Amount.</p> <p>(b) Performance Security – Performance Bond: in the amount(s) of 10% percent of the Accepted Contract Amount and in the same currency(ies) of the Accepted Contract Amount.</p>
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E. Finishing the Contract

GCC 57.2 (g)	The maximum number of days is: three months
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GCC 58.1	The percentage to apply to the value of the work not completed, representing the Procuring Entity's additional cost for completing the Works, is: Not Applicable
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FORM No 1: NOTIFICATION OF INTENTION TO AWARD

This Notification of Intention to Award shall be sent to each Tenderer that submitted a Tender. Send this Notification to the Tenderer's Authorized Representative named in the Tender Information Form on the format below. -----

FORMAT

1. For the attention of Tenderer's Authorized Representative

- i) Name: *[insert Authorized Representative's name]*
- ii) Address: *[insert Authorized Representative's Address]*
- iii) Telephone: *[insert Authorized Representative's telephone/fax numbers]*
- iv) Email Address: *[insert Authorized Representative's email address]*

[IMPORTANT: insert the date that this Notification is transmitted to Tenderers. The Notification must be sent to all Tenderers simultaneously. This means on the same date and as close to the same time as possible.]

2. Date of transmission: *[email]* on *[date]* (local time)

This Notification is sent by (Name and designation) _____

3. Notification of Intention to Award

- i) Procuring Entity: *[insert the name of the Procuring Entity]*
- ii) Project: *[insert name of project]*
- iii) Contract title: *[insert the name of the contract]* iv) Country: *[insert country where ITT is issued]*
- v) ITT No: *[insert ITT reference number from Procurement Plan]*

This Notification of Intention to Award (Notification) notifies you of our decision to award the above contract. The transmission of this Notification begins the Standstill Period. During the Standstill Period, you may:

4. Request a debriefing in relation to the evaluation of your tender

Submit a Procurement-related Complaint in relation to the decision to award the contract.

a) The successful tenderer

- i) Name of successful Tender _____
- ii) Address of the successful Tender _____
- iii) Contract price of the successful Tender Kenya Shillings _____ (in words

b) Other Tenderers

Names of all Tenderers that submitted a Tender. If the Tender's price was evaluated include the evaluated price as well as the Tender price as read out. For Tenders not evaluated, give one main reason the Tender was unsuccessful.

SNo	Name of Tender	Tender Price as read out	Tender's evaluated price (Note a)	One Reason Why not Evaluated
1				
2				
3				
4				
5				

(Note a) State NE if not evaluated

5. How to request a debriefing

- a) DEADLINE: The deadline to request a debriefing expires at midnight on [insert date] (local time).
- b) You may request a debriefing in relation to the results of the evaluation of your Tender. If you decide to request a debriefing your written request must be made within three (5) Business Days of receipt of this Notification of Intention to Award.
- c) Provide the contract name, reference number, name of the Tenderer, contact details; and address the request for debriefing as follows:
 - i) Attention: [insert full name of person, if applicable]
 - ii) Title/position: [insert title/position]
 - iii) Agency: [insert name of Procuring Entity]
 - iv) Email address: [insert email address]
- d) If your request for a debriefing is received within the 3 Days deadline, we will provide the debriefing within five (3) Business Days of receipt of your request. If we are unable to provide the debriefing within this period, the Standstill Period shall be extended by five (3) Days after the date that the debriefing is provided. If this happens, we will notify you and confirm the date that the extended Standstill Period will end.
- e) The debriefing may be in writing, by phone, video conference call or in person. We shall promptly advise you in writing how the debriefing will take place and confirm the date and time.
- f) If the deadline to request a debriefing has expired, you may still request a debriefing. In this case, we will provide the debriefing as soon as practicable, and normally no later than fifteen (15) Days from the date of publication of the Contract Award Notice.

6. How to make a complaint

- a) Period: Procurement-related Complaint challenging the decision to award shall be submitted by midnight, [insert date] (local time).
- b) Provide the contract name, reference number, name of the Tenderer, contact details; and address the Procurement-related Complaint as follows:
 - i) Attention: [insert full name of person, if applicable]
 - ii) Title/position: [insert title/position]
 - iii) Agency: [insert name of Procuring Entity]
 - iv) Email address: [insert email address]
- c) At this point in the procurement process, you may submit a Procurement-related Complaint challenging the decision to award the contract. You do not need to have requested, or received, a debriefing before making this complaint. Your complaint must be submitted within the Standstill Period and received by us before the Standstill Period ends.
- d) Further information: For more information refer to the Public Procurement and Disposals Act 2015 and its Regulations available from the Website info@ppra.go.ke or complaints@ppra.go.ke. You should read these documents before preparing and submitting your complaint.
- e) There are four essential requirements:
 - i) You must be an 'interested party'. In this case, that means a Tenderer who submitted a Tender in this tendering process, and is the recipient of a Notification of Intention to Award.

- ii) The complaint can only challenge the decision to award the contract
- iii) You must submit the complaint within the period stated above.
- iv) You must include, in your complaint, all of the information required to support your complaint.

7. Standstill Period

- i) DEADLINE: The Standstill Period is due to end at midnight on *[insert date]* (local time).
- ii) The Standstill Period lasts ten (14) Days after the date of transmission of this Notification of Intention to Award.
- iii) The Standstill Period may be extended as stated in paragraph Section 5 (d) above.

If you have any questions regarding this Notification please do not hesitate to contact us. On behalf of the Procuring Entity:

Signature:_____ **Name:**_____

Title/position:_____ **Telephone:**_____ **Email:**_____

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FORM FOR REVIEW(r.203(1))

PUBLIC PROCUREMENT ADMINISTRATIVE REVIEW BOARD

APPLICATION NO.....OF.....20..... BETWEEN
.....APPLICANT
AND
.....RESPONDENT (Procuring Entity)

Request for review of the decision of the..... (Name of the Procuring Entity ofdated the...day of20.....in the matter of Tender No.....of20..... for(Tender description).

REQUEST FOR REVIEW

I/We.....,the above named Applicant(s), of address: Physical address.....P. O. Box No..... Tel. No.....Email, hereby request the Public Procurement Administrative Review Board to review the whole/part of the above mentioned decision on the following grounds , namely:

- 1.
- 2.

By this memorandum, the Applicant requests the Board for an order/orders that:

- 1.
- 2.

SIGNED(Applicant) Dated on.....day of/...20.....

FOR OFFICIAL USE ONLY Lodged with the Secretary Public Procurement Administrative Review Board on.....day of20.....

SIGNED

Board Secretary

[letterhead paper of the Procuring Entity] [date]

To: *[name and address of the Contractor]*

This is to notify you that your Tender dated *[date]* for execution of the *[name of the Contract and identification number, as given in the Contract Data]* for the Accepted Contract Amount *[amount in numbers and words] [name of currency]*, as corrected and modified in accordance with the Instructions to Tenderers, is hereby accepted by (*name of Procuring Entity*).

You are requested to furnish the Performance Security within 30 days in accordance with the Conditions of Contract, using, for that purpose, one of the Performance Security Forms included in Section VIII, Contract Forms, of the Tender Document.

Authorized Signature:.....

Name and Title of Signatory:.....

Name of Procuring Entity.....

Attachment: *Contract Agreement*.....

FORM NO 4 CONTRACT AGREEMENT

THIS AGREEMENT made the _____ day of _____, 20____, between _____ of _____ (hereinafter “the Procuring Entity”), of the one part, and _____ of _____ (hereinafter “the Contractor”), of the other part:

WHEREAS the Procuring Entity desires that the Works known as __ should be executed by the Contractor, and has accepted a Tender by the Contractor for the execution and completion of these Works and the remedying of any defects therein,

The Procuring Entity and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.
2. The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents.
 - a) the Letter of Acceptance
 - b) the Letter of Tender
 - c) the addenda Nos _____ (if any)
 - d) the Special Conditions of Contract
 - e) the General Conditions of Contract;
 - f) the Specifications
 - g) the Drawings; and
 - h) the completed Schedules and any other documents forming part of the contract.
3. In consideration of the payments to be made by the Procuring Entity to the Contractor as specified in this Agreement, the Contractor hereby covenants with the Procuring Entity to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.
4. The Procuring Entity hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the Laws of Kenya on the day, month and year specified above.

Signed and sealed by _____ (for the Procuring Entity)

Signed and sealed by _____ (for the Contractor).

FORM NO. 5 PERFORMANCE SECURITY**[Option 1 - Unconditional Demand Bank Guarantee]***[Guarantor letterhead]***Beneficiary:** _____ *[insert name and Address of Procuring Entity]* **Date:** __________ *[Insert date of issue]***Guarantor:** *[Insert name and address of place of issue, unless indicated in the letterhead]*

1. We have been informed that _____ (hereinafter called "the Contractor") has entered into Contract No. _____ dated _____ with (name of Procuring Entity) _____ (the Procuring Entity as the Beneficiary), for the execution of _____ (hereinafter called "the Contract").
2. Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.
3. At the request of the Contractor, we as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of _____ (in words),¹ such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of the Beneficiary's complying demand supported by the Beneficiary's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Applicant is in breach of its obligation(s) under the Contract, without the Beneficiary needing to prove or to show grounds for your demand or the sum specified therein.
4. This guarantee shall expire, no later than the Day of, 2.....², and any demand for payment under it must be received by us at the office indicated above on or before that date.
5. The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed *[six months]* *[one year]*, in response to the Beneficiary's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."

*[Name of Authorized Official, signature(s) and seals/stamps].***Note:** *All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.***FORM No. 6 PERFORMANCE SECURITY****[Option 2– Performance Bond]***[Note: Procuring Entities are advised to use Performance Security – Unconditional Demand Bank Guarantee instead of Performance Bond due to difficulties involved in calling Bond holder to action]**[Guarantor letterhead or SWIFT identifier code]***Beneficiary:** _____ *[insert name and Address of Procuring Entity]* **Date:** _____ *[Insert date of issue]*.**PERFORMANCE BOND No.:****Guarantor:** *[Insert name and address of place of issue, unless indicated in the letterhead]*

1. By this Bond____as Principal (hereinafter called "the Contractor") and _____] as Surety (hereinafter called "the Surety"), are held and firmly bound unto _____] as Obligee (hereinafter called "the Procuring Entity") in the amount of _____for the payment of which sum well and truly to be made in the types and proportions of currencies in which the Contract Price is payable, the Contractor and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.
2. WHEREAS the Contractor has entered into a written Agreement with the Procuring Entity dated the _____ day of _____, 20 , for _____in accordance with the documents, plans, specifications, and amendments thereto, which to the extent herein provided for, are by reference made part hereof and are hereinafter referred to as the Contract.
3. NOW, THEREFORE, the Condition of this Obligation is such that, if the Contractor shall promptly and faithfully perform the said Contract (including any amendments thereto), then this obligation shall be null and void; otherwise, it shall remain in full force and effect. Whenever the Contractor shall be, and declared by the Procuring Entity to be, in default under the Contract, the Procuring Entity having performed the Procuring Entity's obligations thereunder, the Surety may promptly remedy the default, or shall promptly:
 - 1) complete the Contract in accordance with its terms and conditions; or
 - 2) obtain a tender or tenders from qualified tenderers for submission to the Procuring Entity for completing the Contract in accordance with its terms and conditions, and upon determination by the Procuring Entity and the Surety of the lowest responsive Tenderers, arrange for a Contract between such Tenderer, and Procuring Entity and make available as work progresses (even though there should be a default or a succession of defaults under the Contract or Contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the Balance of the Contract Price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "Balance of the Contract Price," as used in this paragraph, shall mean the total amount payable by Procuring Entity to Contractor under the Contract, less the amount properly paid by Procuring Entity to Contractor; or
 - 3) pay the Procuring Entity the amount required by Procuring Entity to complete the Contract in accordance with its terms and conditions up to a total not exceeding the amount of this Bond.
4. The Surety shall not be liable for a greater sum than the specified penalty of this Bond.
5. Any suit under this Bond must be instituted before the expiration of one year from the date of the issuing of the Taking-Over Certificate. No right of action shall accrue on this Bond to or for the use of any person or corporation other than the Procuring Entity named herein or the heirs, executors, administrators, successors, and assigns of the Procuring Entity.
6. In testimony whereof, the Contractor has hereunto set his hand and affixed his seal, and the Surety has caused these presents to be sealed with his corporate seal duly attested by the signature of his legal representative, this day____of____20_____.

SIGNED ON _____on behalf of By_in the capacity of In the presence of

SIGNED ON _____on behalf of By_in the capacity of In the presence of

presence of

FORM NO. 7 - ADVANCE PAYMENT SECURITY

[Demand Bank Guarantee]

[Guarantor letterhead]

Beneficiary: _____ *[Insert name and Address of Procuring Entity]*

Date: _____ *[Insert date of issue]*

ADVANCE PAYMENT GUARANTEE No.: _____ *[Insert guarantee reference number]* **Guarantor:**
_____ *[Insert name and address of place of issue, unless indicated in the letterhead]*

1. We have been informed that _____ (hereinafter called "the Contractor") has entered into Contract No. _____ dated _____ with the Beneficiary, for the execution of _____ (hereinafter called "the Contract").
2. Furthermore, we understand that, according to the conditions of the Contract, an advance payment in the sum _____ (in words) is to be made against an advance payment guarantee.
3. At the request of the Contractor, we as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of _____ (in words) upon receipt by us of the Beneficiary's complying demand supported by the Beneficiary's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating either that the Applicant:
 - a) has used the advance payment for purposes other than the costs of mobilization in respect of the Works; or
 - b) has failed to repay the advance payment in accordance with the Contract conditions, specifying the amount which the Applicant has failed to repay.
4. A demand under this guarantee may be presented as from the presentation to the Guarantor of a certificate from the Beneficiary's bank stating that the advance payment referred to above has been credited to the Contractor on its account number _____ at _____.
5. The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as specified in copies of interim statements or payment certificates which shall be presented to us. This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate indicating that ninety (90) percent of the Accepted Contract Amount, less provisional sums, has been certified for payment, or on the _____ day of _____, 20____, whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.
6. The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed *[six months]* *[one year]*, in response to the Beneficiary's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee.

[Name of Authorized Official, signature(s) and seals/stamps]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

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FORM NO. 8 - RETENTION MONEY SECURITY

[Demand Bank Guarantee]

[Guarantor letterhead]

Beneficiary: _____ [Insert name and Address of Procuring Entity]

Date: _____ [Insert date of issue]

Advance payment guarantee no. [Insert guarantee reference number]

Guarantor: [Insert name and address of place of issue, unless indicated in the letterhead]

1. We have been informed that _____ [insert name of Contractor, which in the case of a joint venture shall be the name of the joint venture] (hereinafter called "the Contractor") has entered into Contract No. _____ [insert reference number of the contract] dated _____ with the Beneficiary, for the execution of _____ [insert name of contract and brief description of Works] (hereinafter called "the Contract").
2. Furthermore, we understand that, according to the conditions of the Contract, the Beneficiary retains moneys up to the limit set forth in the Contract ("the Retention Money"), and that when the Taking-Over Certificate has been issued under the Contract and the first half of the Retention Money has been certified for payment, and payment of [insert the second half of the Retention Money] is to be made against a Retention Money guarantee.
3. At the request of the Contractor, we, as Guarantor, hereby irrevocably undertake to pay the Beneficiary any sum or sums not exceeding in total an amount of [insert amount in figures] _____ ([insert amount in words _____])¹ upon receipt by us of the Beneficiary's complying demand supported by the Beneficiary's statement, whether in the demand itself or in a separate signed document accompanying or identifying the demand, stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or show grounds for your demand or the sum specified therein.
4. A demand under this guarantee may be presented as from the presentation to the Guarantor of a certificate from the Beneficiary's bank stating that the second half of the Retention Money as referred to above has been credited to the Contractor on its account number _____ at _____ [insert name and address of Applicant's bank].
5. This guarantee shall expire no later than the Day of, 2.....², and any demand for payment under it must be received by us at the office indicated above on or before that date.
6. The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [six months] [one year], in response to the Beneficiary's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee.

[Name of Authorized Official, signature(s) and seals/stamps]

Note: All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.

¹The Guarantor shall insert an amount representing the amount of the second half of the Retention Money.

²Insert a date that is twenty-eight days after the expiry of retention period after the actual completion date of the contract. The Procuring Entity should note that in the event of an extension of this date for completion of the Contract, the Procuring Entity would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee.

FORM NO. 9 BENEFICIAL OWNERSHIP DISCLOSURE FORM

(Amended and issued pursuant to PPRA CIRCULAR No. 02/2022)

INSTRUCTIONS TO TENDERERS: DELETE THIS BOX ONCE YOU HAVE COMPLETED THE FORM

This Beneficial Ownership Disclosure Form ("Form") is to be completed by the successful tenderer pursuant to Regulation 13 (2A) and 13 (6) of the Companies (Beneficial Ownership Information) Regulations, 2020. In case of joint venture, the tenderer must submit a separate Form for each member. The beneficial ownership information to be submitted in this Form shall be current as of the date of its submission.

For the purposes of this Form, a Beneficial Owner of a Tenderer is any natural person who ultimately owns or controls the legal person (tenderer) or arrangements or a natural person on whose behalf a transaction is conducted, and includes those persons who exercise ultimate effective control over a legal person (Tenderer) or arrangement.

Tender Reference No.: _____ [insert identification
no] Name of the Tender Title/Description: _____ [insert name of the assignment] to: _____
[insert complete name of Procuring Entity]

In response to the requirement in your notification of award dated [insert date of notification of award] to furnish additional information on beneficial ownership: [select one option as applicable and delete the options that are not applicable]

I) We hereby provide the following beneficial ownership information. **Details of beneficial ownership**

	Details of all Beneficial Owners	% of shares a person holds in the company Directly or indirectly	% of voting rights a person holds in the company	Whether a person directly or indirectly holds a right to appoint or remove a member of the board of directors of the company or an equivalent governing body of the Tenderer (Yes / No)	Whether a person directly or indirectly exercises significant influence or control over the Company (tenderer) (Yes / No)
1.	Full Name	Directly-----	Directly.....	1. Having the right to appoint a majority of the board of the directors or an equivalent governing body of the Tenderer: Yes -----No----	1. Exercises significant influence or control over the Company body of the Company (tenderer) Yes -----No----
	National identity card number or Passport number	----- % of shares% of voting rights	2. Is this right held directly or indirectly?:	2. Is this influence or control exercised directly or indirectly?
	Personal Identification Number (where applicable)	Indirectly-----	Indirectly-----	Direct.....	
	Nationality	----- % of shares	-----% of voting rights	...	
	Date of birth [dd/mm/yyyy]				
	Postal address				
	Residential address				

	Telephone number				Indirect.....	Direct.....
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	Details of all Beneficial Owners	% of shares a person holds in the company Directly or indirectly	% of voting rights a person holds in the company	Whether a person directly or indirectly holds a right to appoint or remove a member of the board of directors of the company or an equivalent governing body of the Tenderer (Yes / No)	Whether a person directly or indirectly exercises significant influence or control over the Company (tenderer) (Yes / No)
	Email address				Indirect.....
	Occupation or profession				

2.	Full Name		Directly----- ----- %	Directly.....% of	1. Having the right to appoint a majority of the board of the directors or an equivalent governing body of the Tenderer: Yes ----No----	1. Exercises significant influence or control over the Company body of the Company (tenderer) Yes ----No----
	National identity card number or Passport number		of shares	voting rights	2. Is this right held directly or indirectly?:	2. Is this influence or control exercised directly or indirectly?
	Personal Identification Number (where applicable)		Indirectly----- ----- %	Indirectly----- % of voting rights	Direct..... ...	Direct.....
	Nationality(ies)				Indirect.....	Indirect.....
	Date of birth [dd/mm/yyyy]					
	Postal address					
	Residential address					
	Telephone number					
	Email address					
	Occupation or profession					

3. e.t c						

II) Am fully aware that beneficial ownership information above shall be reported to the Public Procurement Regulatory Authority together with other details in relation to contract awards and shall be maintained in the Government Portal, published and made publicly available pursuant to Regulation 13(5) of the Companies (Beneficial

Ownership Information) Regulations, 2020.(Notwithstanding this paragraph Personally Identifiable Information in line with the Data Protection Act shall not be published or made public). *Note that Personally Identifiable Information (PII) is defined as any information that can be used to distinguish one person from another and can be used to deanonymize previously anonymous data. This information includes National identity card number or Passport number, Personal Identification Number, Date of birth, Residential address, email address and Telephone number.*

III) In determining who meets the threshold of who a beneficial owner is, the Tenderer must consider a natural person who in relation to the company:

- (a) holds at least ten percent of the issued shares in the company either directly or indirectly;
- (b) exercises at least ten percent of the voting rights in the company either directly or indirectly
- (c) holds a right, directly or indirectly, to appoint or remove a director of the company; or
- (d) exercises significant influence or control, directly or indirectly, over the company.

IV) What is stated to herein above is true to the best of my knowledge, information and belief.

Name of the Tenderer:[insert complete name of the Tenderer]_____*

*Name of the person duly authorized to sign the Tender on behalf of the Tenderer: ** [insert complete name of person duly authorized to sign the Tender]*

Designation of the person signing the Tender: [insert complete title of the person signing the Tender]

Signature of the person named above: [insert signature of person whose name and capacity are shown above]

Date this [insert date of signing] day of..... [Insert month], [insert year]

Bidder Official Stamp