HARRY GWALA DISTRICT MUNICIPALITY

GREATER MNQUMENI WATER SUPPLY SCHEME PHASE 5

CONTRACT NO: HGDM748/HGDM/2021

CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM AND RISING MAIN: CIVIL, MECHANICAL AND ELECTRICAL.

CIDB CONTRACTOR GRADING:

7CE OR HIGHER

Harry Gwala District Municipality
40 Main Street
IXOPO
3276

Contact Name: Mr D. Gqiba
Telephone: (039) 834 8700
Fax: (039) 834 1517

NAME OF TENDERER	
ADDRESS OF TENDERER	
TELEPHONE	
EMAIL	

TENDER CLOSING DATE: 25 August 2022 @ 12H00

SUMMARY FOR TENDER OPENING PURPOSES

Name of Tenderer	
Tendered Amount	R
Alternative Tender offered	Yes ☐ No
If "Yes" state amount	R
Specified time for completion	months
• Alternative time for completion	Yes ☐ No
• If yes, state time offered	months
Preferences as Claimed	
• **Contracts Exceeding R 50 000 000 (90/10 structure)**	
- BBBEE Preference Based on BEE Verification Certificate Score	points
Details of Contact Person	
• Name	
• Telephone No.	
• Fax No.	
• E-mail Address	

Note : In the event of a conflict between the data provided in the Summary and that given in the tender, the latter shall prevail.

SIGNATURE……
(of person authorised to sign the tender)

TABLE OF CONTENTS

The Tenderer shall satisfy himself that this document is complete in accordance with the above schedule and if any pages are found to be missing, or duplicated, shall immediately request the Engineer to rectify the discrepancy. No liability will be admitted by the Employer in respect of errors in the Tenderer's tender due to the foregoing.

T1 TENDER PROCEDURES

TABLE OF CONTENTS

T1.1 TENDER NOTICE AND INVITATION TO TENDER

HARRY GWALA DISTRICT MUNICIPALITY
INFRASTRUCTURE SERVICES DEPARTMENT

BID NOTICE

Bids are hereby invited from qualified and experienced Bidders for the construction of the following Infrastructure projects within the Harry Gwala District municipality

NO.	PROJECT NAME	CIDB GRADING	COMPULSORY BRIEFING DATE	TENDER NUMBER	CLOSING DATE
i.	CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM AND RISING MAIN: CIVIL, MECHANICAL AND ELECTRICAL.	**7CE OR HIGHER**	10 August 2022 at 10:30am Bidders to meet at Harry Gwala District Municipality Council Chamber and then drive to site.	Contract No. **HGDM748/HGDM/2021**	25 August 2022 @ 12h00

Only Bidders that have the required CIDB Grading listed on the table above per project. Joint Ventures are also eligible to submit Bids provided that every member of the Joint Venture is registered with the CIDB and a combined grade of Joint Venture calculated in accordance with the CIDB regulations is equal to or higher than the specified Contractor grading.

Invalid or non-submission of the following documents will lead to the disqualification.

- Original Valid Tax Clearance Certificate from SARS or a SARS Pin;
- CIDB Registration Certificate or registration number
- Proof of Registration on the Central Supply Database.
- Certified Copies of Company or CC Documents together with certified copies of member/s ID;
- JV Agreement (if applicable);
- A signed MBD4 form must be submitted with all bids (available on our website or at reception)

The following will apply in all the above bids:

- Price(s) quoted must be firm and must be inclusive of VAT;
- A firm delivery period must be indicated;
- All tenders must be valid for 90 days after the tender closing date
- A Valid B-BBEE status level verification certificate for claiming preference points.
- 80/20 Preference point system will be used in Evaluation

COLLECTION OF BID DOCUMENTS

Bid documents may be collected from the **03 August 2022** between **09h00 and 16h00** at Harry Gwala District Municipality Offices, Finance Services Department, situated at Ixopo 40 Main Street, Ixopo 3276.Tender documents will be issued upon payment of a non-refundable cash fee of **R 1000 each**.

CLOSING DATE

The closing date for the bids is as per the table above. Bids must be enclosed in **SEALED ENVELOPES** and clearly labelled with the contract number and project name on the outside of the envelopes addressed to **The Municipal Manager.**

Bids must be deposited in the Bid Box at the reception area of Harry Gwala District Municipal, 40 Main Street, IXOPO before the closing date. Telegraphic, telexed or faxed bids will not be considered and late bids will not be accepted.

Harry Gwala District Municipality does not bind itself to accept the lowest or any Bid and reserves the right to accept the whole or any part of the bid.

BID ENQUIRIES

All bid enquiries and other matters shall be directed to:

Executive Director: Water Services
Mr D M Gqiba
Harry Gwala District Municipality
40 Main Street
IXOPO
3276
Tel.: 039-834 8700
Fax: 039 834 2259

Mrs TT Thiyane-Magaqa
Acting Municipal Manager

T1.2 TENDER DATA

T1.2 TENDER DATA

GENERAL

The Conditions of Tender applicable to this contract are the Standard Conditions of Tender as contained in Annexure F of the CIDB *Standard for Uniformity in Construction Procurement, including the amendment made through Board Notice 136 Government Gazette No 38960 of 10 July 2015*. This document is obtainable separately. Tenderers shall obtain their own copies.

The Tender Data make several references to the Standard Conditions of Tender for details that apply specifically to this tender. The Tender Data shall have preference in the interpretation of any ambiguity or inconsistency between it and the Standard Conditions of Tender.

Each item of Tender Data given below is cross-referenced to the relevant clause in the Standard Conditions of Tender to which it mainly applies. The Tender Data shall have precedence in the interpretation of any ambiguity or inconsistency between it and the Standard Conditions of Tender. Each item of Tender Data given below is cross-referenced to the relevant clause in the Standard Conditions of Tender.

CLAUSE No	
F.1	**GENERAL**
F.1.1	**Actions** The Employer for this Contract is: Name : Harry Gwala District Municipality Contact Name : Mr Skhanyiso Ngcobo Address : 40 Main Street Ixopo 3276 Private Bag X501, Ixopo 3276 Tel : 039 834 2485 Fax : 039 834 1701 E-mail address : ngcobosk@harrygwaladm.gov.za
F.1.2	**Tender Documents** **(a) The Tender Document,** issued by the Employer consists of the following: **THE TENDER** **T1: Tendering Procedures** T1.1: Tender Notice and Invitation to Tender T1.2: Tender Data **T2: Returnable Documents** T2.1: List of Returnable Documents T2.2: Returnable Schedules and Documents **THE CONTRACT** **Part 1: Agreements and Contract Data** C1.1: Form of Offer and Acceptance C1.2: Pro-Forma Forms to be completed by successful tenderer only C1.3: Contract Data **Part 2: Pricing Data** C2.1: Pricing Instructions C2.2: Bill of Quantities

CLAUSE No	

Part 3: Scope of Work
C3.1: Description of the Works
C3.2: Engineering
C3.3: Procurement
C3.4: Construction Specifications

Part 4: Site Information
C4.1: Locality Plan
C4.2: Geotechnical

Part 5: Annexures
C5.1: Construction Health & Safety Specification
C5.2: Environmental Management Plan
C5.3: Contract Signboard

(b) **The Drawings,** issued separately from this document

The Tender Document and drawings shall be obtained from the Employer at the physical address stated in the Tender Notice, upon payment of the deposit stated in the Tender Notice.

In addition, the following documents, which are obtainable separately, are also referred to and are deemed to form part of this tender.

(c) **"General Conditions of Contract for Construction Works – 3rd Edition 2015"**

This document is issued by the South African Institution of Civil Engineering. (Short title "General Conditions of Contract 2015"), and is obtainable separately. Tenderers shall obtain their own copies.

(d) **"Standardised Specifications for Civil Engineering Construction" SABS 1200**

This document is obtainable separately, and Tenderers shall obtain their own copies of the applicable sections.

(e) **The Occupational Health and Safety Act N° 85 of 1993 and Amendment Act N° 181 of 1993, and the Construction Regulations 2014 (Government Gazette N° 37305 of 07 February 2014, Notice N° R84)**

This document is obtainable separately, and Tenderers shall obtain their own copies.

(f) In addition Tenderers are advised, in their own interest, to obtain their own copies of the following acts, regulations and standards referred to in this document as they are essential for the Tenderer to get acquainted with the basics of construction management, the implementation of preferential construction procurement policies and participation of targeted enterprise and labour.

(i) The Construction Industry Development Board Act No 38 of 2000 and the Regulations in terms of the CIDB Act 38/2000, as at the closing time of this Tender,

(ii) SANS 1921:2004 Construction and Management

Part 1: General Engineering and Construction Works;

CLAUSE No	
	Part 2: Accommodation of Traffic on Public Roads occupied by the Contractor; Part 6: HIV & AIDS Awareness. (iii) SANS 10396:2003 Implementing Preferential Construction Procurement Policies using Targeted Procurement Procedures (iv) SANS 1914:2003 Targeted Construction Procurement, Parts 1 to 6, dealing with Participation of Targeted Enterprises, Joint Ventures, Targeted Labour, etc. **(g)** The **Harry Gwala District Municipality** Supply Chain Management Policy in terms of Section III of the Local Government Municipal Finance Management Act (Act N° 56 of 2003).
F.1.4	**Communication and Employer's Agent** The Employer's agent is: Name : ECA Consulting (Pty) Ltd Contact Name : Mr Louis Fourie Address : 67 St Patrick's Road, Scottsville, PMB Tel : 034 983 2825 Fax : 034 983 2945 E-mail address : louis@ecaconsult.co.za All communication between the Tenderer and the Employer shall be addressed to Mr Louis Fourie of ECA Consulting (Pty) Ltd on weekdays between the hours of 08h00 and 17h00 (8 am to 5 pm).
F.1.5	**The Employer's right to accept or reject any tender offer** The Employer is not obliged to accept the lowest or any tender offered.
F.2	**TENDERER'S OBLIGATIONS**
F.2.1	**Eligibility** A Tenderer will only be eligible to submit a tender if he/she meets all of the following criteria: (a) Only those Tenderers who are registered with the CIDB, in a contractor as stated in the Tender Notice and Invitation to Tender determined in accordance with Regulations 25 (1B) or 25 (7A) of the Construction Industry Development Regulations, are eligible to have their tenders evaluated *See Returnable Documents T2.2.1 FORM A.* (b) Joint ventures are eligible to submit tenders provided that: 1. every member of the joint venture is registered with the CIDB 2. the lead partner has a contractor grading designation in the class of construction work as specified in the Invitation to Tender. 3. the combined contractor grading designation calculated in accordance with the Construction Industry Development

CLAUSE No	
	Regulations is equal to or higher than the contractor grading designation required. (c) Only those tenderers who have in their employ management and supervisory staff satisfying the requirements of the scope of work for supervisory and management staff are eligible to submit tenders. (d) Tenderers are required to achieve the stipulated minimum thresholds, as per the relevant Treasury Instruction Note on local content and production. (*See Returnable Documents T2.2.1 FORM J3)* *(e)* The tenderer is registered on the CSD data base. (*See Returnable Documents T2.2.1 FORM U.)*
F.2.7	**Site visit and clarification meeting** The arrangements for the compulsory clarification meeting and site inspection are as stated in the Tender Notice and Invitation to Tender. Enquiries regarding the visit (at least one full working day in advance) may be directed to: **Contact Name: Mr Louis Fourie (Consultant)** **Tel N°: 034 983 2825** **Cellular N°: 083 633 4967**
F.2.8	**Seek clarification** Working days shall be defined as Monday to Friday Inclusive and shall exclude all gazetted public holidays.
F.2.11	**Alterations to documents** A Tender offer shall not be considered if alterations have been made to the offer or contract data (unless such alterations have been duly authenticated by the Tenderer) or if any particulars required therein have not been completed in all respects. Use of correction fluid is not permitted, and the presence of correction fluid in the tender shall render the tender submission invalid.
F.2.12	**Alternative tender offers** No Alternative Offers will be accepted
F.2.13	**Submitting a Tender Offer**
F.2.13.2	Tenderers to note that the returnable documents are listed in T.2 (Returnable Documents).
F.2.13.3	Under no circumstances whatsoever may the tender forms be retyped or redrafted.Tenderers are to note that no loose documents will be accepted. All returnable documents must be separately bound and labelled. *Tender offers shall be submitted as an original with one (1) copy. Where an original or certified copy of a particular returnable document is required, these shall be included as originals or certified copies, as appropriate in both the "original" and the "copy" documents.* The "Copy" document need not have copies of the entire document. Parts T2.2 (Returnable Schedules and Documents), C1.1 (Form of Offer and Acceptance), C1.2 (Contract Data) and C2.2 (Bill of Quantities) shall be submitted as the "Copy" document. Failure to submit a copy document will render the tender submission

CLAUSE No	
	invalid.
F.2.13.5	Delivery of Tender The Employer's address for delivery of tender offers and identification details to be shown on each tender offer package are: **Location of tender box : Harry Gwala District Municipality Building** **Physical address : 40 Main Street, Ixopo** **Identification details : Greater Mnqumeni Abstraction Works HGDM748/HGM/2021** Under no circumstances must documents be handed to an employee of Harry Gwala District Municipality or handed in at the Procurement Department. Tender documents sent via courier services must also be deposited in the Tender Box and not handed to an employee of Harry Gwala District Municipality Late tenders and tenders not in the tender box at the time of opening will not be accepted by the District Municipality and will be returned to the applicant unopened. **NB: HGDM will not accept responsibility for tender documents which are not deposited in the Tender Box.**
F.2.13.6	A two envelope procedure will NOT be followed. (Read with F.3.5 hereafter).
F.2.13.9	Telephonic, telegraphic, telex, facsimile or e-mailed tender offers will not be accepted.
F.2.15.1	**Closing Time** The closing time for submission of Tender Offers is as stated in the Tender Notice and Invitation to Tender.
F.2.16.1	**Tender Offer Validity** The Tender Offer validity period is **120 days** from the closing time for submission of tenders.
F.2.18	**Provide Other Material** The tenderer shall, when requested by the Employer to do so, submit the names of all management and supervisory staff that will be employed together with satisfactory evidence that such staff members satisfy the eligibility criteria.
F.2.19	**Inspections, tests and analyses** Access shall be provided for inspections and testing by personnel acting on behalf of the Employer, subject to prior arrangement.
F.2.20	**Sureties, Bonds and Policies** The Tenderer is required to submit with his Tender a letter of intent from an approved financial institution registered with the Financial Services Board undertaking to provide the PERFORMANCE GUARANTEE - DEMAND GUARANTEE to the format included in Part T2.2 of this procurement document.
F.2.22	**Return of Tender Documents** Where a tenderer who received a tender document does not submit a tender, the tender documents issued to him must be returned to the Employer within **35 days**

<table>
<tr><th>CLAUSE No</th><th></th></tr>
<tr><td></td><td>after the closing date for submission of tenders.</td></tr>
<tr><td>F.2.23</td><td>Certificates
The tenderer shall submit with his tender:
Certificates as called for in Section T2 – Returnable Documents. Proof of qualifications and other documentation required shall only be accepted on the basis of originals and certified copies of certificates and other documents.
Certificates as required in the Returnable Schedules and Forms must be provided with the tender for each party to a consortium / joint venture.</td></tr>
<tr><td>F.3</td><td>THE EMPLOYER’S UNDERTAKINGS</td></tr>
<tr><td>F.3.1</td><td>Respond to requests from the tenderer
Working days shall be defined as Monday to Friday Inclusive and shall exclude all gazetted public holidays.</td></tr>
<tr><td>F.3.4</td><td>Opening of Tender Submissions
Tenders will be opened immediately after closing time of tenders (see Tender Notice and Invitation to Tender) at the location of the tender box.</td></tr>
<tr><td>F.3.5</td><td>Two-envelope system
The two-envelope system will NOT be followed for this contract.</td></tr>
<tr><td>F.3.8</td><td>Test for Responsiveness
The minimum qualifying Functionality Evaluation Score shall be 65 (Sixty five) points</td></tr>
<tr><td>F.3.11</td><td>Evaluation of Tender Offers
The procedure for the evaluation of responsive Tenders is Method 2 (Financial Offer and Preference)</td></tr>
<tr><td>F.3.11.3</td><td>Method 2: Functionality, Price and Preference
The procedure for the evaluation of responsive Tenders is Method 2 (Functionality, Price and Preference). With the applicable preference point systems being:
80/20 system for Tenders with a Rand value of less than R50 000 000.00, inclusive of VAT, in which 80 points are allocated for price and 20 points for preference in respect of all responsive Tenders received.</td></tr>
<tr><td>F.3.11.8</td><td>Scoring preferences
Points for preference will be scored as set out in Returnable Documents T2.2.1 FORMS P & Q (MBD 6.1). The tenderer is to complete this Section to claim points for B-BBEE Status Level.</td></tr>
<tr><td>F.3.11.9</td><td>Scoring Functionality
The table below lists the returnable schedules that set out the scoring criteria and sub-criteria, and the percentage weighting for the score achieved against the relevant schedule:
<table>
<tr><th>Returnable Schedule</th><th>Criteria</th><th></th><th></th><th>Total Weighting %</th></tr>
<tr><td rowspan="3">Form O.1</td><td rowspan="3">Tenderer’s Experience In Supply And Installation Of HDPe Water Pipelines</td><td>No of Projects completed</td><td>Points</td><td rowspan="3">18</td></tr>
<tr><td>1 Project</td><td>4</td></tr>
<tr><td>2 Projects</td><td>8</td></tr>
</table></td></tr>
</table>

CLAUSE No							
			Greater Than 330mm Nominal Bore And Greater Than 500m In	3 Projects	13		
				4 Projects	18		
		Form O.2	Tenderer's Experience In Installation Of Mechanical And Electrical Components Of Water Pumping Stations With A Nominal Delivery Of 100ℓ/Sec	**No of Projects completed**	**Points**		15
				1 Project	3		
				2 Projects	8		
				3 Projects	12		
				4 Projects	15		
		Form O.3	Tenderer's Experience In The Construction Of River Diversion Works On Rivers Wider Than 10m	**No of Projects completed**	**Points**		20
				1 Project	5		
				2 Projects	10		
				3 Projects	15		
				4 Projects	20		
		Form O.4	Tenderer's Experience in The Construction Of Reinforced Concrete Structures 6m Or Higher	**No of Projects completed**	**Points**		21
				1 Project	5		
				2 Projects	10		
				3 Projects	15		
				4 Projects	21		
		Form O.5	Financial Resources	**Bank Rating**	**Points**		5
				Rating A Rating B Rating C Rating D	5		
				Rating E Rating F Rating G Rating H	0		
		Form O.6	Experience of Key Personnel	**Key Personnel**	**Experience**		16
				Contracts Manager: Relevant Professional Registration with ECSA or SACPCMP with more than 5 years' appropriate experience	2		
				Construction Manager / Site Agent: Relevant Professional Registration with ECSA or SACPCMP with more than 8 years' of appropriate experience	6		
				Construction Manager / Site Agent: Relevant Professional Registration with ECSA or SACPCMP with 5-8 years' of appropriate experience	4	6	
				Construction Manager / Site Agent: Relevant Professional Registration with ECSA or SACPCMP with 2-4 years' of appropriate experience	2		
				Structural Foreman: With more than 10 years' appropriate	6	6	

CLAUSE No	

<table>
<tr><td></td><td></td><td>experience</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>Structural Foreman:
With 8-10 years' appropriate experience</td><td>4</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Structural Foreman:
With 5-8 years' appropriate experience</td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td>Pipe Laying Foreman:
With more than 8 years' appropriate experience</td><td colspan="2">2</td><td></td></tr>
<tr><td rowspan="4">Form O.7</td><td rowspan="4">Quality Assurance Plan and Control Procedures</td><td>Score Status</td><td colspan="2">Points</td><td rowspan="4">5</td></tr>
<tr><td>Have ISO 9001 Accreditation</td><td colspan="2">5</td></tr>
<tr><td>Have Own Internal QA Plan</td><td colspan="2">3</td></tr>
<tr><td>None</td><td colspan="2">0</td></tr>
<tr><td>Form O.8</td><td>Total Possible Points</td><td></td><td colspan="2"></td><td>100</td></tr>
</table>

Failure to score a single point in any of the criteria listed above will deem the bid to be non-responsive and the bidder will be disqualified. Additionally a score of less than that stipulated in F.3.8 will deem the bid to be non-responsive and the bidder will be disqualified

The score allocated by each Bid Evaluation Committee member for a tender shall be the sum, of the scores relevant to each of the above listed returnable schedules multiplied by the percentage weighting for each as shown above.

F.3.13 Acceptance of Tender Offer

F.3.13.1 Tender Offers will only be accepted if, in addition to the conditions listed in the Standard Conditions of Tender;

(a) The Tenderer has purchased the tender documents as stated in the Tender Advertisement and Notice to Tenderers.

See Returnable Documents T2.2.1 FORM B.

(b) The Tenderer has attended the compulsory briefing meeting.

See Returnable Documents T2.2.1 FORM C.

(c) The tenderer has the legal capacity to enter into the Contract and the signatory to the tender has the legal capacity to sign the tender.

See Returnable Documents T2.2.1 FORMS D-D4.

(d) The Tenderer is in good standing financially, and is not

- Insolvent
- in receivership
- bankrupt
- being wound up
- having his affairs administered by a court or a judicial officer
- suspending his business activities
- subject to legal proceedings in respect of the foregoing.

Tenderers are required to submit a Bank Rating with this tender.

CLAUSE No	
	See Returnable Documents T2.2.1 FORMS G. (e) The Tenderer can provide proof that he/she is in good standing with respect to duties, taxes, levies and contributions required in terms of legislation applicable to the work in the contract. *See Returnable Documents T2.2.1 FORMS H.1. – H.6.* (f) The Tenderer can demonstrate that he/she possesses the necessary professional and technical qualifications and competent, financial resources, equipment and other physical facilities, managerial capability, personnel, experience and reputation to perform the contract; *See Returnable Documents T2.2.1 FORMS G and T2.2.2 FORMS X ,Y ,Z, AA,and BB* (g) The Tenderer or any of its principals, directors or managers is not employed in the service of the State or any municipality. In the event that such principals are involved, official approval from the Executing Authority regarding carrying out remunerative work outside of the public service must be included in the tender submission. The tenderer must completed the Declaration of Interest and the Compulsory Enterprise Questionnaire and there are no conflicts of interest which may impact on the tenderer's ability to perform the contract in the best interests of the employer or potentially compromise the tender process. *See Returnable Documents T2.2.1 FORMS J.1. – J.3.* (h) The Tenderer must demonstrate that he/she is able to arrange an acceptable performance guarantee should he/she be awarded the contract. *See Returnable Documents T2.2.1 FORM K and Performance Guarantee Section C1.3.* (i) The Tenderer must confirm that he/she has the necessary competencies and resources to carry out the work safely in accordance with the Occupational Health and Safety Act, N° 85 of 1993, and the OSHA 1993 Construction Regulations 2014. *See Returnable Documents T2.2.1 FORM L.* *(j)* The Tenderer and his principals are not under any restriction to participate in the Employers procurement due to corrupt or fraudulent practices. *See Returnable Documents T2.2.1 FORM M.1 &M.2.* (k) The tenderer is up to date with the payment of their Municipal Accounts and Rates. *See Returnable Documents T2.2.1 FORM N.* (l) The tenderer or any of its directors/shareholders is not listed on the Register of Tender Defaulters in terms of the Prevention and Combating of Corrupt Activities Act of 2004 as a person prohibited from doing business with the public sector. (m) The Tenderer has not abused the Employer's Supply Chain

CLAUSE No	
	Management System and has not been given a written notice to the effect that he has failed to perform on any previous contract. (n) The Employer is satisfied that the Tenderer or any of his principals have not influenced the tender offer and acceptance by the following criteria: • having offered, promised or given a bribe or other gift or remuneration to any person in connection with the obtaining or execution of this contract; • having acted in a fraudulent or corrupt manner in obtaining or executing this contract; • having approached an officer or employee of the Employer or the employer's Agent with the objective of influencing the award of a contract in the Tenderer's favour; • having entered into any agreement or arrangement, whether legally or not, with any other person, firm or company to refrain from tendering for this contract or as to the amount of the Tender to be submitted by either party; • having disclosed to any other person, firm or company other than the Employer, the exact or approximate amount of his proposed Tender; The Employer may, in addition to using any other legal remedies, repudiate the Tender offer and acceptance and declare the Contract invalid should it have been concluded already. The Employer does not bind itself to accept the lowest or any tender.
F.3.17	**Provide Copies of the Contract** The number of paper copies of the signed contract to be provided by the Employer is: **one.**
F.3.20	**Mandatory Sub-Contracting.** The successful tenderer will be required to subcontract a portion of the works to designated groups as per the contract data.

T2 RETURNABLE DOCUMENTS AND SCHEDULES

TABLE OF CONTENTS

T2.1 LIST OF RETURNABLE DOCUMENTS

The Tender Document must be submitted as a whole. All forms must be properly completed as required, and the document shall not be taken apart or altered in any way whatsoever.

The list of returnable documents comprises the following: tick ☑

T2.2.1. RETURNABLE SCHEDULES AND OTHER DOCUMENTS REQUIRED FOR TENDER EVALUATION PURPOSES

A.	Details of Registration with CIDB	☐
B.	Proof of Purchase of Tender Documents	☐
C.	Certificate of Attendance at Site Meeting	☐
D	Certificate of Authority for Signatory	☐
D.1.	Certificate for Company	☐
D.2.	Certificate for Close Corporation	☐
D.3.	Certificate for Partnership	☐
D.3.a.	Certificate for Joint Venture	☐
D.3.b.	Resolution of Board of Directors to enter into Consortia or Joint Ventures	☐
D.3.c.	Joint Venture Disclosure Form	☐
D.4.	Certificate for Sole Proprietor	☐
E.	Registration Certificate / Agreement / ID Document	☐
F.	Tenderer's Financial Standing	☐
G.	Bank Rating	☐
H.1.	VAT Registration Certificate	☐
H.2.	Tax Clearance Certificate Requirements (MBD2)	☐
H.3.	Tax Clearance Certificate	☐
H.4.	Skills Development Levy Certificate	☐
H.5.	Workmen's Compensation Registration Certificate	☐
H.6.	Unemployment Insurance Fund (UIF) Registration Certificate	☐
I.	Quality Assurance Plan and Control Procedures	☐
J.1.	Compulsory Enterprise Questionnaire	☐
J.2.	Declaration of Interest	☐
J.3.	Declaration Certificate for Local Production and Content (MBD6.2)	☐
K.	Form of Intent to Provide a Performance Guarantee	☐
L.	Health and Safety Declaration	☐
M.1.	Declaration of Tenderer's Past Supply Chain Management Practices - MDB8	☐
M.2.	Certificate of Independent Bid Determination MBD 9	☐
N.	Municipal Account	☐
O.	Quality Scorecard (Functionality)	☐
O.1.	Criteria: Tenderer's Experience In Supply And Installation Of Hdpe Water Pipelines Greater Than 330mm Nb And Greater Than 500m In Length - Applicable To Last 8 Years:	☐
O.2.	Criteria: Tenderer's Experience In Installation Of Mechanical And Electrical Components Of Water Pumping Stations With A Nominal Delivery Of 100ℓ/Sec – Applicable To Last 8 Years:	☐
O.3.	Criteria: Tenderer's Experience In The Construction Of River Diversion Works On Rivers Wider Than 10m - Applicable To Last 8 Years:	☐
O.4	Criteria: Tenderer's Experience In The Construction Of Reinforced Concrete Structures 6m Or Higher - Applicable To Last 8 Years:	☐
O.5.	Criteria: Financial Resources (Bank Rating)	☐
O.6.	Criteria: Experience of Key Personnel	☐
O.7.	Criteria: Quality Assurance Plan and Control Procedures	☐

O.8. Total Score for Quality ..... ☐
P. Preference Points – B-BBEE Status Level (MBD 6.1) ..... ☐
Q. B-BBEE Certificate: ..... ☐
R. Declaration for Procurement above R10 Million (MBD 4): ..... ☐
S. Audited Financial Statements : ..... ☐
T. Registration on Council Database : ..... ☐

T2.2.2. RETURNABLE SCHEDULES AND OTHER DOCUMENTS THAT WILL BE INCORPORATED INTO THE CONTRACT

U. Record of Addenda to Tender Document ..... ☐
V. Amendments, Qualifications and Alternatives ..... ☐
W. Preliminary Programme ..... ☐
X. Preliminary Cash Flow ..... ☐
Y. Schedule of Plant and Equipment ..... ☐
Z. Proposed Subcontractors ..... ☐
AA. Key Personnel ..... ☐

Note: Tenderer to tick off each box to ensure that the necessary schedules and documents have been filled in and are included into the tender document.

In addition to the above Returnable Documents, the Tenderer shall provide the following information regarding his tender:

Information with regards their Lightning protection proposal
Information with regards their MCC and control design.
Information with regards their Pump set selections

The above documentation shall be bound in a separate document, clearly indexed and cross referenced. Information requested in support of Forms A to X above may also be bound in the above-mentioned document provided they are clearly referenced back to the relevant form.

T2.2 RETURNABLE SCHEDULES

T2.2.1 RETURNABLE SCHEDULES AND DOCUMENTS REQUIRED FOR TENDER EVALUATION PURPOSES

FORM A DETAILS OF REGISTRATION WITH CIDB

PRIMARY CONTRACTOR

Contractors Name: ……

Contractors CIDB Registration Number: ……..

Contractors CIDB Registration Classification: ……..

JOINT VENTURE PARTNER 1 (Where Applicable)

Contractors Name: ……

Contractors CIDB Registration Number: ……..

Contractors CIDB Registration Classification: ……..

JOINT VENTURE PARTNER 2 (Where Applicable)

Contractors Name: ……

Contractors CIDB Registration Number: ……..

Contractors CIDB Registration Classification: ……..

Note: This information will be checked on the CIDB Website

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM B PROOF OF PURCHASE OF TENDER DOCUMENTS

[The Tenderer shall insert here proof of purchase of the tender documents in the form of an official receipt or other acceptable form of proof]

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM C CERTIFICATE OF ATTENDANCE AT SITE MEETING

This is to certify that *(tenderer)* _____

of *(Address)* _____

_____

was represented by the person(s) named below at the compulsory briefing meeting held for all tenderers at T**he Council Chambers of the Harry Gwala District Municipality in Ixopo on the date and time as stated in the tender advertisement, and followed by a compulsory site inspection of the proposed area of work.**

I / We acknowledge that the purpose of the meeting and the compulsory site visit was to acquaint myself / ourselves with the site of the works and / or matters incidental to doing the work specified in the tender documents in order for me / us to take account of everything necessary when compiling our rates and prices included in the tender.

Particulars of person(s) attending the meeting:

Name: _____ Signature: _____

Capacity: _____

Name: _____ Signature: _____

Capacity: _____

Attendance of the above person(s) at the site meeting is confirmed by the Client's representative, namely:

Name: _____ Signature: _____

Capacity: _____ Date and Time: _____

Attendance of the above person(s) at the site visit is confirmed by the Client's representative, namely:

Name: _____ Signature: _____

Capacity: _____ Date and Time: _____

FORM D CERTIFICATE OF AUTHORITY FOR SIGNATORY

Indicate the status of the tenderer by ticking the appropriate box hereunder. The tenderer must complete the certificate set out below for the relevant category, **and attach its required certificates to the page provided at the end of this form.**

	(a) COMPANY	**(b) CLOSE CORPORATION**	**(c) PARTNERSHIP**	**(d) JOINT VENTURE**	**(e) SOLE PROPRIETOR**
Status (√ tick)					
Complete Section	D1	D2	D3	D4a, D4b, D4c, D4d	D5
Provide Certificates	Company Registration	Company Registration	Company Registration	Company Registration Agreements Power of Attorney	ID Document

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM D.1 CERTIFICATE FOR COMPANY

I, ...chairperson of the Board of Directors of .....…… hereby confirm that by resolution of the Board (copy attached) taken on ..... 20....., Mr/Ms……..…….. acting in the capacity of ……..…….....…, was authorised to sign all documents in connection with the tender for **Contract No: HGDM748/HGM/2021** and any contract resulting from it, on behalf of the company.

Chairman: .....

As Witnesses: 1. . .....

2. .....

Date: .....

FORM D.2 CERTIFICATE FOR CLOSE CORPORATION

We, the undersigned, being the key members in the business trading as .....

.....hereby authorise Mr/Ms ..... ,

acting in the capacity of ..... , to sign

all documents in connection with the tender for **Contract No: HGDM748/HGM/2021** and any contract resulting from it, on our behalf.

NAME	ADDRESS	SIGNATURE	DATE

Note : This certificate is to be completed and signed by all of the key members upon whom rests the direction of the affairs of the Close Corporation as a whole.

Signed: .....

As Witnesses: 1. .....

2. .....

Date: .....

FORM D.3 CERTIFICATE FOR PARTNERSHIP

We, the undersigned, being the key partners in the business trading as,.....

..... hereby authorise Mr/Ms .....

acting in the capacity of ……. ..... , to sign all documents in connection with the tender for **Contract No: HGDM748/HGM/2021** and any contract resulting from it, on our behalf.

NAME	ADDRESS	SIGNATURE	DATE

Note : This certificate is to be completed and signed by all of the key partners upon whom rests the direction of the affairs of the Partnership as a whole.

Signed: .....

As Witnesses: 1. .....

2. .....

Date: .....

FORM D.3.a CERTIFICATE FOR JOINT VENTURE

We, the undersigned, are submitting this tender offer in Joint Venture and hereby authorize Mr/Ms, ... authorized signatory of the company..... acting in the capacity of lead partner, to sign all documents in connection with the tender offer for **Contract No: HGDM748/HGM/2021** and any contract resulting from it, on our behalf.

This authorization is evidenced by the attached power of attorney signed by legally authorized signatories of all the partners to the Joint Venture.

NAME OF FIRM	ADDRESS	AUTHORISING SIGNATURE, NAME AND CAPACITY
Lead Partner		
JV Partner 1		
JV Partner 2		

Note : This certificate is to be completed and signed by all of the key partners upon whom rests the direction of the affairs of the Partnership as a whole.

Signed: .....

As Witnesses: 1. .....

2. .....

Date: .....

FORM D.3.b RESOLUTION OF BOARD OF DIRECTORS TO ENTER INTO CONSORTIA OR JOINT VENTURES

(IF APPLICABLE)

Resolution of a meeting of the Board of Directors/Members/Partners* of:

_____

_____
(Legally correct full name and registration number, if applicable, of the Enterprise)

Held at _____ (place) on _____ (date)

Resolved that:

1. The Enterprise submit a Bid/Tender, in consortia/joint venture with the following enterprise:

   _____

   _____

   (List all the legally correct full names and registration numbers, if applicable, of the Enterprises forming the consortia/joint venture)

   to the Client and for the work explained in the Scope of Work for **Contract No: HGDM748/HGM/2021**

2. Mr/Mrs/Miss/Ms*:
   _____

   in his/her* capacity as: _____ (position in the Enterprise)

   and who will sign as follows: _____

   be, and is hereby, authorised to sign a consortium/joint venture agreement with the parties listed under item 1 above, and any and all other documents and/or correspondence in connection with and relating to the consortium/joint venture, in respect of the project described under Item 1 above.

3. The Enterprise accepts joint and several liability with the parties listed under item 1 above for the due fulfilment of the obligations of the joint venture/consortium deriving from, and in any way connected with, the Contract to be entered into with the Client in respect of the project described under Item 1 above.

   The Enterprise chooses as its *domicilium citandi et executandi* for all purposes arising from this joint venture/consortium agreement and the Contract with the Client in respect of the project under Item 1 above:

   Physical address: _____

   _____

   _____

   _____

   _____ (code)

Postal address: _____

_____

_____

_____ (code)

Telephone: _____ (with code)

Fax: _____ (with code)

Email: _____

	Name	**Enterprise**	**Capacity**	**Signature**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

Note:
1. * Delete which is not applicable
2. This resolution must be signed by all the Directors/Members/Partners of the Bidding Enterprise.
3. Should the number of Directors/Members/Partners exceed the space available above, additional names and signatures must be added on a separate page.

Signed: .....

As Witnesses: 1. .....

2. .....

Date: .....

FORM D.3.c JOINT VENTURE DISCLOSURE FORM (TO BE COMPLETED IN CASE OF TENDER BY JV)

Note: 1) This form needs not be completed for Joint Ventures which have targeted enterprise partners.

2) All the information requested must be filled in the spaces provided. If additional space is required, additional sheets may be attached.

3) A copy of the joint venture agreement must be attached to this form. In order to demonstrate the targeted enterprise partner's share in the ownership, control, management responsibilities, risks and profits of the joint venture, the proposed joint venture agreement must include specific details relating to:

i) The contributions of capital and equipment
ii) Work items to be performed by the targeted enterprise partner's own forces.
iii) Work items to be performed under the supervision of the targeted enterprise partner.
iv) The commitment of management, supervisory and operative personnel employed by the targeted enterprise partner to be dedicated to the performance of the Contract.

4) Copies of all written agreements between partners concerning the contract must be attached to this form including those which relate to ownership options and to restrictions/limits regarding ownership and control.

5) Targeted enterprise partners must each complete an Enterprise Declaration Affidavits.

JOINT VENTURE PARTICULARS

(a) Name : .....
Postal address : .....
Physical address : .....
Telephone : ..... Fax .....

IDENTITY OF EACH NON-TARGETED ENTERPRISE PARTNERS

(b) Name : .....
Postal address : .....
Physical address : .....
Telephone : ..... Fax .....
Contact Person : .....

(Continue as required for further non-targeted enterprise partners)

(c) Name : .....
Postal address : .....
Physical address : .....
Telephone : ..... Fax .....
Contact Person : .....

IDENTITY OF EACH TARGETED ENTERPRISE PARTNER

(d) Name : .....
Postal address : .....
Physical address : .....
Telephone : ..... Fax .....
Contact Person : .....

(e) Name : .....
Postal address : .....

Physical address : .....
Telephone : ..... Fax .....
Contact Person : .....

(f) Name : .....
Postal address : .....
Physical address : .....
Telephone : ..... Fax .....
Contact Person : .....

DESCRIPTION OF THE ROLE OF THE TARGETED PARTNERS IN THE JOINT VENTURE.

OWNERSHIP OF THE JOINT VENTURE

a)	Percentage Ownership in respect of	:	Targeted Enterprises ..... %		Targeted Enterprises ..... %	
b)	Profit an Loss Sharing	:	Targeted Enterprises ..... %		Targeted Enterprises ..... %	
c)	Initial Capital Contribution	:	Targeted Enterprises	R	Targeted Enterprises	R .....
d)	Ongoing Capital Contribution	:	Targeted Enterprises	R	Targeted Enterprises	R .....
e)	Major Plant and Equipment Contribution	:	Targeted Enterprises		Targeted Enterprises	

RECENT CONTRACTS EXECUTED BY PARTNERS IN THEIR OWN RIGHT OR AS PARTNERS IN OTHER JOINT VENTURES

Targeted Enterprise Partners

1. **:** .....
2. **:** .....
3. **:** .....
4. **:** .....
5. **:** .....

Non-Targeted Enterprise Partners

1. **:** .....
2. **:** .....
3. **:** .....

CONTROL AND PARTICIPATION IN THE JOINT VENTURE.

(Identify by name and firm those individuals who are, or will be, responsible for, and have authority to engage in the relevant management functions and policy and decision making, indicating any limitations in their authority e.g. co-signature requirements and Rand limits).
(continue on next page)

Function	Targeted Enterprise Partner		Non-Targeted Enterprise	
	Enterprise	Name of Person	Enterprise	Name of Person
Cheque Signing				

Authority to enter into contracts on behalf of the Joint Venture				
Signing, co-signing and/or collateralizing of loans				
Acquisition of lines of credit				
Acquisition of performance bonds				
Negotiating and signing labour agreements				

MANAGEMENT OF CONTRACT PERFORMANCE
(Fill in the name and firm of the responsible person).

Function	**Targeted Enterprise Partner**		**Non-Targeted Enterprise**	
	Enterprise	Name of Person	Enterprise	Name of Person
Supervision of field operations				
Major purchasing				
Estimating				
Technical management				

MANAGEMENT AND CONTROL OF JOINT VENTURE

a) Managing Partner **:** _____

b) What authority does each partner have to commit or obligate the other to financial institutions, insurance companies, suppliers, subcontractors and /or other parties participating in the execution of the contemplated works?

Partner	**Targeted Enterprise Status**		**Authority Status**	
	YES	**NO**	**YES**	**NO**

PERSONNEL

a. State the approximate number of operative personnel (by trade/ function/ discipline) needed to perform the Joint Venture work under the contract.

TRADE/FUNCTION/	Total Qty Required	Qty supplied by Targeted Enterprise	Qty supplied by non-Targeted Enterprise

b) Name of individual who will be responsible for hiring Joint Venture employees **:** .....

c) Name of individual who will be responsible for preparation of Joint Venture payrolls **:** .....

CONTROL AND STRUCTURE OF THE JOINT VENTURE.

Briefly describe the manner in which the Joint Venture is structured and controlled.

The undersigned warrants that he/she is duly authorised to sign this Joint Venture Disclosure Form and affirms that the foregoing statements are correct and include all material information necessary to identify and explain the terms and operations of the Joint Venture and the intended participation of each partner in the undertaking.

The undersigned further covenants and agrees to provide the Employer with complete and accurate information regarding actual Joint Venture work and the payment therefore, and any proposed changes in any provisions of the Joint Venture agreement, and to permit the audit and examination of the books, records and files of the Joint Venture, or those of each partner relevant to the Joint Venture, by duly authorised representatives of the Employer.

Signature : .....

Name : .....

Duly authorised to sign on behalf of : .....

Address : .....

.....

Telephone : .....

Fax : .....

Date : .....

FORM D.4 CERTIFICATE FOR SOLE PROPRIETOR

I, ..., hereby confirm that I am the sole

owner of the business trading as ....

Signature of Sole owner: .....

As Witnesses:

1. .....

2. .....

Date: .....

FORM E REGISTRATION CERTIFICATE / AGREEMENT / ID DOCUMENT

[Important note to Tenderer: Registration Certificates for Companies, Close Corporations and Partnerships, or Agreements and Powers of Attorney for Joint Ventures, or ID documents for Sole Proprietors, all as referred to in the foregoing forms and in T2.1, must be inserted here]

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM F TENDERER'S FINANCIAL STANDING

The Tenderer shall provide information about his commercial position, which includes information necessary for the Client to evaluate the Tenderer's financial standing.

To that end, the Tenderer must provide with his tender, a bank rating, certified by his banker, to the effect that he will be able to successfully complete the contract at the tendered amount within the specified time for completion.

However, should the Tenderer be unable to provide a bank rating with his tender, he shall state the reasons as to why he is unable to do so, and in addition provide the following details of his banker and bank account that he intends to use for project:

Name of account holder : .....

Name of Bank: ..... Branch: .....

Account number: ..... Type of account: .....

Telephone number:..... Facsimile number: .....

Name of contact person (*at bank:* .....

Failure to provide either the required bank details or a certified bank rating with his tender, will result in the tender being considered ineligible.

The Client undertakes to treat the information thus obtained as confidential, strictly for the use of evaluation of the tender submitted by the Tenderer.

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM G BANK RATING

[Attach rating here]

FORM H.1

FORM H.1 VAT REGISTRATION CERTIFICATE

[The tenderer's VAT Registration Certificate to be inserted here].

FORM H.2 TAX CLEARANCE CERTIFICATE EQUIREMENTS (MBD 2)

TAX CLEARANCE CERTIFICATE REQUIREMENTS

It is a condition of bid that the taxes of the successful bidder must be in order, or that satisfactory arrangements have been made with South African Revenue Service (SARS) to meet the bidder's tax obligations.

1 In order to meet this requirement bidders are required to complete in full the attached form TCC 001 "Application for a Tax Clearance Certificate" and submit it to any SARS branch office nationally. The Tax Clearance Certificate Requirements are also applicable to foreign bidders / individuals who wish to submit bids.

2 SARS will then furnish the bidder with a Tax Clearance Certificate that will be valid for a period of 1 (one) year from the date of approval.

3 The original Tax Clearance Certificate must be submitted together with the bid. Failure to submit the original and valid Tax Clearance Certificate will result in the invalidation of the bid. Certified copies of the Tax Clearance Certificate will not be acceptable.

4 In bids where Consortia / Joint Ventures / Sub-contractors are involved, each party must submit a separate Tax Clearance Certificate.

5 Copies of the TCC 001 "Application for a Tax Clearance Certificate" form are available from any SARS branch office nationally or on the website www.sars.gov.za.

6 Applications for the Tax Clearance Certificates may also be made via eFiling. In order to use this provision, taxpayers will need to register with SARS as eFilers through the website www.sars.gov.za.

Alternatively, please provide the following information for verification:

Name of registered entity: _____ SARS PIN Number: _____

SARS Registration number: _____

FORM H.3 TAX CLEARANCE CERTIFICATE

[Original Tax Clearance Certificate obtained from SARS to be inserted here].

FORM H.4 SKILLS DEVELOPMENT LEVY CERTIFICATE

[The Tenderer's Skills Development Levy Certificate to be inserted here].

FORM H.5 WORKMEN'S COMPENSATION REGISTRATION CERTIFICATE

[The tenderer's Workmen's Compensation Registration Certificate or proof of payment of contributions to be inserted here].

FORM H.6 UNEMPLOYMENT INSURANCE FUND (UIF) REGISTRATION CERTIFICATE

[The Tenderer's Unemployment Insurance Fund (UIF) Registration Certificate to be inserted here].

FORM I QUALITY ASSURANCE PLAN AND CONTROL PROCEDURES

[The tenderer to attach proof of ISO Accreditation or Own Internal QA Plan to this page].

FORM J.1 COMPULSORY ENTERPRISE QUESTIONNAIRE

The following particulars must be furnished. In the case of a joint venture, separate enterprise questionnaires in respect of each partner must be completed and submitted.

Section 1: Name of enterprise: .....

Section 2: VAT registration number, if any: .....

Section 3: CIDB registration number, if any: .....

Section 4: Particulars of sole proprietors and partners in partnerships

Name*	Identity number*	Personal income tax number*

*Complete only if sole proprietor or partnership and attach separate page if more than 3 partners

Section 5: Particulars of companies and close corporations

Company registration number: .....

Close corporation number: .....

Tax reference number: .....

Section 6: Record in the service of the state

Indicate by marking the relevant boxes with a cross, if any sole proprietor, partner in a partnership or director, manager, principal shareholder or stakeholder in a company or close corporation is currently or has been within the last 12 months in the service of any of the following:

a member of any municipal council		an employee of any provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act 1 of 1999)	
a member of any provincial legislature			
a member of the National Assembly or the National Council of Province			
a member of the board of directors of any municipal entity		a member of an accounting authority of any national or provincial public entity	
an official of any municipality or municipal entity		an employee of Parliament or a provincial legislature	

If any of the above boxes are marked, disclose the following:

Name of sole proprietor, partner, director, manager, principal shareholder or stakeholder	Name of institution, public office, board or organ of state and position held	Status of service (tick appropriate column)	
		Current	Within last 12 months

*insert separate page if necessary

Section 7: Record of spouses, children and parents in the service of the state

Indicate by marking the relevant boxes with a cross, if any spouse, child or parent of a sole proprietor, partner in a partnership or director, manager, principal shareholder or stakeholder in a company or close corporation is currently or has been within the last 12 months in the service of any of the following:

a member of any municipal council		an employee of any provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act 1 of 1999)	
a member of any provincial legislature			
a member of the National Assembly or the National Council of Province			
a member of the board of directors of any municipal entity		a member of an accounting authority of any national or provincial public entity	
an official of any municipality or municipal entity		an employee of Parliament or a provincial legislature	

If any of the above boxes are marked, disclose the following:

Name of spouse, child or parent	Name of institution, public office, board or organ of state and position held	Status of service (tick appropriate column)	
		Current	Within last 12 months

*insert separate page if necessary

The undersigned, who warrants that he/she is duly authorised to do so on behalf of the enterprise:

i) authorizes the Client to obtain a tax clearance certificate from the South African Revenue Services that my/our tax matters are in order;

ii) confirms that neither the name of the enterprise or the name of any partner, manager, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears on the Register of Tender Defaulters established in terms of the Prevention and Combating of Corrupt Activities Act of 2004;

iii) confirms that no partner, manager, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise, has within the last five years been convicted of fraud or corruption;

iv) confirms that I/we are not associated, linked or involved with any other tendering entities submitting tender offers and have no relationship with any of the tenderers or those responsible for compiling the scope of work that could cause or be interpreted as a conflict of interest; and

v) confirms that the contents of this questionnaire are within my personal knowledge and are to the best of my belief both true and correct.

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM J.2 DECLARATION OF INTEREST (MBD 4)

1. No bid will be accepted from persons in the service of the state∗.

2. Any person, having a kinship with persons in the service of the state, including a blood relationship, may make an offer or offers in terms of this invitation to bid. In view of possible allegations of favouritism, should the resulting bid, or part thereof, be awarded to persons connected with or related to persons in service of the state, it is required that the bidder or their authorised representative declare their position in relation to the evaluating/adjudicating authority and/or take an oath declaring his/her interest.

3. In order to give effect to the above, the following questionnaire must be completed and submitted with the bid.

3.1 Full Name of bidder or his or her representative: ……

3.2 Identity Number: ……

3.3 Position occupied in the company (Director, Trustee, Shareholder, etc): ……...

3.4 Company Registration Number: ……

3.5 Tax Reference Number: ……

3.6 VAT Registration Number: ……..……

3.7 The names of all directors / Trustees / Shareholders** / members, their individual identity numbers and state employee numbers must be indicated in paragraph 4 below:

Please Tick or mark the correct option in the following questions

3.8 Are you presently in the service of the state∗ **YES / NO**

3.8.1 If so, furnish particulars.

……

……

3.9 Have you been in the service of the state during the previous twelve months? **YES / NO**

3.9.1 If so, furnish particulars.

……

∗ MSCM Regulations: "in the service of the state" means to be –
(a) a member of –
  (i) any municipal council;
  (ii) any provincial legislature; or
  (iii) the national Assembly or the national Council of provinces;
(b) a member of the board of directors of any municipal entity;
(c) an official of any municipality or municipal entity;
(d) an employee of any national or provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No.1 of 1999);
(e) a member of the accounting authority of any national or provincial public entity; or
(f) an employee of Parliament or a provincial legislature.

**"Shareholder" means a person who owns shares in the company and is actively involved in the management of the company or business and exercises control over the company.

……

3.10 Do you, have any relationship (family, friend, other) with persons in the service of the state and who may be involved with the evaluation and or adjudication of this bid? **YES / NO**

3.10.1 If so, furnish particulars.

……

……

3.11 Are you, aware of any relationship (family, friend, other) between a bidder and any persons in the service of the state who may be involved with the evaluation and or adjudication of this bid? **YES / NO**

3.11.1 If so, furnish particulars

……

……

3.12 Are any of the company's directors, managers, principal shareholders or stakeholders in service of the state? **YES / NO**

3.12.1 If so, furnish particulars.

……

……

3.13 Are any spouse, child or parent of the company's directors, managers, principal shareholders or stakeholders in service of the state? **YES / NO**

3.13.1 If so, furnish particulars.

……

……

3.14 Do you or any of the directors, trustees, managers, principal shareholders or stakeholders of this company have any interest in any other related companies or business whether or not they are bidding of this contract. **YES / NO**

3.14.1 If so, furnish particulars.

……

……

4. Full details of directors / trustees / members / shareholders.

Full Name	Identity Number	State Employee Number

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM J.3 DECLARATION CERTIFICATE FOR LOCAL PRODUCTION AND CONTENT (MBD 6.2)

This Municipal Bidding Document (MBD) must form part of all bids invited. It contains general information and serves as a declaration form for local content (local production and local content are used interchangeably).

Before completing this declaration, bidders must study the General Conditions, Definitions, Directives applicable in respect of Local Content as prescribed in the Preferential Procurement Regulations, 2011 and the South African Bureau of Standards (SABS) approved technical specification number SATS 1286:201x.

1. General Conditions

1.1. Preferential Procurement Regulations, 2011 (Regulation 9.(1) and 9.(3) make provision for the promotion of local production and content.

1.2. Regulation 9.(1) prescribes that in the case of designated sectors, where in the award of bids local production and content is of critical importance, such bids must be advertised with the specific bidding condition that only locally produced goods, services or works or locally manufactured goods, with a stipulated minimum threshold for local production and content will be considered.

1.3. Regulation 9.(3) prescribes that where there is no designated sector, a specific bidding condition may be included, that only locally produced services, works or goods or locally manufactured goods with a stipulated minimum threshold for local production and content, will be considered.

1.4. Where necessary, for bids referred to in paragraphs 1.2 and 1.3 above, a two stage bidding process may be followed, where the first stage involves a minimum threshold for local production and content and the second stage price and B-BBEE.

1.5. A person awarded a contract in relation to a designated sector, may not sub-contract in such a manner that the local production and content of the overall value of the contract is reduced to below the stipulated minimum threshold.

1.6. The local content (LC) as a percentage of the bid price must be calculated in accordance with the SABS approved technical specification number SATS 1286: 2011 as follows:

$$LC = \{1 - \frac{x}{y}\} \times 100$$

Where
x = imported content in Rand (ZAR)
y = bid price in Rand (ZAR), excluding value added tax (VAT)

Prices referred to in the determination of x must be converted to Rand (ZAR) by using the exchange rate published by the South African Reserve Bank (SARB) at 12:00 on the date, one week (7 calendar days) prior to the closing date of the bid as required in paragraph 4.1 below.

1.7. A bid will be disqualified if:

- the bidder fails to achieve the stipulated minimum threshold for local production and content indicated in paragraph 3 below; and.
- this declaration certificate is not submitted as part of the bid documentation.

2. Definitions

2.1. **"bid"** includes advertised competitive bids, written price quotations or proposals;

2.2. **"bid price"** price offered by the bidder, excluding value added tax (VAT);

2.3. **"contract"** means the agreement that results from the acceptance of a bid by an organ of state;
2.4. **"designated sector"** means a sector, sub-sector or industry that has been designated by the Department of Trade and Industry in line with national development and industrial policies for local production, where only locally produced services, works or goods or locally manufactured goods meet the stipulated minimum threshold for local production and content;

2.5. **"duly sign"** means a Declaration Certificate for Local Content that has been signed by the Chief Financial Officer or other legally responsible person nominated in writing by the Chief Executive, or senior member / person with management responsibility (close corporation, partnership or individual).

2.6. **"imported content"** means that portion of the bid price represented by the cost of components, parts or materials which have been or are still to be imported (whether by the supplier or its subcontractors) and which costs are inclusive of the costs abroad, plus freight and other direct importation costs, such as landing costs, dock duties, import duty, sales duty or other similar tax or duty at the South African port of entry;

2.7. **"local content"** means that portion of the bid price which is not included in the imported content, provided that local manufacture does take place;

2.8. **"stipulated minimum threshold"** means that portion of local production and content as determined by the Department of Trade and Industry; and

2.9. **"sub-contract"** means the primary contractor's assigning, leasing, making out work to, or employing another person to support such primary contractor in the execution of part of a project in terms of the contract.

3. The stipulated minimum threshold(s) for local production and content for this bid is/are as follows:

Industry/sector/sub-sector		**Minimum threshold for local content**
Electrical and telecom cables	:	90%
Valves and Actuators	:	70%
Steel Pipes & Fittings	:	80%
uPVC Pipes & Fittings	:	90%
HDPe Pipes	:	90%
Pumps and Motors	:	70%

4. Does any portion of the services, works or goods offered have any imported content? YES / NO

4.1 If yes, the rate(s) of exchange to be used in this bid to calculate the local content as prescribed in paragraph 1.6 of the general conditions must be the rate(s) published by the SARB for the specific currency at 12:00 on the date, one week (7 calendar days) prior to the closing date of the bid.
The relevant rates of exchange information is accessible on www.reservebank.co.za.
Indicate the rate(s) of exchange against the appropriate currency in the table below:

Currency	**Rates of exchange**
US Dollar	
Pound Sterling	
Euro	
Yen	
Other	

NB: Bidders must submit proof of the SARB rate (s) of exchange used.

LOCAL CONTENT DECLARATION BY CHIEF FINANCIAL OFFICER OR OTHER LEGALLY RESPONSIBLE PERSON NOMINATED IN WRITING BY THE CHIEF EXECUTIVE OR SENIOR MEMBER/PERSON WITH MANAGEMENT RESPONSIBILITY (CLOSE CORPORATION, PARTNERSHIP OR INDIVIDUAL)

IN RESPECT OF BID No. HGDM748/HGM/2021.....
ISSUED BY: (Procurement Authority / Name of Municipality / Municipal Entity):

HARRY GWALA DISTRICT MUNICIPALITY

NB The obligation to complete, duly sign and submit this declaration cannot be transferred to an external authorized representative, auditor or any other third party acting on behalf of the bidder.

I, the undersigned, ……..... (full names),
do hereby declare, in my capacity as …… ……..
of .....(name of bidder entity), the following:

(a) The facts contained herein are within my own personal knowledge.

(b) I have satisfied myself that the goods/services/works to be delivered in terms of the above-specified bid comply with the minimum local content requirements as specified in the bid, and as measured in terms of SATS 1286.

(c) The local content has been calculated using the formula given in clause 3 of SATS 1286, the rates of exchange indicated in paragraph 4.1 above and the following figures:

Electrical and Telecom Cables

Bid price, excluding VAT (y)	R
Imported content (x), as calculated in terms of SATS 1286:2011	R
Stipulated minimum threshold for local content (paragraph 3 above)	90%
Local content %, as calculated in terms of SATS 1286:2011	

Valves and Actuators

Bid price, excluding VAT (y)	R
Imported content (x), as calculated in terms of SATS 1286:2011	R
Stipulated minimum threshold for local content (paragraph 3 above)	70%
Local content %, as calculated in terms of SATS 1286:2011	

Steel Pipes (Lined and Coated)

Bid price, excluding VAT (y)	R
Imported content (x), as calculated in terms of SATS 1286:2011	R
Stipulated minimum threshold for local content (paragraph 3 above)	80%
Local content %, as calculated in terms of SATS 1286:2011	

Steel Pipe Fittings and Specials (Lined and Coated)

Bid price, excluding VAT (y)	R
Imported content (x), as calculated in terms of SATS 1286:2011	R
Stipulated minimum threshold for local content (paragraph 3 above)	80%
Local content %, as calculated in terms of SATS 1286:2011	

Pumps, Motor and Associated Accessories

Bid price, excluding VAT (y)	R
Imported content (x), as calculated in terms of SATS 1286:2011	R
Stipulated minimum threshold for local content (paragraph 3 above)	70%
Local content %, as calculated in terms of SATS 1286:2011	

If the bid is for more than one product, a schedule of the local content by product shall be attached.

(d) I accept that the Procurement Authority / Municipality /Municipal Entity has the right to request that the local content be verified in terms of the requirements of SATS 1286.

(e) I understand that the awarding of the bid is dependent on the accuracy of the information furnished in this application. I also understand that the submission of incorrect data, or data that are not verifiable as described in SATS 1286, may result in the Procurement Authority / Municipal / Municipal Entity imposing any or all of the remedies as provided for in Regulation 13 of the Preferential Procurement Regulations, 2011 promulgated under the Policy Framework Act (PPPFA), 2000 (Act No. 5 of 2000).

SIGNATURE: _____ **DATE:** _____

WITNESS No. 1 _____ **DATE:** _____

WITNESS No. 2 _____ **DATE:** _____

SATS 1286.2011

Annex C

Local Content Declaration - Summary Schedule

(C1) Tender No.
(C2) Tender description:
(C3) Designated product(s)
(C4) Tender Authority:
(C5) Tendering Entity name:
(C6) Tender Exchange Rate: Pula ____ EU ____ GBP ____
(C7) Specified local content %

Note: VAT to be excluded from all calculations

		Calculation of local content						Tender summary			
Tender item no's	List of items	Tender price - each (excl VAT)	Exempted imported value	Tender value net of exempted imported content	Imported value	Local value	Local content % (per item)	Tender Qty	Total tender value	Total exempted imported content	Total Imported content
(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)

(C20) Total tender value R 0
(C21) Total Exempt imported content R 0
(C22) Total Tender value net of exempt imported content R 0
(C23) Total Imported content R 0
(C24) Total local content R 0
(C25) Average local content % of tender

Signature of tenderer from Annex B

Date:

SATS 1286.2011

Annex C

Local Content Declaration - Summary Schedule

(C1)	**Tender No.**	
(C2)	**Tender description:**	
(C3)	**Designated product(s)**	
(C4)	**Tender Authority:**	
(C5)	**Tendering Entity name:**	
(C6)	**Tender Exchange Rate:**	Pula / EU / GBP
(C7)	**Specified local content %**	

Note: VAT to be excluded from all calculations

Tender item no's	List of items	Calculation of local content: Tender price - each (excl VAT)	Exempted imported value	Tender value net of exempted imported content	Imported value	Local value	Local content % (per item)	Tender summary: Tender Qty	Total tender value	Total exempted imported content	Total Imported content
(C8)	*(C9)*	*(C10)*	*(C11)*	*(C12)*	*(C13)*	*(C14)*	*(C15)*	*(C16)*	*(C17)*	*(C18)*	*(C19)*

(C20) Total tender value R 0

(C21) Total Exempt imported content R 0

(C22) Total Tender value net of exempt imported content R 0

(C23) Total Imported content R 0

(C24) Total local content R 0

(C25) Average local content % of tender

Signature of tenderer from Annex B

Date:

SATS 1286.2011

Annex C

Local Content Declaration - Summary Schedule

(C1) Tender No.
(C2) Tender description:
(C3) Designated product(s)
(C4) Tender Authority:
(C5) Tendering Entity name:
(C6) Tender Exchange Rate: Pula ____ EU ____ GBP ____
(C7) Specified local content %

Note: VAT to be excluded from all calculations

		Calculation of local content						Tender summary			
Tender item no's	List of items	Tender price - each (excl VAT)	Exempted imported value	Tender value net of exempted imported content	Imported value	Local value	Local content % (per item)	Tender Qty	Total tender value	Total exempted imported content	Total Imported content
(C8)	(C9)	(C10)	(C11)	(C12)	(C13)	(C14)	(C15)	(C16)	(C17)	(C18)	(C19)

(C20) Total tender value R 0
(C21) Total Exempt imported content R 0
(C22) Total Tender value net of exempt imported content R 0
(C23) Total Imported content R 0
(C24) Total local content R 0
(C25) Average local content % of tender

Signature of tenderer from Annex B

Date:

SATS 1286.2011

Annex C

Local Content Declaration - Summary Schedule

(C1) Tender No.
(C2) Tender description:
(C3) Designated product(s)
(C4) Tender Authority:
(C5) Tendering Entity name:
(C6) Tender Exchange Rate: Pula ______ EU ______ GBP ______
(C7) Specified local content %

Note: VAT to be excluded from all calculations

		Calculation of local content						Tender summary			
Tender item no's	List of items	Tender price - each (excl VAT)	Exempted imported value	Tender value net of exempted imported content	Imported value	Local value	Local content % (per item)	Tender Qty	Total tender value	Total exempted imported content	Total Imported content
(C8)	*(C9)*	*(C10)*	*(C11)*	*(C12)*	*(C13)*	*(C14)*	*(C15)*	*(C16)*	*(C17)*	*(C18)*	*(C19)*

(C20) Total tender value: R 0
(C21) Total Exempt imported content: R 0
(C22) Total Tender value net of exempt imported content: R 0
(C23) Total Imported content: R 0
(C24) Total local content: R 0
(C25) Average local content % of tender: ______

Signature of tenderer from Annex B

____

Date: ______________

FORM K FORM OF INTENT TO PROVIDE A PERFORMANCE GUARANTEE

[The Tenderer must attach hereto a letter from the bank or institution. with whom he has made the necessary arrangements, to the effect that the said bank or institution will be prepared to provide the required performance guarantee forthwith upon award of the contract to this tenderer].

Tenderers are to refer to Form C1.3: Form of Guarantee.

FORM L HEALTH AND SAFETY DECLARATION

In terms of Clause 5(h) of the OHSA Construction Regulations 2014 (referred to as "the Regulations" hereafter), a Contractor may only be appointed to perform construction work if the Client is satisfied that the Contractor has the necessary competencies and resources to carry out the work safely in accordance with the Occupational Health and Safety Act No 85 of 1993 and the Construction Regulations 2014.

To that effect a person duly authorised by the tenderer must complete and sign the declaration hereafter in detail.

Declaration by Tenderer

1. I the undersigned hereby declare and confirm that I am fully conversant with the Occupational Health and Safety Act No 85 of 1993 (as amended by the Occupational Health and Safety Amendment Act No 181 of 1993), and the Construction Regulations 2014.
2. I hereby declare that my company / enterprise has the competence and the necessary resources to safely carry out the construction work under this contract in compliance with the Construction Regulations and the Client's Health and Safety Specifications.
3. I hereby undertake, if my tender is accepted, to provide a sufficiently documented Health and Safety Plan in accordance with Regulation 7(1) of the Construction Regulations, approved by the Client or his representative, before I will be allowed to commence with construction work under the contract. I hereby agree that my company/enterprise will not have a claim for compensation for delay or extension of time because of my failure to obtain the necessary approval for the said safety plan.
4. I confirm that copies of my company's approved Health and Safety Plan, the Client's Safety Specifications as well as the OHSA 1993 Construction Regulations 2014 will be provided on site and will at all times be available for inspection by the Contractor's personnel, the Client's personnel, the Engineer, visitors, and officials and inspectors of the Department of Labour.
5. I hereby confirm that adequate provision has been made in my tendered rates and prices in the bill of quantities to cover the cost of all resources, actions, training and all health and safety measures envisaged in the OHSA 1993 Construction Regulations 2014, including the cost for specific items that may be scheduled in the bill of quantities.
6. I hereby confirm that I will be liable for any penalties that may be applied by the Client in terms of the said Regulations for failure on my part to comply with the provisions of the Act and the Regulations as set out in Clause 33 of the Regulations.
7. I agree that my failure to complete and execute this declaration to the satisfaction of the Client will mean that I am unable to comply with the requirements of the OHSA 1993 Construction Regulations 2014, and accept that my tender will be prejudiced and may be rejected at the discretion of the Client.
8. I am aware of the fact that, should I be awarded the contract, I must submit the notification required in terms of Clause 4 of the OHSA 1993 Construction Regulations 2014 before I will be allowed to proceed with any work under the contract.

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM M.1 DECLARATION OF TENDERER'S PAST SUPPLY CHAIN MANAGEMENT PRACTICES (MBD 8)

1 This Municipal Tender Document must form part of all bids invited.

2 It serves as a declaration to be used by municipalities and municipal entities in ensuring that when goods and services are being procured, all reasonable steps are taken to combat the abuse of the supply chain management system.

3 The tender of any tenderer may be rejected if that tender, or any of its directors have:

a. abused the municipality's / municipal entity's supply chain management system or committed any improper conduct in relation to such system;

b. been convicted for fraud or corruption during the past five years;

c. willfully neglected, reneged on or failed to comply with any government, municipal or other public sector contract during the past five years; or

d. been listed in the Register for Tender Defaulters in terms of section 29 of the Prevention and Combating of Corrupt Activities Act (N° 12 of 2004).

4 In order to give effect to the above, the following questionnaire must be completed and submitted with the tender.

Item	Question	Yes	No
4.1	*Is the tenderer or any of its directors listed on the National Treasury's database as a company or person prohibited from doing business with the public sector?* (Companies or persons who are listed on this database were informed in writing of this restriction by the National Treasury after the *audi alteram partem* rule was applied).	Yes ☐	No ☐
4.1.1	If so, furnish particulars:		
4.2	**Is the tenderer or any of its directors listed on the Register for Tender Defaulters in terms of section 29 of the Prevention and Combating of Corrupt Activities Act (N° 12 of 2004)?** (To access this Register enter the National Treasury's website, www.treasury.gov.za, click on the icon "Register for Tender Defaulters" or submit your written request for a hard copy of the Register to facsimile number (012) 3265445).	Yes ☐	No ☐
4.2.1	If so, furnish particulars:		
4.3	Was the tenderer or any of its directors convicted by a court of law (including a court of law outside the Republic of South Africa) for fraud or corruption during the past five years?	Yes ☐	No ☐
4.3.1	If so, furnish particulars:		

Item	Question	Yes	No
4.4	**Does the tenderer or any of its directors owe any municipal rates and taxes or municipal charges to the municipality / municipal entity, or to any other municipality / municipal entity, that is in arrears for more than three months?**	Yes ☐	No ☐
4.4.1	If so, furnish particulars:		
4.5	Was any contract between the tenderer and the municipality / municipal entity or any other organ of state terminated during the past five years on account of failure to perform on or comply with the contract?	Yes ☐	No ☐
4.5.1	If so, furnish particulars:		

CERTIFICATION

I, THE UNDERSIGNED (FULL NAME) ……
CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM TRUE AND CORRECT.

I ACCEPT THAT, IN ADDITION TO CANCELLATION OF A CONTRACT, ACTION MAY BE TAKEN AGAINST ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM M.2 CERTIFICATE OF INDEPENDENT BID DETERMINATION (MBD 9)

1 This Municipal Bidding Document (MBD) must form part of all bids[1] invited.

2 Section 4 (1) (b) (iii) of the Competition Act N°. 89 of 1998, as amended, prohibits an agreement between, or concerted practice by, firms, or a decision by an association of firms, if it is between parties in a horizontal relationship and if it involves collusive bidding (or bid rigging).[2] Collusive bidding is a *per se* prohibition meaning that it cannot be justified under any grounds.

3 Municipal Supply Regulation 38 (1) prescribes that a supply chain management policy must provide measures for the combating of abuse of the supply chain management system, and must enable the accounting officer, among others, to:

a. take all reasonable steps to prevent such abuse;

b. reject the bid of any bidder if that bidder or any of its directors has abused the supply chain management system of the municipality or municipal entity or has committed any improper conduct in relation to such system; and

c. cancel a contract awarded to a person if the person committed any corrupt or fraudulent act during the bidding process or the execution of the contract.

4. This MBD serves as a certificate of declaration that would be used by institutions to ensure that, when bids are considered, reasonable steps are taken to prevent any form of bid-rigging.

5. In order to give effect to the above, the attached Certificate of Bid Determination (MBD 9) must be completed and submitted with the bid:

[1] Includes price quotations, advertised competitive bids, limited bids and proposals.

[2] Bid rigging (or collusive bidding) occurs when businesses, that would otherwise be expected to compete, secretly conspire to raise prices or lower the quality of goods and / or services for purchasers who wish to acquire goods and / or services through a bidding process. Bid rigging is, therefore, an agreement between competitors not to compete.

I, the undersigned, in submitting the accompanying bid:

CONTRACT NO: HGDM748/HGM/2021: CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM AND RISING MAIN: CIVIL, MECHANICAL AND ELECTRICAL.

in response to the invitation for the bid made by:

HARRY GWALA DISTRICT MUNICIPALITY

do hereby make the following statements that I certify to be true and complete in every respect:

I certify, on behalf of: _____that:
(Name of Bidder)

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

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

3. I am authorized by the bidder to sign this Certificate, and to submit the accompanying bid, on behalf of the bidder;
4. Each person whose signature appears on the accompanying bid has been authorized by the bidder to determine the terms of, and to sign, the bid, on behalf of the bidder;

5. For the purposes of this Certificate and the accompanying bid, I understand that the word "competitor" shall include any individual or organization, other than the bidder, whether or not affiliated with the bidder, who:

   (a) has been requested to submit a bid in response to this bid invitation;
   (b) could potentially submit a bid in response to this bid invitation, based on their qualifications, abilities or experience; and
   (c) provides the same goods and services as the bidder and/or is in the same line of business as the bidder

6. The bidder has arrived at the accompanying bid independently from, and without consultation, communication, agreement or arrangement with any competitor. However communication between partners in a joint venture or consortium[3] will not be construed as collusive bidding.

7. In particular, without limiting the generality of paragraphs 6 above, there has been no consultation, communication, agreement or arrangement with any competitor regarding:

   (a) prices;
   (b) geographical area where product or service will be rendered (market allocation)
   (c) methods, factors or formulas used to calculate prices;
   (d) the intention or decision to submit or not to submit, a bid;
   (e) the submission of a bid which does not meet the specifications and conditions of the bid; or
   (f) bidding with the intention not to win the bid.

8. In addition, there have been no consultations, communications, agreements or arrangements with any competitor regarding the quality, quantity, specifications and conditions or delivery particulars of the products or services to which this bid invitation relates.

9. The terms of the accompanying bid have not been, and will not be, disclosed by the bidder, directly or indirectly, to any competitor, prior to the date and time of the official bid opening or of the awarding of the contract.

   [3] **Joint venture or Consortium means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract.**

10. I am aware that, in addition and without prejudice to any other remedy provided to combat any restrictive practices related to bids and contracts, bids that are suspicious will be reported to the Competition Commission for investigation and possible imposition of administrative penalties in terms of section 59 of the Competition Act N° 89 of 1998 and or may be reported to the National Prosecuting Authority (NPA) for criminal investigation and or may be restricted from conducting business with the public sector for a period not exceeding ten (10) years in terms of the Prevention and Combating of Corrupt Activities Act N° 12 of 2004 or any other applicable legislation.

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM N MUNICIPAL ACCOUNT

Information required in terms of the Harry Gwala District Municipality's Supply Chain Management Policy. Latest municipal services account statement must be attached.

FURTHER DETAILS OF THE BIDDER/S: Proprietor / Director(s) / Partners, etc:

Physical Business address of the Bidder	Municipal Account Number(s)

If there is not enough space for all the names, please attach the additional details to the Tender document.

Name of Director / Member / Partner	Identity Number	Physical **residential** address of Director / Member / Partner	Municipal Account number(s)

I, _____, the undersigned,
(full name in block letters)
certify that the information furnished on this declaration form is correct and that I/we have no undisputed commitments for municipal services towards a municipality or other service provider in respect of which payment if overdue for more than 30 days.

_____
Signature

THUS DONE AND SIGNED for and on behalf of the Bidder / Contractor

at _____ on the _____ day of _____ 20__

<u>Please note</u>:
Even if the requested information is not applicable to the Bidder, the table above should be endorsed NOT APPLICABLE and THIS DECLARATION MUST STILL BE SIGNED

FORM O QUALITY SCORECARD (FUNCTIONALITY)

Points for quality will be calculated **by the Employer** based on information provided by the Tenderer in the following Quality Scorecard.

Only Tenderers scoring 65% or more for quality will be considered eligible for evaluation.

Tenderers should supply supporting information to prove points claimed where it's not available in other Returnable Schedules.

PARTICULAR NOTES REGARDING FORMS FOR TENDERERS EXPERIENCE:

TENDERER'S EXPERIENCE FORMS MUST BE FULLY COMPLETED BY THE TENDERER – Attaching generic lists of completed projects will not be accepted. A full description of the project must be provided to enable proper assessment of the type of work carried out. If there is insufficient space on the form provided, Tenderers may attach a suitably typed up list of projects in the same format as this form. NO MORE THAN THE REQUIRED PROJECTS PER CATEGORY TO BE PROVIDED – if more than the required number of projects are provided, only the required number will be considered for scoring.

FORM O.1 CRITERIA: TENDERER'S EXPERIENCE IN SUPPLY AND INSTALLATION OF HDPE WATER PIPELINES GREATER THAN 330MM NOMINAL BORE AND GREATER THAN 500M IN LENGTH

Maximum Score = 18

1	List below up to 4 contracts of similar work undertaken for each discipline/category as main contractor **A SIGNED AND CERTIFIED CERTIFICATE OF COMPLETION FOR THE RESPECTIVE PROJECTS MUST BE INCLUDED IN THE TENDER SUBMISSION IN ORDER TO CLAIM POINTS. Along with a detailed description**					**No of Projects Completed**	**Points**	**Score (S)**
Category	**Contract**	**Client Reference**						
		Project Value	**Contact Name**	**Client Organisation**	**Tel N°**			
Supply and Installation of HDPe Water Pipelines Greater than 330mm Nominal Bore and Greater than 500m in Length.	**Name of Project :** **Largest Pipeline Diameter :** **Largest Pipeline Length :** **Largest Pipeline Material Type :**					1 Project	4	
	Name of Project : **Largest Pipeline Diameter :** **Largest Pipeline Length :** **Largest Pipeline Material Type :**					2 Projects	8	
	Name of Project : **Largest Pipeline Diameter :** **Largest Pipeline Length :** **Largest Pipeline Material Type :**					3 Projects	13	
	Name of Project : **Largest Pipeline Diameter :** **Largest Pipeline Length :** **Largest Pipeline Material Type :**					4 Projects	18	
						Possible Full Points =	**18**	
						Actual Points Obtained S1 =		

FORM O.2 CRITERIA: TENDERER'S EXPERIENCE IN INSTALLATION OF MECHANICAL AND ELECTRICAL COMPONENTS OF WATER PUMPING STATIONS WITH A NOMINAL DELIVERY OF 100ℓ/SEC

Maximum Score = 15

2	List below up to 4 contracts of similar work undertaken for each discipline/category as main contractor. **A SIGNED AND CERTIFIED CERTIFICATE OF COMPLETION FOR THE RESPECTIVE PROJECTS MUST BE INCLUDED IN THE TENDER SUBMISSION IN ORDER TO CLAIM POINTS. Along with a detailed description**					**No of Projects Completed**	**Points**	**Score (S)**
Category	**Contract**	**Client Reference**						
		Project Value	**Contact Name**	**Client Organisation**	**Tel N°**			
Installation of Mechanical and Electrical Components of Water Pumping Stations with a Nominal Delivery of 100ℓ /sec	Name of Project :…… Pumping Station Nominal Flow Rate: ……..ℓ/sec Rating of Pump Motors: ……..kW					1 Project	3	
	Name of Project: …… Pumping Station Nominal Flow Rate: ……..ℓ/sec Rating of Pump Motors: ……..kW					2 Projects	8	
	Name of Project: …… Pumping Station Nominal Flow Rate: ……..ℓ/sec Rating of Pump Motors: ……..kW					3 Projects	12	
	Name of Project: …… Pumping Station Nominal Flow Rate: ……..ℓ/sec Rating of Pump Motors: ……..kW					4 Projects	15	
						Possible Full Points =	**15**	
						Actual Points Obtained S2 =		

FORM O.3 CRITERIA: TENDERER'S EXPERIENCE IN THE CONSTRUCTION OF RIVER DIVERSION WORKS ON RIVERS WIDER THAN 10M:

Maximum Score = 20

3	List below up to 4 contracts of similar work undertaken for each discipline/category as main contractor. **A SIGNED AND CERTIFIED CERTIFICATE OF COMPLETION FOR THE RESPECTIVE PROJECTS MUST BE INCLUDED IN THE TENDER SUBMISSION IN ORDER TO CLAIM POINTS. Along with a detailed description**					**No of Projects Completed**	**Points**	**Score (S)**
Category	**Contract**	**Client Reference**						
		Project Value	**Contact Name**	**Client Organisation**	**Tel N°**			
Construction Of River Diversion Works On Rivers Wider Than 10m	Name of Project : Width of River : Type of Diversion (Concrete, : Earth, Gabion, etc :					1 Project	5	
	Name of Project : Width of River : Type of Diversion (Concrete, : Earth, Gabion, etc :					2 Projects	10	
	Name of Project : Width of River : Type of Diversion (Concrete, : Earth, Gabion, etc :					3 Projects	15	
	Name of Project : Width of River : Type of Diversion (Concrete, : Earth, Gabion, etc :					4 Projects	20	
						Possible Full Points =	**20**	
						Actual Points Obtained S3 =		

FORM O.4

FORM O.4 CRITERIA: TENDERER'S EXPERIENCE IN THE CONSTRUCTION OF REINFORCED CONCRETE STRUCTURES 6m High OR HIGHER

Maximum Score = 21

4	List below up to 4 contracts of similar work undertaken for each discipline/category as main contractor. **A SIGNED AND CERTIFIED CERTIFICATE OF COMPLETION FOR THE RESPECTIVE PROJECTS MUST BE INCLUDED IN THE TENDER SUBMISSION IN ORDER TO CLAIM POINTS. Along with a detailed description**					**No of Projects Completed**	**Points**	**Score (S)**
Category	**Contract**	**Client Reference**						
		Project Value	**Contact Name**	**Client Organisation**	**Tel N°**			
Construction of Reinforced Concrete Structures 6m high Or Higher	Name of Project : Type of Structure : Height of Structure :					1 Project	5	
	Name of Project : Type of Structure : Height of Structure :					2 Projects	10	
	Name of Project : Type of Structure : Height of Structure :					3 Projects	15	
	Name of Project : Type of Structure : Height of Structure :					4 Projects	21	
						Possible Full Points =	**21**	
						Actual Points Obtained S4 =		

FORM O.5 CRITERIA: FINANCIAL RESOURCES (BANK RATING):

Maximum Score = 5

5	**Score one of the ratings listed below as reflected on rating received – see Section E1**	**Points**	**Score (S)**
5.1	Bank Rating A – Undoubted for the amount of enquiry Bank Rating B – Good for the amount of enquiry Bank Rating C – Good for the amount quoted if applied strictly in the way of business Bank Rating D – Fair trade for the amount of enquiry	5	
5.2	Bank Rating E – Figures considered too high Bank Rating F – Financial Position Unknown Bank Rating G – Dishonour on records Bank Rating H – Frequently Dishonoured	**0**	
	Possible Full Points =	**5**	
	Actual Points Obtained S5 =		

Note: Tenderers are to submit a copy of their bank rating in FORM G

FORM O.6 CRITERIA: EXPERIENCE OF KEY PERSONNEL:

Maximum Score = 16

6	Proposed key Personnel	Experience	Points		Score (S)
6.1	Contracts Manager Name:	Relevant Professional Registration with ECSA or SACPCMP with more than 5 years' appropriate experience	2		
6.2	Construction Manager Note the Construction Manager may be the same person as the Contracts Manager Name:	Relevant Professional Registration with ECSA or SACPCMP with more than 8 years' of appropriate experience	6	6	
		Relevant Professional Registration with ECSA or SACPCMP with 5-8 years' of appropriate experience	4		
		Relevant Professional Registration with ECSA or SACPCMP with 2-4 years' of appropriate experience	2		
6.3	Structural Foreman Name:	With more than 10 years' appropriate experience	6	6	
		With 8-10 years' appropriate experience	4		
		With 5-8 years' appropriate experience	2		
6.4	Pipe laying Foreman Name:	With more than 8 years' appropriate experience	2		
		Possible Full Points =	**16**		
		Actual Points Obtained S6 =			

Note: Curricula Vitae to be attached to FORM BB Key Personnel
Years of appropriate experience means experience in the construction of Potable water pipelines, pumping stations, concrete structures etc as appropriate.
Certified copies of Degrees or Diplomas to be attached if points are claimed.

FORM O.7 CRITERIA: QUALITY ASSURANCE PLAN AND CONTROL PROCEDURES:

Maximum Score = 5

7	Score one status as listed below	Points	Score (S)
7.1	ISO 9001 Accreditation	5	
7.2	Own Internal QA Plan	3	
7.3	None	0	
	Possible Full Points =	**5**	
	Actual Points Obtained S7		=

Note: If 6.1 selected, attach current copy of ISO Accreditation Certificates to FORM I
If 6.2 selected attach copy of Internal Quality Assurance Plan to FORM I

FORM O.8 TOTAL SCORE FOR QUALITY (FUNCTIONALITY)

	Criteria	Possible Full Points	Actual Points Obtained
1	Experience applicable to Pipelines	18	S1=
2	Experience applicable to Mechanical & Electrical	15	S2=
3	Experience applicable to River Diversions	20	S3=
4	Experience applicable to Reinforced Concrete Construction	21	S4 =
5	Financial Resources	5	S5 =
6	Experience of Key Personnel	16	S6 =
7	Quality Assurance Plan and Control Procedures	5	S7 =
	Total Possible Points	**100**	**Total Points Obtained** =

Note: **Only Eligible for Evaluation if Total points scored are ≥ 65 points**

FORM P PREFERENCE POINTS – B-BBEE STATUS LEVEL (MBD 6.1)

MBD 6.1

PREFERENCE POINTS CLAIM FORM IN TERMS OF THE PREFERENTIAL PROCUREMENT REGULATIONS 2017

PURCHASES

This preference form must form part of all bids invited. It contains general information and serves as a claim form for preference points for Broad-Based Black Economic Empowerment (B-BBEE) Status Level of Contribution

NB: BEFORE COMPLETING THIS FORM, BIDDERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT OF B-BBEE, AS PRESCRIBED IN THE PREFERENTIAL PROCUREMENT REGULATIONS, 2017.

1. GENERAL CONDITIONS

1.1 The following preference point systems are applicable to all bids:

- the 80/20 system for requirements with a Rand value of up to R 50 000 000 (all applicable taxes included); and
- the 90/10 system for requirements with a Rand value above R 50 000 000 (all applicable taxes included).

1.2 The value of this bid is estimated to NOT exceed R50 000 000 (all applicable taxes included) and therefore the 80/20 system shall be applicable.

1.3 Preference points for this bid shall be awarded for:

(a) Price; and
(b) B-BBEE Status Level of Contribution.

1.3.1 The maximum points for this bid are allocated as follows:

		POINTS
1.3.1.1	**PRICE**	**80**
1.3.1.2	**B-BBEE STATUS LEVEL OF CONTRIBUTION**	**20**
	Total points for Price and B-BBEE must not exceed	**100**

Separate Preference Points Claim Forms will be used for the promotion of the specific goals for which points have been allocated in paragraph 1.3.1.2 (b) above

1.4 Failure on the part of a bidder to fill in and/or to sign this form and submit a B-BBEE Verification Certificate from a Verification Agency accredited by the South African Accreditation System (SANAS) or a Registered Auditor approved by the Independent Regulatory Board of Auditors (IRBA) or an Accounting Officer as contemplated in the Close Corporation Act (CCA) together with the bid, will be interpreted to mean that preference points for B-BBEE status level of contribution are not claimed.

1.5. The purchaser reserves the right to require of a bidder, either before a bid is adjudicated or at any time subsequently, to substantiate any claim in regard to preferences, in any manner required by the purchaser.

2. DEFINITIONS

2.1 **"all applicable taxes"** includes value-added tax, pay as you earn, income tax, unemployment

insurance fund contributions and skills development levies;

2.2 **"B-BBEE"** means broad-based black economic empowerment as defined in section 1 of the Broad-Based Black Economic Empowerment Act;

2.3 "**B-BBEE status level of contributor"** means the B-BBEE status received by a measured entity based on its overall performance using the relevant scorecard contained in the Codes of Good Practice on Black Economic Empowerment, issued in terms of section 9(1) of the Broad-Based Black Economic Empowerment Act;

2.4 **"bid"** means a written offer in a prescribed or stipulated form in response to an invitation by an organ of state for the provision of services, works or goods, through price quotations, advertised competitive bidding processes or proposals;

2.5 **"Broad-Based Black Economic Empowerment Act"** means the Broad-Based Black Economic Empowerment Act, 2003 (Act N°. 53 of 2003);

2.6 **"comparative price"** means the price after the factors of a non-firm price and all unconditional discounts that can be utilized have been taken into consideration;

2.7 **"consortium or joint venture"** means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract;

2.8 **"contract"**Error! Bookmark not defined. means the agreement that results from the acceptance of a bid by an organ of state;

2.9 **"EME"** means any enterprise with an annual total revenue of R5 million or less.

2.10 **"Firm price"** means the price that is only subject to adjustments in accordance with the actual increase or decrease resulting from the change, imposition, or abolition of customs or excise duty and any other duty, levy, or tax, which, in terms of the law or regulation, is binding on the contractor and demonstrably has an influence on the price of any supplies, or the rendering costs of any service, for the execution of the contract;

2.11 **"functionality"** means the measurement according to predetermined norms, as set out in the bid documents, of a service or commodity that is designed to be practical and useful, working or operating, taking into account, among other factors, the quality, reliability, viability and durability of a service and the technical capacity and ability of a bidder;

2.12 **"non-firm prices"** means all prices other than "firm" prices;

2.13 **"person"** includes a juristic person;

2.14 **"rand value"** means the total estimated value of a contract in South African currency, calculated at the time of bid invitations, and includes all applicable taxes and excise duties;

2.15 ***"sub*-contract"*** means the primary contractor's assigning, leasing, making out work to, or employing, another person to support such primary contractor in the execution of part of a project in terms of the contract;

2.16 **"total revenue"** bears the same meaning assigned to this expression in the Codes of Good Practice on Black Economic Empowerment, issued in terms of section 9(1) of the Broad-Based Black Economic Empowerment Act and promulgated in the *Government Gazette* on 9 February 2007;

2.17 **"trust"** means the arrangement through which the property of one person is made over or bequeathed to a trustee to administer such property for the benefit of another person; and **"trustee"** means any person, including the founder of a trust, to whom property is bequeathed in order for such property to be administered for the benefit of another person.

3. ADJUDICATION USING A POINT SYSTEM

3.1 The bidder obtaining the highest number of total points will be awarded the contract.

3.2 Preference points shall be calculated after prices have been brought to a comparative basis taking into account all factors of non-firm prices and all unconditional discounts;.

3.3 Points scored must be rounded off to the nearest 2 decimal places.

3.4 In the event that two or more bids have scored equal total points, the successful bid must be the one scoring the highest number of preference points for B-BBEE.

3.5 However, when functionality is part of the evaluation process and two or more bids have scored equal points including equal preference points for B-BBEE, the successful bid must be the one scoring the highest score for functionality.

3.6 Should two or more bids be equal in all respects, the award shall be decided by the drawing of lots.

4. POINTS AWARDED FOR PRICE

4.1 THE 80/20 OR 90/10 PREFERENCE POINT SYSTEMS

A maximum of 80 or 90 points is allocated for price on the following basis:

80/20 **or** **90/10**

$$Ps = 80\left(1 - \frac{Pt - P\min}{P\min}\right) \quad \text{or} \quad Ps = 90\left(1 - \frac{Pt - P\min}{P\min}\right)$$

Where

Ps = Points scored for comparative price of bid under consideration

Pt = Comparative price of bid under consideration

Pmin = Comparative price of lowest acceptable bid

5. POINTS AWARDED FOR B-BBEE STATUS LEVEL OF CONTRIBUTION

5.1 In terms of Regulation 5 (2) and 6 (2) of the Preferential Procurement Regulations, preference points must be awarded to a bidder for attaining the B-BBEE status level of contribution in accordance with the table below:

B-BBEE Status Level of Contributor	Number of points (90/10 system)	Number of points (80/20 system)
1	10	20
2	9	18
3	8	14
4	5	12
5	4	8
6	3	6
7	2	4
8	1	2
Non-compliant contributor	0	0

5.2 Bidders who qualify as EMEs in terms of the B-BBEE Act must submit a certificate issued by an Accounting Officer as contemplated in the CCA or a Verification Agency accredited by SANAS or a Registered Auditor. Registered auditors do not need to meet the prerequisite for IRBA's approval for the purpose of conducting verification and issuing EMEs with B-BBEE Status Level Certificates.

5.3 Bidders other than EMEs must submit their original and valid B-BBEE status level verification certificate or a certified copy thereof, substantiating their B-BBEE rating issued by a Registered Auditor approved by IRBA or a Verification Agency accredited by SANAS.

5.4 A trust, consortium or joint venture, will qualify for points for their B-BBEE status level as a legal entity, provided that the entity submits their B-BBEE status level certificate.

5.5 A trust, consortium or joint venture will qualify for points for their B-BBEE status level as an unincorporated entity, provided that the entity submits their consolidated B-BBEE scorecard as if they were a group structure and that such a consolidated B-BBEE scorecard is prepared for every separate bid.

5.6 Tertiary institutions and public entities will be required to submit their B-BBEE status level certificates in terms of the specialized scorecard contained in the B-BBEE Codes of Good Practice.

5.7 A person will not be awarded points for B-BBEE status level if it is indicated in the bid documents that such a bidder intends sub-contracting more than 25% of the value of the contract to any other enterprise that does not qualify for at least the points that such a bidder qualifies for, unless the intended sub-contractor is an EME that has the capability and ability to execute the sub-contract.

5.8 A person awarded a contract may not sub-contract more than 25% of the value of the contract to any other enterprise that does not have an equal or higher B-BBEE status level than the person concerned, unless the contract is sub-contracted to an EME that has the capability and ability to execute the sub-contract.

6. BID DECLARATION

6.1 Bidders who claim points in respect of B-BBEE Status Level of Contribution must complete the following:

7. B-BBEE STATUS LEVEL OF CONTRIBUTION CLAIMED IN TERMS OF PARAGRAPHS 1.3.1.2 AND 5.1

7.1 B-BBEE Status Level of Contribution: …… = ……(maximum of 10 or 20 points)

(Points claimed in respect of paragraph 7.1 must be in accordance with the table reflected in paragraph 5.1 and must be substantiated by means of a B-BBEE certificate issued by a Verification Agency accredited by SANAS or a Registered Auditor approved by IRBA or an Accounting Officer as contemplated in the CCA).

8 SUB-CONTRACTING

8.1 Will any portion of the contract be sub-contracted? YES / NO (delete which is not applicable)

8.1.1 If yes, indicate:

(i) what percentage of the contract will be subcontracted? .....……%

(ii) the name of the sub-contractor? ……

(iii) the B-BBEE status level of the sub-contractor? ……..

(iv) whether the sub-contractor is an EME? YES / NO (delete which is not applicable)

9 DECLARATION WITH REGARD TO COMPANY/FIRM

9.1 Name of company/firm ..... :

9.2 VAT registration number : .....

9.3 Company registration number ……

9.4 Type of Company/Firm

☐ Partnership/Joint Venture / Consortium
☐ One person business/sole propriety
☐ Close corporation
☐ Company
☐ (Pty) Limited
[TICK APPLICABLE BOX]

9.5 Describe Principal Business Activities

…… .....

…… .....

…… .....

9.6 Company Classification

☐ Manufacturer
☐ Supplier
☐ Professional service provider
☐ Other service providers, e.g. transporter, etc.
[TICK APPLICABLE BOX]

9.7 Total Number of Years the Company/Firm has been in Business? ……..…

9.8 I/we, the undersigned, who is / are duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the B-BBE status level of contribution indicated in paragraph 7 of the foregoing certificate, qualifies the company/ firm for the preference(s) shown and I / we acknowledge that:

(i) The information furnished is true and correct;

(ii) The preference points claimed are in accordance with the General Conditions as indicated in paragraph 1 of this form.

(iii) In the event of a contract being awarded as a result of points claimed as shown in paragraph 7, the contractor may be required to furnish documentary proof to the satisfaction of the purchaser that the claims are correct;

(iv) If the B-BBEE status level of contribution has been claimed or obtained on a fraudulent basis or any of the conditions of contract have not been fulfilled, the purchaser may, in addition to any other remedy it may have –

(a) disqualify the person from the bidding process;

(b) recover costs, losses or damages it has incurred or suffered as a result of that person's conduct;

(c) cancel the contract and claim any damages which it has suffered as a result of having to make less favourable arrangements due to such cancellation;

(d) restrict the bidder or contractor, its shareholders and directors, or only the shareholders and directors who acted on a fraudulent basis, from obtaining business from any organ of state for a period not exceeding 10 years, after the audi alteram partem (hear the other side) rule has been applied; and

(e) forward the matter for criminal prosecution.

WITNESSES:

1. ……

……

SIGNATURE(S) OF TENDERER(S)

2. ……

DATE:…….....

ADDRESS:……..

……..

……..

……..

FORM Q B-BBEE CERTIFICATE

[Attach B-BBEE Certificate here]

FORM R DECLARATION FOR PROCUREMENT ABOVE R10 MILLION (ALL APPLICABLE TAXES INCLUDED (MDB 4)

For all procurement expected to exceed R10 million (all applicable taxes included), bidders must complete the following questionnaire:

1. Are you by law required to prepare annual financial statements for auditing? ***YES / NO**

1.1 If yes, submit audited annual financial statements for the past three years or since the date of establishment if established during the past three years.

……

……

2. Do you have any outstanding undisputed commitments for municipal services towards any municipality for more than three months or any other service provider in respect of which payment is overdue for more than 30 days? ***YES / NO**

2.1 If no, this serves to certify that the bidder has no undisputed commitments for municipal services towards any municipality for more than three months or other service provider in respect of which payment is overdue for more than 30 days.

2.2 If yes, provide particulars.

……

……

……

……

3. Has any contract been awarded to you by an organ of state during the past five years, including particulars of any material non-compliance or dispute concerning the execution of such contract? ***YES / NO**

3.1 If yes, provide particulars.

……

……

4. Will any portion of goods or services be sourced from outside the Republic, and, if so, what portion and whether any portion of payment from the municipality / municipal entity is expected to be transferred out of the Republic? ***YES / NO**

4.1 If yes, provide particulars.

……

……

I, THE UNDERSIGNED (NAME) ..... CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM IS CORRECT. I ACCEPT THAT THE STATE MAY ACT AGAINST ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM S AUDITED FINANCIAL STATEMENTS

[Attach AUDITED FINANCIAL STATEMENTS here]

FORM T REGISTRATION ON COUNCIL DATABASE

Registration on the Council Database is a prerequisite prior to the submission and closing of the Proposal. It is the responsibility of the Proposer to ensure that the registration documents are received by the Supply Chain Management Office. Further information in this regard can be obtained from the Supply Chain Practitioner on 039 834 8700.

Proposers are to obtain proof of registration letter from the Supply Chain Office and attach a copy thereof to this page.

FORM U REGISTRATION ON CENTRAL SUPPLIER DATABASE

Registration on the Central Supplier Database is a prerequisite prior to the submission and closing of the Proposal.

Tenderer are to obtain proof of registration letter from the CSD and attach a copy thereof to this page or Provide their CSD registration number below.

CSD Supplier Reference Number: _____

T2.2.2 RETURNABLE SCHEDULES AND OTHER DOCUMENTS THAT WILL BE INCORPORATED INTO THE CONTRACT

FORM V RECORD OF ADDENDA TO TENDER DOCUMENTS

I / We confirm that the following communications amending the tender documents that I / we received from the client or his agent before the closing date for submission of this tender offer have been taken into account in this tender offer.

ADDENDUM No	DATE	TITLE OR DETAILS

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM W AMENDMENTS, QUALIFICATIONS AND ALTERNATIVES

(This is not an invitation for amendments, deviations or alternatives but, should the Tenderer desire to make any departures from the provisions of this contract, he shall set out his proposals clearly hereunder. The Client will not consider any amendment, alternative offers or discounts unless forms (a), (b) and (c) have been completed to the satisfaction of the Client).

I / We herewith propose the amendments, alternatives and discounts as set out in the tables below:

(a) AMENDMENTS

PAGE, CLAUSE OR ITEM N°	PROPOSED AMENDMENT

[Notes: 1. Proposals for amendments to the General and Special Conditions of Contract will not be considered, and may invalidate the offer;

2. The Tenderer must give full details of all the financial implications of the amendments and qualifications in a covering letter attached to his tender.]

(b) ALTERNATIVES

PROPOSED ALTERNATIVE	DESCRIPTION OF ALTERNATIVE

[Notes: 1. Individual alternative items that do not justify an alternative tender, and an alternative offer for time for completion should be listed here.

2. In the case of a major alternative to any part of the work, a separate Bill of Quantities, programme, etc, and a detailed statement setting out the salient features of the proposed alternatives must accompany the tender.

3. Alternative tenders involving technical modifications to the design of the works and methods of construction shall be treated separately from the main tender offer.]

(c) DISCOUNTS

ITEM ON WHICH DISCOUNT IS OFFERED	DESCRIPTION OF DISCOUNT OFFERED

[Note: The Tenderer must give full details of the discounts offered in a covering letter attached to his tender, failing which, the offer for a discount may have to be disregarded.]

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM X PRELIMINARY PROGRAMME

The Tenderer shall detail below or attach a preliminary programme reflecting the proposed sequence and tempo of execution of the various activities comprising the work for this Contract. The programme shall be in accordance with the information supplied in the Contract, requirements of the Scope of Work and with all other aspects of his Tender.

PROGRAMME

ACTIVITY	WEEKS																																															

[Note: The programme must be based on the completion time as specified in the Contract Data. The Tenderer shall attach a form that has enough columns to cover the time periods involved in the period for performance of the contract. No other completion time that may be indicated on this programme will be regarded as an alternative offer, unless it is listed in Table (b) of Returnable Documents O (previous section), and supported by a detailed statement to that effect, all as specified in the Tender Data]

SIGNATURE: ....……….....…….. DATE: ....

(of person authorised to sign on behalf of the Tenderer)

FORM Y PRELIMINARY CASH FLOW

[The Tenderer shall attach a preliminary cash flow reflecting the proposed monthly cash flow in unison with the construction program. The Tenderer shall attach a form that has enough columns to cover the time periods involved in the period for performance of the contract. The program shall be in accordance with the information supplied in the Contract, requirements of the Project Specifications and with all other aspects of this tender.]

Note: The cash flow must be based upon the completion time proposed by the tenderer or as stated elsewhere in this tender document as the case may be.

Pro Forma Cash Flow

CASH FLOW	1	2	3	4	5	6	7	8	9	10	11	12
Per Month												
Cumulative												

FORM Z SCHEDULE OF PLANT AND EQUIPMENT

The following are lists of major items of relevant equipment that I / we presently own or lease and will have available for this contract if my / our tender is accepted.

(a) Details of major equipment that is owned by me / us and immediately available for this contract.

DESCRIPTION *(type, size, capacity etc.)*	QUANTITY	YEAR OF MANUFACTURE

Attach additional pages if more space is required

(b) Details of major equipment that will be hired, or acquired for this contract if my / our tender is accepted

DESCRIPTION *(type, size, capacity etc.)*	QUANTITY	HOW ACQUIRED	
		HIRE/ BUY	SOURCE

Attach additional pages if more space is required

The Tenderer undertakes to bring onto site without additional cost to the Client any additional plant not listed but which may be necessary to complete the contract within the specified contract period.

Failure to complete this form properly and correctly, will lead to the conclusion that the tenderer does not have the necessary plant and equipment resources at his disposal, which will prejudice his tender.

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM AA PROPOSED SUBCONTRACTORS

I/We hereby notify you that it is my/our intention to employ the following subcontractors for work in this contract.

If I/we am/are awarded a contract I/we agree that this notification does not change the requirement for me/us to submit the names of proposed subcontractors in accordance with requirements of the contract for such appointments. If there are no such requirements in the contract, then your written acceptance of this list shall be binding between us.

I/We confirm that all subcontractors who are contracted to construct a house or building are registered as home builders with the National Home Builders Registration Council.

NAMES AND ADDRESSES OF PROPOSED SUBCONTRACTORS	COMPANY REGISTRATION No AND CIDB CLASSIFICATION	DESCRIPTION OF WORK TO BE EXECUTED BY SUBCONTRACTOR

[Tenderers are to attach to this page the relative experience of the proposed Sub-Contractors.]

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

FORM BB KEY PERSONNEL

In terms of the Scope of Work and the Conditions of Tender, unskilled workers may only be brought in from outside the local community if such personnel are not available locally.

The Tenderer shall list below the personnel which he intends to utilize on the Works, including key personnel which may have to be brought in from outside if not available locally. **Full names must be provided for at least the first four rows.**

CATEGORY OF EMPLOYEE	NAMES AND/OR NUMBER OF PERSONS		
	KEY PERSONNEL, PART OF THE CONTRACTOR'S ORGANISATION	KEY PERSONNEL TO BE IMPORTED IF NOT AVAILABLE LOCALLY	UNSKILLED PERSONNEL TO BE RECRUITED FROM LOCAL COMMUNITY
Contracts Manager*			
Construction Manager*			
Pipelaying Foreman*			
Concrete Foreman*			
Mechanical & Electrical Foreman*			
Site Supervisor, Quality Control*			
Health & Safety Officer*			
Artisans and other Skilled workers			
Others:.....			

The Tenderer shall attach hereto the *curricula vitae*, in the form included hereafter, of at least the personnel marked "*" in the format provided on the following page. The information is necessary for evaluation of the tender.

Signature: _____ Date: _____

Name: _____ Capacity: _____

Tenderer: _____

CURRICULUM VITAE OF ……..

PROPOSED POSITION ON PROJECT ……..

Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	**Full time on Project: Y / N**
Professional Registration Number:	**Attend site meetings: Y / N**
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record Pertinent to Required Service:	

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

…… **……**
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

CURRICULUM VITAE OF ……..

PROPOSED POSITION ON PROJECT ……..

Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	**Full time on Project: Y / N**
Professional Registration Number:	**Attend site meetings: Y / N**
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record Pertinent to Required Service:	

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

…… **……**
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

CURRICULUM VITAE OF ……..

PROPOSED POSITION ON PROJECT ……..

Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	**Full time on Project: Y / N**
Professional Registration Number:	**Attend site meetings: Y / N**
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record Pertinent to Required Service:	

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

…… **……**
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

CURRICULUM VITAE OF ……..

PROPOSED POSITION ON PROJECT ……..

Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	**Full time on Project: Y / N**
Professional Registration Number:	**Attend site meetings: Y / N**
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record Pertinent to Required Service:	

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

…… **……**
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

CURRICULUM VITAE OF ……..

PROPOSED POSITION ON PROJECT ……..

Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	**Full time on Project: Y / N**
Professional Registration Number:	**Attend site meetings: Y / N**
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record Pertinent to Required Service:	

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

…… **……**
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

CURRICULUM VITAE OF ……..

PROPOSED POSITION ON PROJECT ……..

Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	**Full time on Project: Y / N**
Professional Registration Number:	**Attend site meetings: Y / N**
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record Pertinent to Required Service:	

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

…… **……**
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

CURRICULUM VITAE OF ……..

PROPOSED POSITION ON PROJECT ……..

Name:	**Date of birth:**
Profession:	**Nationality:**
Qualifications:	**Full time on Project: Y / N**
Professional Registration Number:	**Attend site meetings: Y / N**
Name of Employer (firm):	
Current position:	**Years with firm:**
Employment Record:	
Experience Record Pertinent to Required Service:	

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

…… **……**
SIGNATURE OF THE INCUMBENT IN THE SCHEDULE **DATE**

C1 AGREEMENT AND CONTRACT DATA

TABLE OF CONTENTS

C1.1 AGREEMENT (FORM OF OFFER AND ACCEPTANCE)

IMPORTANT NOTE:

ALL Tenderers MUST complete and sign Form A: OFFER (the first page hereafter).

Form B: ACCEPTANCE will be signed by the Employer and then only in the case of the successful Tenderer.

Form C: SCHEDULE OF DEVIATIONS must be signed by the Employer as well as the successful Tenderer after award of the contract.

A tender in which Form A: OFFER has not been completed and signed by the Tenderer, will not be valid and will be disqualified at the discretion of the Employer.

FORM A OFFER

The Employer, identified in the Acceptance signature block, has solicited offers to enter into a contract in respect of the following works:

CONTRACT HGDM748/HGM/2021: CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM AND RISING MAIN: CIVIL, MECHANICAL AND ELECTRICAL.

The tenderer, identified in the Offer signature block below, has examined the documents listed in the Tender Data and addenda thereto as listed in The Tender Schedules, and by submitting this Offer has accepted the Conditions of Tender.

By the representative of the Tenderer, deemed to be duly authorised, signing this Section of this Form of Offer and Acceptance, the Tenderer offers to perform all of the obligations and liabilities of the Contractor under the Contract including compliance with all its terms and conditions according to their true intent and meaning for an amount to be determined in accordance with the Conditions of Contract identified in the Contract Data.

THE OFFERED TOTAL OF THE PRICES INCLUSIVE OF VALUE ADDED TAXES

.....

.....

.....Rand (in words); R ..... (in figures),

This Offer may be accepted by the Employer by signing the Acceptance part of this Form of Offer and Acceptance and returning one copy of this document to the Tenderer before the end of the period of validity stated in the Tender Data whereupon the Tenderer becomes a Party named as the Contractor in the Conditions of Contract identified in the Contract Data.

Signature: *(of person authorized to sign the tender .....*

Name: (*of signatory in capitals)*: ....

Capacity: (*of Signatory*): .....

Name of Tenderer: (*organisation*): .....

Address: .....

.. ..

Telephone number: …… Fax number: .....

CIDB Registration Number of Tenderer: .....
Witness 1:

Signature: .....

Name: *(in capitals):*..... ..

Date: .....

Witness 2:

Signature: .....

Name: *(in capitals):*..... ..

Date: .....

[Failure of a Tenderer to sign this part of the Form of Offer and Acceptance will invalidate the tender]

FORM B ACCEPTANCE

By signing this part of the Form of Offer and Acceptance, the Employer identified below accepts the Tenderer's Offer. In consideration thereof, the Employer shall pay the Contractor the amount due in accordance with the Conditions of Contract identified in the Contract Data. Acceptance of the Tenderer's Offer shall form an agreement between the Employer and the Tenderer upon the terms and conditions contained in this agreement and in the Contract that is the subject of this Agreement.

The terms of the contract are contained in The Contract which contains:

Part 1 Agreement and Contract Data

Part 2 Pricing Data

Part 3 Scope of Work

Part 4 Site Information

Part 5 Annexures

The schedules, forms, drawings and documents or paths thereof, which may be incorporated by reference into Parts 1 to 5 above.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Tender Schedules as well as any changes to the terms of the Offer agreed by the Tenderer and the Employer during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Agreement. No amendments to or deviations from said documents are valid unless contained in this Schedule, which must be duly signed by the authorised representative(s) of both parties.

The Tenderer shall within the period stated in the Contract Data after receiving a completed copy of this Agreement, including the Schedule of Deviations (if any), contact the Employer's agent (whose details are given in the Contract Data) to arrange the delivery of any bonds, guarantees, proof of insurance and any other documentation to be provided in terms of the Conditions of Contract identified in the Contract Data at, or just after, the date this Agreement comes into effect. Failure to fulfil any of these obligations in accordance with those terms shall constitute a repudiation of this Agreement.

Notwithstanding anything contained herein, this Agreement comes into effect on the date when the Tenderer receives one fully completed original copy of this document, including the Schedule of Deviations (if any). Unless the Tenderer (now Contractor) within five days of the date of such receipt notifies the Employer in writing of any reason why he cannot accept the contents of this agreement, this agreement shall constitute a binding contract between the parties.

FOR THE EMPLOYER

Signature: .....

Name: (*of signatory in capitals)*: ....

Capacity: (*of Signatory*): .....

Name of Employer: (*organisation*): .....

Address: ....

. .....

Telephone number: …… Fax number: .....

Witness 1:

Signature: ....

Name: *(in capitals):*..... ..

Date: .....

Witness 2:

Signature: ....

Name: *(in capitals):*..... ..

Date: .....

FORM C SCHEDULE OF DEVIATIONS

The extent of deviations from the tender documents issued by the Employer prior to the tender closing date is limited to those permitted in terms of the Tender Data and the Conditions of Tender.

A Tenderer's covering letter will not necessarily be included in the final contract document. Should any matter in such letter, which constitutes a deviation as aforesaid become the subject of agreements reached during the process of offer and acceptance, the outcome of such agreement shall be recorded here.

Any other matter arising from the process of offer and acceptance either as a confirmation, clarification or change to the tender documents and which it is agreed by the Parties becomes an obligation of the contract shall also be recorded here.

Any change or addition to the tender documents arising from the above agreements and recorded here shall also be incorporated into the final draft of the Contract.

1. Subject: .....

Details: .....

.....

2. Subject: .....

Details: .....

.....

3. Subject: .....

Details: .....

.....

4. Subject: .....

Details: .....

.....

5. Subject: .....

Details: .....

.....

6. Subject: .....

Details: .....

.....

7. Subject: .....

Details: .....

.....

By the duly authorised representatives signing this Schedule of Deviations, the Employer and the Tenderer agree to and accept the foregoing Schedule of Deviations as the only deviations from and amendments to the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, as well as any confirmation, clarification or change to the terms of the offer agreed by the Tenderer and the Employer during this process of offer and acceptance.

It is expressly agreed that no other matter whether in writing, oral communication or implied during the period between the issue of the tender documents and the receipt by the Tenderer of a completed signed copy of this Agreement shall have any meaning or effect in the contract between the parties arising from this Agreement.

FOR THE CONTRACTOR:

Signature: …… .....

Name: (*of signatory in capitals)*: ....

Capacity: (*of Signatory*): .....

Name of Contractor: (*organisation*): .....

Address: ....

. .....

Witness 1:

Signature: ....

Name: *(in capitals):*..... ..

Date: .....

Witness 2:

Signature: ....

Name: *(in capitals):*..... ..

Date: .....

FOR THE EMPLOYER

Signature: .....

Name: (*of signatory in capitals)*: ....

Capacity: (*of Signatory*): .....

Name of Employer: (*organisation*): .....

Address: ....

. .....

Witness 1:

Signature: ....

Name: *(in capitals):*..... ..

Date: .....

Witness 2:

Signature: ....

Name: *(in capitals):*..... ..

Date: ……..

C1.2 CONTRACT DATA (CONDITIONS OF CONTRACT)

C1.2.1 CONDITIONS OF CONTRACT

GENERAL CONDITIONS OF CONTRACT

The General Conditions of Contract for Construction Works (2015), published by the South African Institution of Civil Engineering, is applicable to this Contract.

Copies of these conditions of contract may be obtained from the South African Institution of Civil Engineering (Tel 011 – 805 5947).

It is agreed that the only variations from the said General Conditions of Contract are those set out hereafter under "Special Conditions of Contract".

SPECIAL CONDITIONS OF CONTRACT

These Special Conditions of Contract (SCC) form an integral part of the Contract. They shall amplify, modify or supersede, as the case may be, the GCC 2015 to the extent specified below, and shall take precedence and shall govern.

The clauses of the SCC hereafter are numbered "SCC" followed in each case by the number of the applicable Clause or Sub-Clause in the GCC 2015, and if applicable, the heading, or (where a new condition that has no relation to the existing clauses is introduced) by a number that follows after the last Clause number in the GCC 2015.

CLAUSE No

SCC 1.1 Definitions

Add the following to the end of Sub-Clause 1.1.1

SCC 1.1.1.35 “Client”, as used in the Occupational Health and Safety Act, 1993 and the Construction Regulations, 2014, shall have the same meaning as “Employer”.

SCC 1.1.136 “Principal Contractor”, as used in the Occupational Health and Safety Act, 1993 and the Construction Regulations, 2014, shall have the same meaning as “Contractor”.

SCC 4.4.1 Replace clause 4.1.1 with the following:

The Contractor is mandated to subcontract a minimum of 30% of the work (Contract participation Goal (CPG)) to:

- an EME or QSE which is at least 51% owned by black people;
- an EME or QSE which is at least 51% owned by black people who are youth ;
- an EME or QSE which is at least 51% owned by black people who are women;
- an EME or QSE which is at least 51% owned by black people with disabilities ;
- an EME or QSE which is 51% owned by black people living in rural or underdeveloped areas or townships;
- a cooperative which is at least 51% owned by black people;
- an EME or QSE which is at least 51% owned by black people who

are military veterans;
As designated in the Preferential Procurement Policy Framework Act, 2000: Preferential Procurement Regulations, 2017. but shall not subcontract the contract as a whole.

The Contractor shall not sub-contract any Works to Sub-Contractors who are not appropriately registered and graded by the Construction Industry Development Board (CIDB). Proof of registration and grading shall be submitted to the Employer's Agent prior to the award of any such work to a Sub-Contractor.

The Employer reserves the right to refuse payment to the Contractor for work carried out by Sub-Contractors who were not appropriately registered and graded by the CIDB at the time the work was being carried out.

Subsequent registration and grading by the CIDB of Sub-Contractors shall have no force or effect in curing the non-compliance retrospectively."

Failure by the contractor to sub-contract the minimum percentage stated (measured upon issue of the certificate of practical completion) will result in an amount equal to 40% of the value of the works to be sub-contracted, being deducted from the amount due to the contractor in the next payment certificate.

SCC 4.4.4 Insert the following after the existing wording of clause 4.4.4:

The contractual relationship between the Contractor and any of its CPG Partners shall be the same as if the Contractor had appointed the CPG Partner in terms of Clause 4.4.3.

SCC 4.4.5 Insert the following after the existing wording of clause 4.4.5:

"The provisions of this Sub-clause shall apply to the appointment of CPG Partners."

SCC 4.4.6 Insert the following after the existing wording of clause 4.4.6

"The provisions of this Sub-clause shall apply to the appointment of CPG Partners."

SCC 4.4.7 Insert the following after the existing wording of clause 4.4.7:

"The provisions of this Sub-clause shall apply to the appointment of CPG Partners."

SCC 4.5.2 Insert the following after the existing wording of clause 4.5.2:

"The Employer shall be responsible for obtaining any construction work permit which may be required in terms of Regulation 3(1) of the Construction Regulations, 2014 (promulgated under Section 43 of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993))."

SCC 4.5.3 Insert the following after the existing wording of clause 4.5.3:

"Failure by the Contractor to provide in a proper and timeous manner all the necessary information and documents as required by Regulation 3(5) of the Construction Regulations, 2014, or as requested by the Employer or his agent, shall result in any claim which the Contractor may make in connection therewith for an extension of time, any direct or indirect costs, or any damages claim, being rejected."

SCC 4.5.4 Insert the following after the existing wording of clause 4.5.4:

"The costs incurred by the Contractor in providing the necessary information and documents pursuant to the application for a construction work permit required by Regulation 3(1) of the Construction Regulations, 2014 shall be deemed to be included in the Contractor's rates and prices, whether itemized separately in the Bill of Quantities or not."

SCC 5.1 Time calculations

SCC 5.1.1.2 The phrase "shall be excluded from the calculation of the time-span concerned" shall be separated from Sub-clause 5.1.1.2 and shall be positioned in a new line below it.

SCC 5.1.1 The entire Sub-clause 5.1.1 shall read as follows:

"5.1.1 Except where otherwise provided in the Contract, where a specific time-span is stipulated in the Contract for carrying out any task, or for the termination of any right, or the duration of any event or circumstance,

5.1.1.1 The special non-working days set out in the Contract Data that fall within the said time-span, as well as

5.1.1.2 The day on which the time-span commences

shall be excluded from the calculation of the time-span concerned."

SCC 5.3 Commencement of the Works

SCC 5.3.1 Insert the following after the existing wording of clause 5.3.1:

"In the event of a construction work permit being required (as contemplated under Regulation 3 of the Construction Regulations, 2014), commencement of the Works shall only be legally permissible once a construction work permit has been issued by the relevant authority.

The Contractor shall be required to make an allowance of 50 (fifty) days from the Commencement Date of the Contract in his initial programme of Works required to be submitted in terms of Clause 5.6.1 so as to allow for the construction work permit to be issued by the Department of Labour, provided that should the Contractor fail to include such an allowance of the said 50 days, he shall be deemed to have done so.

In the event that the construction work permit shall have been issued within the 50 (fifty) day allowance period, the Due Completion Date shall be adjusted accordingly by the Employer's Agent, with due cognisance being taken as to the date on which the construction work permit was

actually issued."

SCC 5.3.2 Insert the following after the existing wording of clause 5.3.2:

"or alternatively, the Employer reserves the right, in its sole discretion, to grant to the Contractor an extension of time for Practical Completion, but without the payment of additional time-related General Items or any other compensation, for a period of not more than 28 (twenty eight) days, to allow the Contractor to submit the documentation referred to in Clause 5.3.1."

SCC 5.14.5.1 Amend Sub-Clause 5.14.5.1 as follows:

In the second line, substitute the word "Guarantor" with "Contractor".

SCC 6.7 Measurement of the Works

SCC 6.7.2 Delete the following words in clause 6.7.2:

"The Employer's Agent shall ascertain and determine the value of the Works but, when required to do so by the Employer's Agent".

And insert the following at the end of the paragraph:

"This measurement shall take place on or before, but not later than, the 20th of the month, but should the 20th be a 'non-working' day, it shall take place on the last working day prior to the 20th.

Payment for works identified in the Scope of Work as being labour-intensive shall only be made in accordance with the provisions of the Contract if the works are constructed strictly in accordance with the provisions of the Scope of Work. Any non-payment for such works shall not relieve the Contractor in any way from his obligations either in contract or in delict."

SCC 6.10 Payment

SCC 6.10.4 Substitute the words "within 28 days" with "on or before but not later than the last day of the month following the month", in clause 6.10.4

SCC 6.10.8 Substitute the words "within 28 days" with "on or before but not later than the last day of the month following the month", in clause 6.10.8

SCC 6.10.9 Substitute the words "within 28 days of the date of such certificate" in clause 6.10.9 with "on or before but not later than the last day of the month following the month in which the Employer's Agent has signed such payment certificate."

C1.2.2 CONTRACT DATA PROVIDED BY THE EMPLOYER

PART 1: DATA PROVIDED BY THE EMPLOYER

CONTRACT SPECIFIC DATA

The following Contract Specific Data, referring to the General Conditions of Contract as stated above, are applicable to this Contract:

CLAUSE No

1.1.1.13 The Defects Liability Period is 12 months.

1.1.1.14 / 5.5.1 The time for achieving Practical Completion of the entire Works is Forty (40) Weeks from the Commencement Date of the Contract including special non-working days and the 50 day allowance for obtaining the construction work permit to be issued by the Department of Labour if applicable.

1.1.1.15 **Name of Employer:** Harry Gwala District Municipality

1.1.1.16 **Name of Employer's Agent**: ECA Consulting (Pty) Ltd

1.1.1.16 Where any other documents forming part of this Contract refer to the "Engineer", it shall also mean the Employer's Agent. Any other documents shall include, but is not limited to, all documents as listed in "Part 1. APPLICABLE DATA"

1.1.1.17 Where the any other documents forming part of this Contract refer to the "Engineer's Representative", it shall also mean the Employer's Agent's Representative. Any other documents shall include, but is not limited to, all documents as listed in "Part 1. APPLICABLE DATA"

1.1.1.26 The Pricing Strategy is Re-measurement Contract.

1.2.1 **Delivery of Notices**

1.2.1.2 **Address of Employer:**

Physical:	Postal:
40 Main Street Ixopo, 3276 Telephone No: (039) 834 8700	Private Bag X501 Ixopo, 3276 Fax No: (039) 834 2259

1.2.1.2 **Address of Employer's Agent:**

Physical:	Postal:
67 St Patrick's Road, Scottsville, Pieternmaritzburg	P O Box 2083 Vryheid 3100

e-mail: louis@ecaconsult.co.zaco.za

CLAUSE No

Telephone No: (034) 983 2825 Fax No: (034) 983 2945
Add the following Sub-Clause:

1.2.1.3 e-mailed to the e-mail address of the addressee as stated in the Contract Data.

5.1.1 & 5.8.1 The non-working times are between 17:00 and 07:00 the following morning

5.1.1.1 The non-working days are Saturdays, Sundays

The special non-working days are:

1. All statutory holidays as declared by National or Regional Government.
2. The year-end break commencing on the first working day after 15 December and ending on the first Monday day after 01 January of the next year.

5.3.1 The documentation required before commencement with Works execution are:

- Health and Safety Plan (Refer to Clause 4.3)
- A signed agreement between the Employer and the Contractor for the works to be completed by the Contractor in terms of the provision of Section 37(2) of the Occupational Health and Safety Act (Act No 85 of 1993) and the Construction regulations of February 2014. (Refer to Clause 4.3);
- Initial Programme (Refer to Clause 5.6)
- Proof of payment to the Employer, that the Contractor had paid all contributions required in terms of the Compensation for Occupational Injuries and Diseases Act (No 130 of 1993). (Refer to Clause 4.3);
- Security (Refer to Clause 6.2)
- Insurance (Refer to Clause 8.6)
- Information and documents required from the Contractor for a construction work permit (if applicable) issued in terms of Regulation 3 of the Construction Regulations, 2014 (Refer to SCC 4.5.2, SCC 4.5.3, SCC 4.5.4 and SCC 5.3.1 above.

5.3.2 The time to submit the documentation required before commencement with Works execution is 21 days.

5.4.2 The access and possession of Site shall not be exclusive to the Contractor but as set out in the Site Information.

5.13.1 The penalty for failing to complete the Works is R 3 000.00 per day.

CLAUSE No

5.14.1 The requirements for achieving practical completion are:

- The works shall be in a state of readiness, fit for the intended use and safe occupation by the Employer.
- The pipelines shall be tested, commissioned and backfilled in accordance with the drawings and specifications.
- The chambers and manholes shall be tested, backfilled and commissioned complete in every aspect.
- All permanent connections to existing infrastructure shall be complete, tested, commissioned and backfilled.
- The access road shall be complete and safe for it intended purpose including all ancillary works
- The pumping Station shall be commissioned and operational
- The whole of the works shall meet all health and safety requirements for occupation and operation by the Employer.

5.16.3 The latent defect period is 10 (ten) years for civil engineering works and 3 (Three)years for electrical and mechanical works

6.2.1 & 6.2.2 Security
The security to be provided by the Contractor shall be a Performance Guarantee (Demand Guarantee) of 10% (ten percent) of the Contract Sum (inclusive of VAT) delivered within the time stated in Clause 5.3.2 above.
The Guarantee shall remain valid and enforceable until the Certificate of Completion is issued, where after the Guarantee shall be returned to the Contractor.

Should the Contractor fail to provide the required Performance Guarantee within the time period stated in Clause 5.3.2 above, or if the Performance Guarantee differs substantially from the pro forma included under Section C1.3 Form of Guarantee, a security of 10% (ten percent) of the Contract Sum shall be retained by the Employer, in addition to the retention withheld in terms of Clause 6.10.3 below, subject to the provision that the Contractor may, at any time during the course of the Contract, provide a correctly worded and valid Performance Guarantee in fulfillment of his obligations under the Contract in order to have the security being withheld for this purpose released to him.

6.5.1.2.3 The percentage allowances to cover overhead charges are:

- 40% of the gross remuneration of workmen and foremen actually engaged in the daywork;
- 15% on the net cost of materials actually used.

No allowance will be made for work done, or for materials and equipment, for which daywork rates have been quoted at tender stage.

6.8 Adjustment in rates and/prices

CLAUSE No

6.8.2 The value of the certificates issued shall be adjusted in accordance with the Contract Price Adjustment Schedule with the following values:

Values of the coefficients shall be:

X = 0,10; a (labour index) = 0,25 b (plant index) = 0,20; c1 (civil materials index) = 0,35; c2 (Mech & Elec materials index) = 0.10 ; d (fuel index) = 0,10

The Site is situated in: Kwa-Zulu Natal Province.

The base month is: The month prior to that in which tenders closed.

The indices for “L”, “P”, “MCiv”, “MM&E” and “F” are the following:

1. “L” is the “Labour Index” and shall be the relevant monthly value given in P0141: (Consumer Price Index) Table A: Consumer Price Indices: Main Areas: “Geographical Areas: KZN” as published by Statistics South Africa.

   “P” is the “Plant and Equipment Index” and shall be the relevant monthly value given in P0151.1 (Construction Materials Indices) Table 4: Mining and Construction Plant and Equipment: “Plant and Equipment” as published by Statistics South Africa.

   “Mciv” is the “Materials Index (Civil)” and shall be the relevant monthly value given in P0151.1 (Construction Materials Indices) Table 6: Civil Engineering Materials Price Indices “Civil Engineering Materials - excluding bitumen” as published by Statistics South Africa.

   “MM&E” is the “Materials Index (Mechanical & Electrical)” and shall be the relevant monthly value given in P0151.1 (Construction Materials Indices) Table 5: Electrical and Mechanical Engineering Input Indices: “Electrical Engineering” as published by Statistics South Africa.

2. “F” is the “Fuel Index” and shall be the relevant monthly value given in P0142.1 (Producer Price Index) Table 1: PPI for Final Manufactured Goods: “Diesel” as published by Statistics South Africa.

6.8.3 Price adjustments for variations in the cost of special materials is NOT allowed.

6.10.1.5 The percentage advance on materials not yet built into the Permanent Works is 80%.

6.10.3 The percentage retention on the amounts due to the Contractor is 10%.

The limit of retention money is 5% of the Contract Price.

A guarantee in lieu of retention money is not permitted.

CLAUSE No

6.10.4 Add the following to this clause:

The Contractor's payment invoices shall be accompanied by labour information for the corresponding period in a format specified by the employer. If the contractor chooses to delay submitting payment invoices, labour returns shall be submitted as per frequency and timeframes stipulated by the Employer. The contractor's invoices shall not be paid until all pending labour information has been submitted.

8.6.1.1.2 The value of equipment and materials supplied by the Employer to be included in the insurance sum is Nil

8.6.1.1.3 The amount to cover professional fees for repairing damage and loss to be included in the insurance sum is R 2 000 000.00.

8.6.1.3 The limit of indemnity for liability insurance is R 5 000 000.00 for each and every claim.

10.5 Adjudication
Dispute resolution shall be by Ad Hoc Adjudication .

The Adjudication Board Rules in GCC 2015 shall apply.

The Pro Forma Adjudication Board Member Agreement (GCC 2015 Appendix 5) shall be used for the appointment of members.

10.5.3 The number of Adjudication Board Members to be appointed is one.

10.7.1 If a dispute is, after adjudication, still unresolved, the dispute shall be resolved by arbitration.

C1.2.3 DATA TO BE PROVIDED BY CONTRACTOR

REF CLAUSE No	
1.1.1.9	**Name of Contractor:** ……...
1.2.1.2	**Address of Contractor:** Physical: …… Postal: ……..…… …….. …….. …….. …… e-mail: …… Telephone No: …… Fax No: ……..
6.2.1	Security is to be provided by the Contractor shall be as stipulated in the data provided by the Employer in Clauses 6.2.1 and 6.2.2.

C1.3 PRO-FORMA FORMS TO BE COMPLETED BY SUCCESSFUL TENDERER ONLY

FORM D AGREEMENT WITH ADJUDICATOR

This agreement is made on the.....day of .....……..... 20..... between the Employer

(name of company / organisation) .....

of (*address)* .....

.....…….…… and the Contractor

(name of company / organisation) .....……

of *(address)* .....……

.....……..
(hereinafter called **the Parties**)

and

(name) .....

of (address) .....

.....……...(herei
nafter called **the Adjudicator**

Disputes or differences may arise/have arisen* between the Parties under

Contract No……for *(contract title)……*

……
and these disputes or differences shall be/have been* referred to adjudication in accordance with the CIDB Adjudication Procedure, (hereinafter called "**the Procedure**") and the Adjudicator may be or has been requested to act.
(Delete as necessary)*

IT IS NOW AGREED as follows:

1. The rights and obligations of the Adjudicator and the Parties shall be as set out in the Procedure.

2. The Adjudicator hereby accepts the appointment and agrees to conduct the adjudication in accordance with the Procedure.

3. The Parties bind themselves jointly and severally to pay the Adjudicator's fees and expenses in accordance with the Procedure as set out in the Contract Data.

4. The Parties and the Adjudicator shall at all times maintain the confidentiality of the adjudication and shall endeavour to ensure that anyone acting on their behalf or through them will do likewise, save with the consent of the other Parties which consent shall not be unreasonably refused.

5. The Adjudicator shall inform the Parties if he intends to destroy the documents which have been sent to him in relation to the adjudication and he shall retain documents for a further period at the request of either Party.

SIGNED by:

(Signature):	*(Signature):*	*(Signature):* .....
Name:	**Name***:*	***Name****:* .....
who warrants that he/ she is duly authorized to sign for and on behalf of the **First Party** in and on behalf of the presence of	who warrants that he/ she is duly authorized to sign for and on behalf of the **Second Party** presence of	the **Adjudicator** in the presence of
Witness:	**Witness:**	**Witness:**
(Signature):	*(Signature):*	*(Signature):* .....
Name:	**Name***:*	***Name****:* .....
Address:.....	Address*:*.....	Address*:* .....
.....	.....	.....
Date:.....	Date:	Date: .....

FORM E PRO FORMA – FORM OF GUARANTEE

GUARANTOR DETAILS AND DEFINITIONS

"Guarantor" means:.....

Physical address:.....

"Employer" means:.....

"Contractor" means: .....

"Employer's Agent" means:.....

"Works" means:.....

"Site" means: .....

"Contract" means: The Agreement made in terms of the Form of Offer and Acceptance and such amendments or additions to the Contract as may be agreed in writing between the parties.

"Contract Sum" means: The accepted amount inclusive of tax of R .....

Amount in words: .....

"Guaranteed Sum" means: The maximum aggregate amount of R .....

Amount in words: .....

Type of performance Guarantee: Fixed

"Expiry Date" means:…… or any other later date set by the Contractor and/or Employer provided such instruction is received prior to the Expiry Date as indicated here.

CONTRACT DETAILS

Employer's Agent issues: interim Payment Certificates, Final Payment Certificate and the Certificate of Completion of the Works as defined in the Contract.

1. VARIABLE PERFORMANCE GUARANTEE

1.1 Where a Variable Performance Guarantee has been selected, the Guarantor's liability shall be limited during the following periods to diminishing amounts of the Guaranteed Sum as follows:

1.1.1 From and including the date of signing the Performance Guarantee up to and including the date of the interim payment certificate certifying, for the first time, more than 50% of the Contract Sum:
R .....
Amount in words:.....

1.1.2 From the day following the date of the said interim payment certificate up to and including the Expiry Date, or the date of issue by the Employer's Agent of the Certificate of Completion of the Works, whichever occurs first:
R .....
Amount in words:.....

1.2 The Employer's Agent and/or the Employer shall advise the Guarantor in writing of the date on which the interim payment certificate certifying, for the first time, more than 50% of the Contract Sum, has been issued and the date on which the Certificate of Completion of the Works has been issued.

2. FIXED PERFORMANCE GUARANTEE

2.1 Where a Fixed Performance Guarantee has been selected, the Guarantor's liability shall be limited to the amount of the Guaranteed Sum.

2.2 The Guarantor's period of liability shall be from and including the date on which the Performance Guarantee is signed, up to and including the Expiry Date, or the date of issue by the Employer's Agent of the Certificate of Completion of the Works, or the date of payment in full of the Guaranteed Sum, whichever occurs first.

2.3 The Employer's Agent and/or the Employer shall advise the Guarantor in writing of the date on which the Certificate of Completion of the Works has been issued.

3. CONDITIONS APPLICABLE TO VARIABLE AND FIXED PERFORMANCE GUARANTEES

3.1 The Guarantor hereby acknowledges that:

3.1.1 Any reference in this Performance Guarantee to the Contract is made for the purpose of convenience and shall not be construed as any intention whatsoever to create an accessory obligation or any intention whatsoever to create a suretyship.

3.1.2 Its obligation under this Performance Guarantee is restricted to the payment of money.

3.2 Subject to the Guarantor's maximum liability reffered to in 1.1 or 2.1, the Guarantor hereby undertakes to pay the Employer the sum certified upon receipt of the documents identified in 3.2.1 to 3.2.3:

3.2.1 A copy of a first written demand issued by the Employer to the Contractor stating that payment of a sum certified by the Employer's Agent in an interim or Final Payment Certificate has not been made in terms of the Contract and failing such payment within

seven (7) calendar days, the Employer intends to call upon the Guarantor to make payment in terms of 3.2.2;

3.2.2 A first written demand issued by the Employer to the Guarantor at the Guarantor's physical address with a copy to the Contractor stating that a period of seven (7) days has elapsed since the first written demand in terms of 3.2.1 and the sum certified has still not been paid;

3.2.3 A copy of the aforesaid payment certificate which entitles the Employer to receive payment in terms of the Contract of the sum certified in 3.2.

3.3 Subject to the Guarantor's maximum liability referred to in 1.1 or 2.1, the Guarantor undertakes to pay to the Employer the Guaranteed Sum or the full outstanding balance upon receipt of a first written demand from the Employer to the Guarantor at the Guarantor's physical address calling up this Performance Guarantee, such demand stating that:

3.3.1 The Contract has been terminated due to the Contractor's default and that this Performance Guarantee is called up in terms of 3.3; or

3.3.2 a provisional or final sequestration or liquidation court order has been granted against the Contractor and that the Performance Guarantee is called up in terms of 3.3; and

3.3.3 the aforesaid written demand is accompanied by a copy of the notice of termination and/or the provisional/final sequestration and/or the provisional liquidation court order.

3.4 It is recorded that the aggregate amount of payments required to be made by the Guarantor in terms of 3.2 and 3.3 shall not exceed the Guarantor's maximum liability in terms of 1.1 or 1.2.

3.5 Where the Guarantor has made payment in terms of 3.3, the Employer shall upon the date of issue of the Final Payment Certificate submit an expense account to the Guarantor showing how all monies received in terms of this Performance Guarantee have been expended and shall refund to the Guarantor any resulting surplus. All monies refunded to the Guarantor in terms of this Performance Guarantee shall bear interest at the prime overdraft rate of the Employer's bank compounded monthly and calculated from the date payment was made by the Guarantor to the Employer until the date of refund.

3.6 Payment by the Guarantor in terms of 3.2 or 3.3 shall be made within seven (7) calendar days upon receipt of the first written demand to the Guarantor.

3.7 Payment by the Guarantor in terms of 3.3 will only be made against the return of the original Performance Guarantee by the Employer.

3.8 The Employer shall have absolute right to arrange his affairs with the Contractor in any manner which the Employer may consider fit and the Guarantor shall not have the right to claim his release from this Performance Guarantee on account of any conduct alleged to be prejudicial to the Guarantor.

3.9 The Guarantor chooses the physical address as stated above for the service of all notices for all purposes in connection herewith.

3.10 This Performance Guarantee is neither negotiable nor transferable and shall expire in terms of 1.1.2 or 2.2, where after no claims will be considered by the Guarantor. The original of this Guarantee shall be returned to the Guarantor after it has expired.

3.11 This Performance Guarantee, with the required demand notices in terms of 3.2 or 3.3, shall be regarded as a liquid document for the purposes of obtaining a court order.

3.12 Where this Performance Guarantee is issued in the Republic of South Africa the Guarantor hereby consents in terms of Section 45 of the Magistrates' Courts Act No 32 of 1994, as amended, to the jurisdiction of the Magistrate's Court of any district having jurisdiction in terms of Section 28 of the said Act, notwithstanding that the amount of the claim may exceed the jurisdiction of the Magistrate's Court.

Signed at.....

Date .....

Guarantor's signatory (1) .....

Capacity.....

Guarantor's signatory (2) .....

Capacity.....

Witness signatory (1) .....

Witness signatory (2) .....

FORM F AGREEMENT IN TERMS OF SECTION 37(2) OF THE OCCUPATIONAL HEALTH AND SAFETY ACT NO 85 OF 1993

THIS AGREEMENT is made between .....

(hereinafter called the EMPLOYER) of the one part, herein represented by: .....

....

in his capacity as: ..... ;

AND: ....

(hereinafter called the CONTRACTOR) of the other part, herein represented by .....

....

in his capacity as: .....
duly authorized to sign on behalf of the Contractor.

WHEREAS the CONTRACTOR is the Mandatary of the EMPLOYER in consequence of an agreement between the CONTRACTOR and the EMPLOYER in respect of

CONTRACT No: ..... (*CONTRACT TITLE*) .....

....
for the construction, completion and maintenance of the works;

AND WHEREAS the EMPLOYER and the CONTRACTOR have agreed to enter into an agreement in terms of the provisions of Section 37(2) of the Occupational Health and Safety Act No 85 of 1993, as amended by OHSA Amendment Act No 181/1993 (hereinafter referred to as the ACT);

NOW THEREFORE the parties agree as follows:

1. The CONTRACTOR undertakes to acquaint the appropriate officials and employees of the CONTRACTOR with all relevant provisions of the ACT and the regulations promulgated in terms thereof.

2. The CONTRACTOR undertakes to fully comply with all relevant duties, obligations and prohibitions imposed in terms of the ACT and Regulations: Provided that should the EMPLOYER have prescribed certain arrangements and procedures that same shall be observed and adhered to by the CONTRACTOR, his officials and employees. The CONTRACTOR shall bear the onus of acquainting himself/herself/itself with such arrangements and procedures.

3. The CONTRACTOR hereby accepts sole liability for such due compliance with the relevant duties, obligations, prohibitions, arrangements and procedures, if any, imposed by the ACT and Regulations, and the CONTRACTOR expressly absolves the EMPLOYER and the Employer's CONSULTING ENGINEERS from being obliged to comply with any of the aforesaid duties, obligations, prohibitions, arrangements and procedures in respect of the work included in the contract.

4. The CONTRACTOR agrees that any duly authorized officials of the EMPLOYER shall be entitled, although not obliged, to take such steps as may be necessary to ensure that the CONTRACTOR has complied with his undertakings as more fully set out in paragraphs 1 and 2 above, which steps may include, but shall not be limited to, the right to inspect any appropriate site or premises occupied by the CONTRACTOR, or to take such steps it may deem necessary to remedy the default of the CONTRACTOR at the cost of the CONTRACTOR.

5. The CONTRACTOR shall be obliged to report forthwith to the EMPLOYER any investigation, complaint or criminal charge which may arise as a consequence of the provisions of the ACT and Regulations, pursuant to work performed in terms of this agreement, and shall, on written demand, provide full details in writing of such investigation, complaint or criminal charge.

Thus signed at …… for and on behalf of the **CONTRACTOR**

on this the ..... ……. day of …….. 20……

SIGNATURE: .....

NAME AND SURNAME: .....

CAPACITY: .....

WITNESSES: 1. .....

2. .....

Thus signed at …….. for and on behalf of the **EMPLOYER**

on this the ……..…….. day of .....……..20……

SIGNATURE: .....

NAME AND SURNAME: .....

CAPACITY: .....

WITNESSES: 1. .....

2. .....

FORM G CERTIFICATE OF AUTHORITY FOR SIGNATORY TO SIGN AGREEMENT IN TERMS OF OCCUPATIONAL HEALTH AND SAFETY ACT, 1993 (ACT NO 85 OF 1993), AND CONSTRUCTION REGULATIONS (GOVERNMENT NOTICE R1010 18 JULY 2003) OR ANY AMENDMENT THERETO

The signatory for the company that is the Contractor in terms of the above-mentioned Contract and the Mandatary in terms of the above-mentioned Act shall confirm his or her authority thereto by attaching to this page a duly signed and dated copy of the relevant resolution of the board of directors. An example is given below:

"By resolution of the board of directors passed at a meeting held on……..20……..

Mr/Mrs……..….whos e signature appears below, has been duly authorised to sign the AGREEMENT IN TERMS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT, 1993 (ACT 85 OF 1993), AND CONSTRUCTION REGULATION (GOVERNMENT NOTICE R1010 18 JULY 2003) OR ANY AMENDMENT THERETO on behalf of

(*Name of Company*)…….....

SIGNED ON BEHALF OF THE COMPANY:

Signature: ……. .....

Name: (*of signatory in capitals)*: ....

Capacity: (*of Signatory*): .....

Witness 1:

Signature: ....

Name: *(in capitals):*..... ..

Date: .....

Witness 2:

Signature: ....

Name: *(in capitals):*..... ..

Date: .....

FORM H MONTHLY DATA SHEETS

To be completed by the Contractor and submitted to the Engineer monthly. Note that the Contractor's invoices shall not be paid until all pending labour information has been submitted.

A template for the recording of monthly labour data will be provided to the successful Contractor. The information required on a monthly basis is listed below.

Beneficiary (Local Labourer) Details:

First Name
Initials
Surname
ID Number
Date of Birth
Gender
Disability
Education (level of)
Start Date
End Date
Language
Address
Cell Number
Government Grant

Experience / Literacy

First Language
Other Language 1
Other Language 2
Highest Level of Education

Location Details

Province
District
Municipality / Village
Ward No.
Address
Cell Number
Nationality

Household Details

Number of People in the Household
Number of Dependents in the Household
Number of Children attending School

Training

ID
Course Name
Code

Type
Start Date
End Date
Number of Trainees
Number of Days
Cost
Status
Training Provider

NOTE: A certified copy of ID documents for all local labourers will be required to be submitted to the Engineer in the month that each local labourer starts work.

CASH FLOW

(To be revised by the Contractor each month to recognize actual and amended construction progress)

Period	***Projected Cashflow* (excluding VAT)**	***Actual Cashflow* (excluding VAT)**
Month 1		
Month 2		
Month 3		
Month 4		
Month 5		
Month 6		
Month 7		
Month 8		
Month 9		
Month 10		
Month 11		
Month 12		
CUMULATIVE TOTALS		

C2 PRICING DATA

TABLE OF CONTENTS

C2.1 PRICING INSTRUCTIONS

1. GENERAL

The Bill of Quantities forms part of the Contract Documents and must be read and priced in conjunction with all the other documents comprising the Contract Documents, which include the Conditions of Tender, Conditions of Contract, the Specifications (including the Project Specification) and the Drawings.

2. DESCRIPTION OF ITEMS IN THE SCHEDULE

The Conditions of Contract, the Contract Data, the Specifications (including the Project Specifications) and the Drawings shall be read in conjunction with the Bill of Quantities.The Bill of Quantities has been drawn up generally in accordance the SABS 1200 Suite of specifications

The short descriptions of the items in the Bill of Quantities are for identification purposes only and comply in general with the measurement and payment clauses of the Standardized Specifications, the Project Specifications and the Particular Specifications, read together with the relevant clauses of the Scope of Work and directives on the drawings, set out what ancillary or associated work and activities are included in the rates for the operations specified.

The Bill comprises items covering the Contractor's profit and costs of general liabilities and of the construction of Temporary and Permanent Works.

Although the Tenderer is at liberty to insert a rate of his own choosing for each item in the Bill, he should note the fact that the Contractor is entitled, under various circumstances, to payment for additional work carried out and that the Engineer is obliged to base his assessment of the rates to be paid for such additional work on the rates the Contractor inserted in the Bill. Clause 8 of each Standardized Specification, and the measurement and payment clause of each Particular Specification, read together with the relevant clauses of the Project Specifications, all set out which ancillary or associated activities are included in the rates for the specified operations

The amounts and rates to be inserted in the Bill of Quantities shall be the full inclusive amounts to the Employer for the work described under the several items. Such amounts shall cover all the costs and expenses that may be required in and for the construction of the work described, and shall cover the costs of all general risks, profits, taxes (but excluding value-added tax), liabilities and obligations set forth or implied in the documents on which the Tender is based.

An amount or rate shall be entered against each item in the Bill of Quantities, whether or not quantities are stated. An item against which no amount or rate is entered will be considered to be covered by the other amounts or rates in the Bill.

The Tenderer shall also fill in a rate against the items where the words "rate only" appear in the amount column. Although no work is foreseen under these items and no quantities are consequently given in the quantity column, the tendered rates shall apply should work under these items actually be required.

Should the Tenderer group a number of items together and tender one sum for such group of items, the single tendered sum shall apply to that group of items and not to each individual item, or should he indicate against any item that full compensation for such item has been included in another item, the rate for the item included in another item shall be deemed to be nil.

The tendered rates, prices and sums shall, subject only to the provisions of the Conditions of Contract, remain valid irrespective of any change in the quantities during the execution of the Contract.

The quantities of work as measured and accepted and certified for payment in accordance with the Conditions of Contract, and not the quantities stated in the Bill of Quantities, will be used to determine payments to the Contractor. The validity of the Contract shall in no way be affected by differences between the quantities in the Bill of Quantities and the quantities certified for payment.

Ordering of materials are not to be based on the Bill of Quantities, but only on information issued for construction purposes.

For the purposes of this Bill of Quantities, the following words shall have the meanings hereby assigned to them:

Unit	:	The unit of measurement for each item of work as defined in the Standardized, Project or Particular Specifications
Quantity	:	The number of units of work for each item
Rate	:	The payment per unit of work at which the Tenderer tenders to do the work
Amount	:	The quantity of an item multiplied by the tendered rate of the (same) item
Sum	:	An amount tendered for an item, the extent of which is described in the Bill of Quantities, the Specifications or elsewhere, but of which the quantity of work is not measured in units

The following will be applicable to activities related to the Expanded Public works programme (EPWP);

- Those parts of the contract to be constructed using labour intensive methods have been marked in the Bills of Quantities with the letters LI in a separate column filled in against every item so designated. The works, or parts of the works so designated are to be constructed using labour intensive methods only. The use of plant to provide such works, other than plant specifically provided for in the scope of work, is a variation to the contract. The items marked with the letters LI are not necessarily an exhaustive list of all the activities that must be done by hand, and this clause does not over-ride any of the requirements in the generic labour intensive specification in the Scope of Works.

- Payment for items which are designated to be constructed labour-intensively (either in this schedule or in the Scope of Works) will not be made if they are not constructed using labour-intensive methods. Any unauthorized use of plant to carry out work which was not done labour-intensively will not be condoned and any works so constructed will not be certified for payment.

3. QUANTITIES REFLECTED IN THE SCHEDULE

The quantities given in the Bill of Quantities are the estimated quantities of work to be done, and will be subject to re-measurement during the execution of the work. The Contractor shall obtain the Engineer's detailed instructions for all work before ordering any materials or executing work or making arrangements for it. The Works as finally completed in accordance with the Contract shall be measured and paid for as specified in the Bill of Quantities, and the contract price for the completed contract shall be computed at the relevant unit rates and prices, all in accordance with the General

and Special Conditions of Contract, the Specifications and Project Specifications and the Drawings. Unless otherwise stated, items are measured net in accordance with the Drawings, and no allowance has been made for waste.
The validity of the contract will in no way be affected by differences between the quantities in the Bill of Quantities and the quantities finally certified for payment.

4. PRICING OF THE BILL OF QUANTITIES

The prices and rates to be inserted by the Tenderer in the Bill of Quantities shall be the full inclusive prices to be paid by the Employer for the work described under the several items, and shall include full compensation for all costs and expenses that may be required in and for the completion of the work and maintenance during the defects liability period of all the work described and as shown on the drawings as well as all overheads, profits, incidentals and the cost of all general risks, liabilities and obligations set forth or implied in the documents on which the Tender is based. Reasonable unit rates and prices shall be entered in the Bill of Quantities as these will be used as a basis for assessment of payment for additional work that may have to be carried out.

Each item shall be priced and extended to the "Total" column by the Tenderer, with the exception of the items for which only rates are required, or items which already have Prime Cost or Provisional Sums affixed thereto. If the Contractor omits to price any items in the Bill of Quantities, then these items will be considered to have a nil rate or price.

All items for which terminology such as "inclusive" or "not applicable" have been added by the Tenderer will be regarded as having a nil rate which shall be valid irrespective of any change in quantities during the execution of the Contract.

The Tenderer shall fill in rates for all items where the words "rate only" appear in the "Total" column. "Rate Only" items have been included where:

(a) an alternative item or material is contemplated;
(b) variations of specified components in the make-up of a pay item may be expected; and
(c) no work under the item is foreseen at tender stage but the possibility that such work may be required is not excluded.

For “Rate Only” items no quantities are given in the "Quantity" column but the quoted rate shall apply in the event of work under this item being required. The Tenderer shall however note that in terms of the Tender Data the Tenderer may be asked to reconsider any such rates which the Employer may regard as unbalanced.

All rates and amounts quoted in the Bill of Quantities shall be in rands and cents and shall include all levies and taxes (other than VAT). VAT will be added in the summary of the Bill of Quantities.

5. PROVISIONAL SUMS

Where Provisional sums or Prime Cost sums are provided for items in the Bill of Quantities, payment for the work done under such items will be made in accordance with the General Conditions of Contract 2015.

The Employer reserves the right, during the execution of the works, to adjust the stated amounts upwards or downwards according to the work actually done under the item, or the item may be omitted altogether, without affecting the validity of the Contract.
The Tenderer shall not under any circumstances whatsoever delete or amend any of the sums inserted in the "Amount" column of the Bill of Quantities and in the Summary of the Bill of Quantities unless ordered or authorized in writing by the Employer before closure of tenders.

Unauthorized changes made by the Tenderer to provisional items in the Bill of Quantities, or to the stated provisional percentages and sums in the Summary of the Bill of Quantities, will not be tolerated.

6. CORRECTION OF ENTRIES

Incorrect entries shall not be erased or obliterated with correction fluid but must be crossed out neatly. The correct figures must be entered above or adjacent to the deleted entry, and the alteration must be initialled by the Tenderer.

7. ARITHMETICAL ERRORS AND CLARIFICATION OF OFFER

Arithmetical errors found in the Bill of Quantities as a result of faulty multiplication or addition, will be dealt with by the Engineer at the tender evaluation stage, as set out in the Conditions of Tender. Refer to Clause F 3.9 of the Conditions of Tender.

If the unit rates or lump sums for some of the items entered in the Bill of Quantities are, in the opinion of the Employer, unreasonable or out of proportion, the Tenderer may be requested to make adjustments in terms of Clause F.2.17 of the Standard Conditions of Tender.

8. CONSISTENCY OF RATES

In order to ensure that payments certified by the Engineer are reasonably consistent with the market value of the work done, and that variations in quantities do not distort the contract valuation, the rates, prices and amounts tendered in the Schedule of Quantities are required to be in balance.

A tender will be considered out of balance if:

(i) The combined, extended total tendered for the contractors Preliminary and General Charges. i.e.
   (a) Fixed obligations
   (b) Value related obligations
   (c) Time related obligations
   Exceeds 18% of the Tender Offer (excluding contingencies, escalation and VAT).

(ii) The rates, prices or amounts tendered for any other items differ by more than 50 (twenty) percent from either the next highest or next lowest rates, prices or amounts tendered, or else from the latest departmental estimates.

Any such unbalanced tender may be rejected if, after fourteen (14) days of having been given written notice by the Employer to adjust those rates or lump sums which are unreasonable or out of balance, the Tenderer fails to make the necessary satisfactory adjustments. These adjustments in rectification will be such that increases are balanced by decreases, leaving the tender offer unchanged.

8. MONTHLY PAYMENTS

Unless otherwise specified in the Specifications and Project Specifications, progress payments in Interim Certificates, reffered to in the General Conditions of Contract 2015, in respect of "sum" items in the Bill of Quantities shall be by means of interim progress installments assessed by the Engineer and based on the measure in which the work actually carried out relates to the extent of the work to be done by the Contractor.

9. UNITS OF MEASUREMENT

The units of measurement described in the Bill of Quantities are metric units for which the standard international abbreviations are used. Abbreviations used in the Bill of Quantities, including some non-standard abbreviations, are as follows:

mm	=	millimetre	h	=	hour
m	=	metre	kg	=	kilogram
km	=	kilometre	t	=	ton (1000 kg)
m^2	=	square metre	No.	=	number
m^2·pass	=	square metre-pass	sum	=	lump sum
ha	=	hectare	MN	=	meganewton
m^3	=	cubic metre	MN.m	=	meganewton-metre
m^3.km	=	cubic metre-kilometre	P C sum	=	Prime Cost sum
ℓ	=	litre	Prov sum	=	Provisional sum
kℓ	=	kilolitre	%	=	per cent
MPa	=	megapascal	pers. Days	=	person days
KW	=	kilowatt			

C2.2 BILL OF QUANTITIES

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
1.1	**PSA 8.3**		**SCHEDULED FIXED CHARGE AND VALUE RELATED ITEMS**				
1.1.1	PSA 8.3.1		Fixed Preliminary and General Charges	Sum	1		
1.1.2	PSA 8.3.2		Fixed and General Health and Safety Obligations	Sum	1		
	PSA 8.3.2		Breakdown of item 1.1.2 above: (Note: It is compulsory to price each item and sum of Rate Only items to equal tendered sum for item 1.1.2				
1.1.3			1a) OH&S documentation	Sum	1		Rate Only
1.1.4			1b) Entry medicals for all workers	Sum	1		Rate Only
1.1.5			1c) Provision of PPE and all other protective clothing	Sum	1		Rate Only
1.1.6			1d) Signage (warning, traffic, hazard, danger, construction, excavation, fire etc.)	Sum	1		Rate Only
1.1.7			1e) Training (OHS reps, First Aiders, Scaffolding Erectors and Inspectors, basic working at heights, Fire-fighters etc.	Sum	1		Rate Only
1.1.8			1f) First Aid (kits, rescue equipment, hazchem spill kits, polyvalent snake antivenom etc.)	Sum	1		Rate Only
1.1.9			1g) Construction vehicle fitments (orange lights, fire extinguishers, buggy whips, wheel stoppers etc.)	Sum	1		Rate Only
1.1.10			1h) All other items	Sum	1		Rate Only
1.1.11	PSA 8.3.3		Value-Related Preliminary and General Charges	Sum	1		
1.1.12	PSA 8.3.4		Value-Related Health and Safety Obligations	Sum	1		
	PSA 8.3.3		Breakdown of item 1.1.12 above: (Note: It is compulsory to price each item below. The sum of Rate Only items below is to equal tendered sum for item 1.1.12				
1.1.13			1a) OH&S documentation	Sum	1		Rate Only
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
1.1.14			1b) Entry medicals for all workers	Sum	1		Rate Only
1.1.15			1c) Provision of PPE and all other protective clothing	Sum	1		Rate Only
1.1.16			1d) Signage (warning, traffic, hazard, danger, construction, excavation, fire etc.)	Sum	1		Rate Only
1.1.17			1e) Training (OHS reps, First Aiders, Scaffolding Erectors and Inspectors, basic working at heights, Fire-fighters etc.	Sum	1		Rate Only
1.1.18			1f) First Aid (kits, rescue equipment, hazchem spill kits, polyvalent snake antivenom etc.)	Sum	1		Rate Only
1.1.19			1g) Construction vehicle fitments (orange lights, fire extinguishers, buggy whips, wheel stoppers etc.)	Sum	1		Rate Only
1.1.20			1h) All other items	Sum	1		Rate Only
1.1.21	GIBB001 10.1		Internal Survey Consistency Check	Sum	1		
1.1.22	GIBB001 10.2		Protection of Beacons outside Servitude or site boundary	No	2		
1.2	**PSA 8.4**		**SCHEDULED TIME-RELATED ITEMS**				
1.2.1	PSA 8.4.1 a)		General Obligations	Sum	1		
1.2.2	PSA 8.4.1 b)		Compliance with OHS Act and Regulations (Including the Construction Regulations	Sum	1		
			Breakdown of item 1.2.2 above: (Note: It is compulsory to price each item below. The Sum of Rate Only items below is to equal tendered sum for item 1.2.2				
1.2.3			1) Alls Costs assosiated with the provision of a full-time and registered Construction Safety Officer (CSO) on Site	Sum	1		Rate Only
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
1.2.4			2) Updating and amending the risk assessments, safe work procedures, the project H&S File, the H&S Plan,medicals for all workers, the provision of PPE and protective clothing and all other H&S matters that fulfil OHS Act 85 of 1993 and construction regulation 2014	Sum	1		Rate Only
1.2.5			3) Full compliance with all H&S matters during the construction of the works under the Contract	Sum	1		Rate Only
1.2.6	PSA 8.4.1 c)		Compliance with Environmental Requirements	Sum	1		
1.2.7	PSA 8.4.1 e)		Provision of Monthly Labour Data Sheets and other reporting required by Employer	Sum	1		
1.2.8	PSA 8.4.1 f)		e)Engagement, management, training & assisting local SMME's	Sum	1		
1.2.9	PSA 8.4.1 g)		Allowance for HIV and Aids Awareness Programme	Sum	1		
1.2.10	PSA 8.7.1 b)		Fixed Monthly Charge for Provision of Vehicle/s (1 off)	Month	10		
1.2.11	PSA 8.7.1 c)		Kilometre rate for Monthly Travel	km	40000		
TOTAL FOR SECTION 1 CARRIED FORWARD TO SUMMARY							

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
2.1	**PSA 8.5**		**SUMS STATED PROVISIONALLY BY THE EMPLOYER'S AGENT**				
2.1.1	PSA 8.5.1		Allowance for the Employment of a CLO for the duration of the contract (payment at Gazetted Task Work Grade 5) for duration of Contract	Prov.Sum	1	120 000.00	120 000.00
2.1.2			Overheads, Charges and profit on item 2.1.1 above	%	120 000.00		
			SIGNAGE				
2.1.3			Supply and install all signage and notices as requested by the Employer (Other than Statutory electrical signage which is measured elsewhere) to comply with the Occupational Health and Safety Act (Act 85 of 1993)	Prov. Sum	1	15 000.00	15 000.00
			ROAD SIGNAGE				
2.1.4			Supply and install all signage and notices as instructed by the Employers Agent	Prov. Sum	1	15 000.00	15 000.00
			FIRST-AID KIT				
2.1.5			Supply and install First Aid Kits as requested by the Employer to comply with the Occupational Health and Safety Act (Act 85 of 1993)	Prov. Sum	1	8 000.00	8 000.00
2.2	**8.6**		**PRIME COST ITEMS**				
			TOPOGRAPHICAL SURVEY				
2.2.1			Ad-hoc survey of cleared areas as requested by the Employers Agent.	PC Sum	1	20 000.00	20 000.00
2.2.2			Overheads, Charges and profit on item 2.2.1 above	%	20 000.00		
			TRAINING AND SUPPORT				
2.2.3	GIBB 021 5.1		Allowance for the provision of accredited training and support to Local Contractors as directed by the Employers Agent (NOT applicable to CPG)	Prov.Sum	1	150 000.00	150 000.00
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
2.2.4			Overheads, Charges and Profit on item 2.2.3 above	%	150 000.00		
2.2.5	GIBB 021 5.2		Allowance for the provision of training area and facilities	Prov.Sum	1	100 000.00	100 000.00
2.2.6			Overheads, Charges and Profit on item 2.2.3 above	%	100 000.00		
			PROJECT STEERING COMMITTEE				
2.2.7			Employment of PSC members from local community for duration of contract	PC Sum	1	18 000.00	18 000.00
2.2.8			Overheads, Charges and Profit on item 2.2.7 above	%	18 000.00		
			GEOTECHNICAL INVESTIGATIONS				
2.2.9			Payments for geotech person for ad-hoc site visits during construction as required (3 quotes arranged for the Employers Agent)	PC Sum	1	50 000.00	50 000.00
2.2.10			Overheads, Charges and Profit on item 2.2.9 above	%	50 000.00		
			THIRD PARTY INSPECTIONS				
2.2.11			Allowance for Third Party Inspections	PC Sum	1.00	80 000.00	80 000.00
2.2.12			Overheads, Charges and Profit on item 2.2.11 above	%	80 000.00		
			OTHER SPARES				
2.2.13			Allowance for any other spares, not detailed in subsequent sections of the bill, delivered to Site as agreed with the Employers Agent (Prime Cost item)	PC Sum	1	50 000.00	50 000.00
2.2.14			Overheads, charges and profit on item 2.2.13 above	%	50 000.00		
			REFURBISHMENT OF WATER TREATMENT PLANT				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
2.2.15			Allowance for repair and refurbishment of the water treatment plant by specialist (Prime Cost item)	PC Sum	1	1 125 000.00	1 125 000.00
2.2.16			Overheads, charges and profit on item 2.2.15 above	%	1 125 000.00		
			REFURBISHMENT OF RESERVOIRS				
2.2.17			Allowance for repair and refurbishment of reinforced concrete reservoirs by specialist (Prime Cost item)	PC Sum	1	600 000.00	600 000.00
2.2.18			Overheads, charges and profit on item 2.2.17 above	%	600 000.00		
			REFURBISHMENT OF PUMPING STATIONS				
2.2.19			Allowance for repair and refurbishment of Pumping Stations by specialist (Prime Cost item)	PC Sum	1	3 000 000.00	3 000 000.00
2.2.20			Overheads, charges and profit on item 2.2.19 above	%	3 000 000.00		
2.3	**PSA 8.7**		**DAY WORKS**				
			LABOUR				
2.3.1			a) Team leader / charge hand	hr	270		
2.3.2			c) Artisan	hr	540		
2.3.3			d) Artisan - Installation Electrician	hr	540		
2.3.4			e) Skilled	hr	1080		
2.3.5			f) Semi-skilled	hr	2160		
2.3.6			g) Unskilled	hr	5160		
			PLANT				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
2.3.7			For plant used in execution of Day Works as agreed with Employers Agent	PC Sum	1	800 000.00	800 000.00
2.3.8			Overheads, Charges and Profit on item 2.3.6 above	%	800 000.00		
			MATERIALS				
2.3.9			For materials used in execution of Day Works as agreed with the Employers Agent	PC Sum	1	1 700 000.00	1 700 000.00
2.3.10			Overheads, Charges and Profit on item 2.3.9 above	%	1 700 000.00		
2.4	**PSA 8.8**		**TEMPORARY WORKS**				
2.4.1	PSA 8.8.1		Construct and Maintain Access Roads	Sum	1		
2.4.2	PSA 8.8.2		Dealing with Traffic	Sum	1		
2.4.3	PSA 8.8.4		Excavation by hand in soft material to expose existing services	m^3	10		
2.4.4	PSA 8.9		Survey Control and Setting out of Works	Sum	1		
2.4.5	7.2		River Diversion and Associated Temporary Works	Sum	1		
2.4.6	7.3		Dewatering as Part of River Diversion	Sum	1		
TOTAL FOR SECTION 2 CARRIED FORWARD TO SUMMARY							

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
3.1	**SABS 1200C**		**SITE CLEARANCE**				
	8.2.8		Demolish existing Abstraction Works				
3.1.1			Existing Gabion and Concrete Abstraction Works structure including transport and disposal of unusable materials at approved disposal sites.	Sum	1		
3.1.2			Extra over Item 3.1.1 to recover all Gabion stone and transport to stockpile within 500m of new site.	m³	331		
3.1.3			Existing reinforced concrete Abstraction Works control chamber structure including transport and disposal of unusable materials at approved disposal sites.	Sum	1		
3.1.4			All steelwork: Gantry, etc. at existing control works - Dismantle and remove steel work, transport to WTW storage within 1km. (Only cutting of bolts permissible; no cutting of structural elements)	Sum	1		
3.1.5			All Pumps and pipework, valves and specials within Abstraction chamber: - Dismantle and remove. transport to WTW storage within 1km. (Only cutting of bolts permissible)	Sum	1		
3.1.6			All Pipework, valves and specials within control chamber: - Dismantle and remove. transport to WTW storage within 1km. (Only cutting of bolts permissible)	Sum	1		
TOTAL FOR SECTION 3 CARRIED FORWARD TO SUMMARY							

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
4.1	**SABS 1200C**		**SITE CLEARANCE**				
	8.2.1		Clear and grub areas to:				
4.1.1		LI	Abstraction Access Road	m²	1913		
	8.2.2		Remove and grub large trees and tree stumps of girth:				
4.1.2		LI	Over 1.0 m and up to and including 2.0 m	No.	3		
4.2	**SABS 1200 D**		**EARTHWORKS**				
			ACCESS ROAD TO NEW ABSTRACTION FACILITY				
4.2.1	8.3.2(a)		Excavate in all material to spoil (spoil site within 20km of site works)	m³	1430		
4.2.2	8.3.2(a)		Cut to Fill for embankments in layers not exceeding 150mm to 95% MOD AASHTO with selected material from stockpiles.	m³	6		
4.2.3	8.3.3(b)		Extra over Item 4.2.1 and 4.2.2 for hard rock excavation	m³	1021		
			RESTRICTED EXCAVATION				
4.2.4	8.3.3(a)		Excavate in all materials to stockpile for road cross over drains, Gabion Mattress boxing out, retaining wall bases and concrete anchor/edge beams.	m³	195		
4.2.5	8.3.3(b)		Extra over Item 4.2.4 for hard rock excavation	m³	100		
4.3			**ACCESS ROAD SURFACING**				
	SABS 1200ME		BASE				
4.3.1	8.3.3		Construct 150mm layer of G7 base compacted to 98% of Mod AASHTO density. Material to be imported from commercial source.	m³	105		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
4.4	**SABS 1200 G**		**CONCRETE (STRUCTURAL)**				
4.4.1	8.2		*Formwork: Road/ foundation Slab*				
	8.2.1		Rough: Plane vertical to elements				
4.4.1.1		LI	Sides of Road/foundation slab and downstand beams	m²	11		
4.4.2	8.3		*Reinforcement:*				
	8.3.2		High tensile welded mesh:				
4.4.2.1		LI	Ref No 395	m²	43		
4.4.3	8.4		*Road Concrete*				
	8.4.3		Strength concrete: Grade 25 MPa/19 mm concrete to:				
4.4.3.1		LI	Concrete Roadway	m³	3		
4.4.3.2		LI	Cross Over Drain	m³	3		
4.4.3.3		LI	As directed by the Engineer	m³	1		
4.4.4	*8.4*		*Gabion Filling Concrete:*				
	8.4.3 8.4.3		Strength concrete: Grade 15 MPa/13 mm concrete to :				
4.4.4.1		LI	Gabion Filling	m³	2		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
4.4.4.2		LI	As directed by the Engineer	m³	2		
	(a)		Wood-floated finishes to:				
4.4.4.3		LI	Top of road and cross over drains	m²	43		
4.4.5	**SABS 1200 MM**		**ANCILLARY**				
			GUARDRAILS				
4.4.5.1	8.2.1	LI	Supply and erect new galvanised steel guard rails complete including excavations, posts, spacers, labour, fixings etc as per Drawing J40044-101	m	175		
4.4.5.2	8.2.2	LI	Extra-over item 4.4.5.1 for horizontally curved	m	100		
4.4.5.3	8.2.3	LI	End wings	No	8		
	SABS 1200 DK		GABIONS & PITCHING Surface preparations for bedding of gabions				
4.4.5.4	8.2.1(a)	LI	Cavities filled with approved excavated materials in minimum layers of 150mm	m²	297		
4.4.5.5	8.2.1(b)	LI	Cavities filled with importerd G7 material from commercial sources in minimum layers of 150mm	m²	297		
		LI	Mattress Gabions: Hexagonal nominal 80mm galvanised and PVC coated wire mesh				
4.4.5.6	8.2.2	LI	0.3m X 1m mattress gabions - Gabion Stone sourced from local stockpile	m³	100		
4.4.5.7		LI	0.3m X 1m mattress gabions - Gabion Stone sourced from commercial sources	m³	13		
4.4.5.8	8.2.2(b)	LI	Gabion baskets 1m wide by 1m high lengths to suit - Gabion Stone sourced from local stockpile	m³	231		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
4.4.5.9		LI	Gabion baskets 1m wide by 1m high lengths to suit - Gabion Stone sourced from Commercial Sources	m³	60		
		LI	Facing of gabions				
4.4.5.10	8.2.3	LI	Extra-over Items 4.4.5.6 to 4.4.5.9 for packing selected stone at exposed face	m²	700		
		LI	Supply and lay non- woven geotextile (minimum mass 270g/m2)				
4.4.5.11	8.2.4	LI	Below and on sides of mattress gabions	m²	930		
TOTAL FOR SECTION 4 CARRIED FORWARD TO SUMMARY							

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
5.1	**SABS 1200C**		**SITE CLEARANCE**				
	8.2.1		Clear and grub areas to:				
5.1.1		LI	Abstraction works (excl. Diversion works)	m²	400		
5.2	**SABS 1200D**		**EARTHWORKS**				
5.2.1			NATURAL ROCK WEIR				
	8.3.3		Restricted excavation: Excavate in all materials and use for embankment, backfill, stockpile or dispose, as ordered				
5.2.1.1	a)		For structure (Measured in Cut) where directed by the engineer	m³	5		
5.2.2			ABSTRACTION WORKS				
	8.3.3		Restricted excavation: Excavate in all materials and use for embankment, backfill, stockpile or dispose, as ordered				
5.2.2.1	a)		For structure (Measured in Cut)	m³	126		
5.2.2.2	b)		Extra over Items 5.2.2.1 for hard rock excavation	m³	126		
5.3	**SABS 1200 G**		**CONCRETE (STRUCTURAL)**				
5.3.1			NATURAL ROCK WEIR				
			Note: This is NOT construction of a new weir. This serves to improve the natural rock weir (with as minimal changes as possible) for hydraulic efficiencies. The excavation, formwork, concrete and reinforcing will be determined on site by the engineer				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
5.3.1.1			*Foundation Treatment*				
5.3.1.1.1	PSG 8.17		Preparation of foundation surfaces for receiving concrete	m²	5		
5.3.1.1.2	SABS 1200 G 8.4.2		75 mm thick blinding layer	m²	50		
			Drill & Grout in Steel dowels, complete including all drilling, cleaning and grouting for the following diameters: (Steel bars measured elsewhere)				
5.3.1.1.3			Y25 Dowels (where required)	m	25		
5.3.1.2	8.2		Formwork:				
	8.2.1		Rough:				
			Plane vertical to elements				
5.3.1.2.1			Side of wier	m	40		
5.3.1.3	8.3		Reinforcement:				
	8.3.1		High-tensile steel bars:				
5.3.1.3.1			25 mm dia dowel bars (where required)	t	2		
5.3.1.4	8.4		*Mass Concrete:*				
	8.4.3		Strength concrete:				
			Grade 15 MPa/19 mm concrete to:				
5.3.1.4.1		LI	Mass concrete foundation	m³	5		
	PSG 8.4.4		Unformed surface finishes:				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
	(b)		Steel-floated finishes to:				
5.3.1.4.2			Weir crest faces	m²	50		
5.3.2			ABSTRACTION WORKS				
5.3.2.1			*Foundation Treatment*				
5.3.2.1.1	PSG 8.17		Preparation of foundation surfaces for receiving concrete	m²	37		
5.3.2.1.2	SABS 1200 G 8.4.2		75 mm thick blinding layer	m²	37		
			Drill & Grout in Steel dowels, complete including all drilling, cleaning and grouting for the following diameters: (Steel bars measured elsewhere)				
5.3.2.1.3			Y25 Dowels	m	40		
5.3.2.2	8.2		*Formwork: Base/ foundation Slab*				
	8.2.1		Rough:				
			Plane vertical to elements				
5.3.2.2.1			Sides of Base/foundation slab and Pier & Abutment base	m²	16.1		
5.3.2.3	8.2		*Formwork: Abstraction Tower*				
	8.2.2		Smooth				
	8.2.2		Vertical Plane to elements				
5.3.2.3.1		LI	Inside Face of dry well	m²	182		
5.3.2.3.2		LI	Outside Face of dry well	m²	190		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
5.3.2.3.3		LI	Structural Support Corbels	m²	2.2		
5.3.2.3.4		LI	Inlet openings	m²	1.3		
5.3.2.3.5		LI	Sides of Drainage Sump and Drainage Trenches	m²	1.2		
5.3.2.3.6		LI	Sides of Pump Plinths	m²	1		
5.3.2.3.7		LI	Sides of pump channel walls	m²	22		
5.3.2.3.8		LI	Sides of external channel upstand	m²	9		
5.3.2.3.9		LI	Sides of columns	m²	32		
5.3.2.3.10		LI	Sides of beams up to and including 10.0 m	m²	6.5		
5.3.2.3.11		LI	Sides of beams over 10.0 m up to and including 15.0 m	m²	7		
5.3.2.3.12		LI	Sides of Inlet Channel Retaining Wall	m²	9		
	8.2.2	LI	Horizontal Plane to elements				
5.3.2.3.13		LI	Horizontal to soffit of Inlet openings	m²	1		
5.3.2.3.14		LI	Horizontal to soffit of Abstraction tower Cantilever Slab up to and including 10.0 m high	m²	18		
5.3.2.3.15		LI	Horizontal to soffit of Abstraction tower beams up to and including 10.0 m high	m²	2.5		
	8.2.5	LI	Smooth Narrow widths				
5.3.2.3.16		LI	250mm deep beam above roller shutter door	m	3		
5.3.2.3.17		LI	All Work, labour materials etc. to form Corbels complete	No.	12		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
5.3.2.3.18		LI	250mm high to side of loading bay slab (all prop heights)	m	20		
5.3.2.3.19			Supply and install 45 x 45 x 5mm GMS angle framing section cast into concrete edge with fishtail lugs at 600mm centres over trench complete including all formwork, labour materials etc measured per linear meter each edge for:				
5.3.2.3.20			Open grid flooring surround	m	20		
5.3.2.4	*8.2*		*Formwork: Abstraction Access Bridge and Pier*				
	8.2.2		Smooth Vertical Plane to elements				
5.3.2.4.1		LI	Sides of Retaining wall	m²	8.7		
5.3.2.4.2		LI	Sides of Parapet wall	m²	20		
5.3.2.4.3		LI	Sides of Pier	m²	18		
		LI	Horizontal Plane to elements				
5.3.2.4.4		LI	Horizontal to Soffit to bridge slab for prop heights over 0m and up to and including 10.0 m high	m²	52		
		LI	Inclined Plane to elements				
5.3.2.4.5		LI	Inclined to soffit of Pier	m²	0.8		
5.3.2.4.6		LI	Inclined to soffit of cantilever beam	m²	0.6		
	8.2.5	LI	Narrow widths (Smooth)				
5.3.2.4.7		LI	Vertical Side of bridge slab (all prop heights)	m²	6.3		
5.3.2.5	8.3	LI	*Reinforcement:*				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
	8.3.1	LI	Mild steel bars:				
5.3.2.5.1		LI	8 to 12 mm dia	t	0.7		
5.3.2.5.2		LI	16 to 20 mm dia	t	0.3		
5.3.2.5.3		LI	25 mm dia	t	0.1		
	8.3.1	LI	High-tensile steel bars:				
5.3.2.5.4		LI	8 to 10 mm dia	t	0.5		
5.3.2.5.5		LI	10 to 12 mm dia	t	4.7		
5.3.2.5.6		LI	16 to 20 mm dia	t	5.5		
5.3.2.5.7		LI	25 to 32 mm dia	t	3.5		
	8.3.2	LI	High tensile welded mesh:				
5.3.2.5.8		LI	Ref No 617	m²	4		
5.3.2.5.9		LI	Ref No 395	m²	4		
5.3.2.6	8.4		*Mass Concrete:*				
	8.4.3		Strength concrete:				
			Grade 15 MPa/19 mm concrete to:				
5.3.2.6.1		LI	Mass concrete foundation	m³	8		
5.3.2.7	*8.4*		*Abstraction Structure Concrete:*				
	8.4.3		Strength concrete:				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
	8.4.3		Class 35 MPa/19 mm concrete (watertight) to:				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
5.3.2.7.1		LI	Foundation slabs	m³	14		
5.3.2.7.2		LI	Abstraction Walls	m³	79		
5.3.2.7.3		LI	Bridge Pier & Abutment	m³	3.4		
5.3.2.8	*8.4*	LI	*Beams and Colomns Concrete:*				
	8.4.3	LI	Grade 35 MPa/19 mm concrete to :				
5.3.2.8.1		LI	Abstraction Column, slab & beams	m³	11		
5.3.2.8.2		LI	Bridge slab & beams	m³	15.4		
5.3.2.9	*PSG 8.4.4*	LI	*Unformed surface finishes:*				
	(b)	LI	Steel-floated finishes to:				
5.3.2.9.1		LI	Foundation slab	m²	20		
5.3.2.9.2		LI	Abstraction floor slab	m²	18		
5.3.2.9.3		LI	Bridge slab	m²	52		
5.3.2.9.4		LI	Intet channel	m²	7		
	PSG 8.16		Other special finish: Floor coatings by specialist Subcontractor Grind floor to sound concrete then clean-off all dust and loose material ready to apply coating, then apply Sika Purcem 21N polyurethane screed, or similar approved product, to a Nominal thickness of 6mm, in strict accordance to the manufacturer's specification				
5.3.2.9.5		LI	Abstraction top floor slab	m²	18		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
5.4	**SABS 1200 H**		**STRUCTURAL STEELWORK**				
5.4.1			*ABSTRACTION WORKS*				
	8.3.9		Open grid flooring Supply, manufacture, deliver and install, hot dip galvanise to ISO1461 or stainless steel EN Grade 1.4301 S/S 304 as specified in GIBB 007 specification open grid flooring with a minimum 40 mm high x 4,5 mm thick bearers (rectagrid RS40 (25 bearer bars per meter) or similar approved with non slip dimples), including welding and bolting in 120x55x13 channels and 152x76x18 channels where required, including base plates, welds, bolt holes and 45 mm x 45 mm x 5 mm angle sections for connections where required, including all anchors, grouting in, bolts nuts and washers:				
5.4.1.1			Walkways and platforms as described on drawings J40044-300/303 and J40044-402	t	1.3		
	8.3.7 c)		Handrails, and stanchions Supply, manufacture, deliver and install, hot dip galvanise to ISO1461 or stainless steel EN Grade 1.4301 S/S 304 as specified in GIBB 007 specification hand and knee rails stanchions with base plates, fixings, end closures and bends including, grouting in, bolts, nuts and washers on. rates to include for painting as per specification if Handrails, stanchions are GMS only.				
5.4.1.2			Supply and Install GMS platform or side mounted stanchions complete including all fixings, labour, materials, tools etc.	No.	12		
5.4.1.3			Supply and Install GMS hand and knee rails compete including all fixing, labour, materials, tools, etc. (both rails measured as a single linear distance)	m	30		
5.4.1.4			Supply and Install GMS Closure to suit complete including all fixing, labour, materials, tools, etc.	No.	20		
5.4.1.5			Supply and Install GMS bends (All angles) to suit complete including all fixing, labour, materials, tools, etc. (both rails bends measured as a single Bend)	No	1		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
	8.3.9		Ladders Supply, manufacture, deliver and install, hot dip galvanise to ISO1461:2009 or stainless steel EN Grade 1.4301 S/S 304 as per GIBB 007 corrosion specification, access ladders with or without safety cage as per drawing indicated below, including all anchors, grouting in, bolts, nuts and washers, site welding for:				
5.4.1.6			GMS "internal type" caged access ladder excluding seperate handle from platfrom level 3 to platform level 2. Refer to Drawing J4004-903	No	1		
5.4.1.7			GMS abstraction "external type" caged access ladder with 1.5m ladder rung extension without cage from platform level 2 to platform level 1. Refer to Drawing J40044-902	No	1		
5.4.1.8			GMS abstraction "external type" caged access ladder with 1.5m ladder rung extension without cage from platform level 2 to platform level 1. Refer to Drawing J40044-902	No	1		
	8.3.8		Pipe Step Ladder Supply, manufacture, deliver and install hot dip galvanise to SANS 1463 or stainless steel EN Grade 1.4301 S/S 304 pipe step ladder detail inclusive of; open grid flooring platform with 30 mm high x 4,5 mm thick bearers, 165mm x 550mm long treads with 30 mm high x 4,5 mm thick bearers surrounded by 45x45 L, hand and knee railings complete with side mounted stanchions, bends and closures, 200x75 PFC stringers each side of treads and platform including all bolts, welds, grouting in and chemical anchors as indicated on drawing for;				
5.4.1.9			GMS pipe step ladder and platform over DN300 pipe as detailed on drawing J40044-403	t	0.7		
	GIBB 007		Screens Design, Manufacture Supply and delivery, handle, install including all nuts, bolts, washers, drilling, grouting, welding complete to for screens as follows: Screen details described on drawing J40044-910				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
5.4.1.10			•Wall mounted removable, wedge wire screen and frame as detailed on the drawing •To suit clear opening 1200mm Wide by 400mm Height. •Frame to be bolted to external wall face. •Wedge wire size as indicated on drawings. •opening at level 471.5masl •Wedge wire to be welded to supports •Supports to be welded to frame •All material and coating described in GIBB 007 and drawings.	No	2		
5.5			**BUILDING WORKS**				
5.5.1	*GIBB012 7.1*		*BRICKWORK*				
			SUPERSTRUCTURE Brickwork of NFX bricks (14 MPa nominal compressive strength) in class I mortar				
5.5.1.1			230 brick walls	m²	104		
			FACE BRICKWORK Extra over brickwork for single sided face brickwork "Corobrick Montana Travertine FBS or similar approved" to External Face of walls with recessed horizontal and vertical joints				
5.5.1.2			Extra over items 5.5.1.1 for face brickwork to exposed external faces	m²	52		
			"Corobrick agate - satin or similar approved" to Internal Face of walls pointed with flush horizontal and vertical joints				
5.5.1.3			Extra over items 5.5.1.1 for face brickwork to exposed internal faces	m²	52		
			BRICKWORK SUNDRIES				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
			Miscellaneous				
5.5.1.4			Extra over brickwork for brick-on-edge header and reinforced brickwork complete including reinforcement above openings for louvres	m	5		
5.5.1.5			Extra over brickwork for brick-on-edge header below openings for louvres	m	5		
5.5.2	*GIBB012 7.8*		*ROOF COVERINGS etc.*				
			PROFILED METAL SHEETING AND ACCESSORIES Klip-Lok 700 profile roll-formed in continuous lengths from certified ZINCALUME AZ150 coated steel G550 0.53mm with a Clean COLORBOND finish to one side and a standard backing coat, Mountain Mist to other and fixed to steel using KL700 clips and class 3 fasteners, in strict accordance with manufacturer's specifications. complete including all labour, materials, fasteners, trimmings closures etc.				
5.5.2.1			Roof covering with pitch not exceeding 25 degrees	m²	42		
5.5.2.2			Timber rafters 38x228 GR7 SAP	m	36.4		
5.5.2.3			Ridge cap 550mm girth 3 times bent & notched on site to suit roof profile	m	5		
5.5.3	*GIBB 0012 7.4*		*CARPENTRY AND JOINERY*				
	revD		(Schedule on Drawing. No.J40044-405) DOORS Design Supply, manufacture, deliver, install and make good roller shutter door, including all ironmongery, frames, joinery, hinges, locks, corrosion protection, as per finishing schedules				
5.5.3.1	revD		RD1 as per schedule J40044-405	No	1		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
			LOUVERS This includes supply, delivery and installation of all equipment, fully installed, including associated fittings, connections, jointing, hangers, supports, scaffolding, labour and all other cost and equipment to provide a complete, SANS compliant and Health and safety compliant installation REFER TO FINISHING SCHEDULE FOR DETAILS OF LOUVERS BELOW. ALL SPECIFICATION, MATERIAL, CONTROLS, NOTES AND ADDITIONAL INFORMATION ON THE SCHEDULE WILL BE DEEMED TO HAVE BEEN INCLUDED FOR IN THE PRICING OF THESE ITEMS.				
5.5.3.2	revD		L01 - as per schedule J40044-405	No	4		
TOTAL FOR SECTION 5 CARRIED FORWARD TO SUMMARY							

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
6.1			**ABSTRACTION WORKS**				
6.1.1	*GIBB 006 GIBB 007*		*HYDRO-MECHNICAL EQUIPMENT*				
			Allow for all the costs and expenses in connection with the design, manufacture, painting, testing, supplying, delivery, offloading and storage of the following materials and equipment: All information can be found in the drawings, the project specification and Hydro-mechanical specification. Corrosion protection shall follow GIBB 007 - painting and corrosion protection specification.				
6.1.1.1			Sluice Gates				
	GIBB 006 GIBB 007		Hand operated sluice gates to suit aperture listed below. Sluice gate shown on drawing J40044-401				
6.1.1.1.1	GIBB 006. 11.3.1		Design, Manufacture Supply and delivery to site of Sluice gate as follows: •Inlet Sluice gate •To suit clear opening Width by Height. 0.4m x 1.2m (gate to be 1200mm by 1200mm minimum) •Frame and slide disc designed to suit off seating pressure head of 11.4m •wall (surface) mounted •Head stock and handwheel at operating level 482 masl •headstock mounted on floor and spindle extend through floor through uPVC boxout •Seals as per GIBB 006 •Manual actuation •All material and coating described in GIBB 006.	No.	2		
6.1.1.1.2	GIBB 006. 11.3.2		Installation / Erection, testing, Commissioning preparation of O&M manuals of sluice gate as listed above	No.	2		
6.1.2			*CRANE, HOISTS, & GANTRIES*				
	GIBB 008 GIBB 007		Allow for all the costs and expenses in connection with the design, manufacture, painting, testing, supplying, delivery, offloading and storage of the following materials and equipment, further details in the Project Specification and on the drawings.: J40044-401				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
	GIBB 008.10.1		Design, manufacture, supply and delivery the following:				
6.1.2.1			•Manually operated overhead Travelling crane, over slung, stooled down if nessasary •Single girder •lifting capacity 2 (tonnes) •Long-travel Length 6.84 (m) •Cross-travel length 4.05 (m) •Minimum Hook to Deck Clearance 3.25 (m) •Maximum Hoist Travel length 14.65 (m) •Clearance height from top of corbel or support 1 (m) •Control Type (Manual) •Available Power Supply [no] •Including long travel rails and beams •Long travel - manual "chain operated type geared bridge wheel system (chain operated from single side)" •Cross travel - manual "chain operated type geared trolley wheel system" •Chain block hoist mechanism -manual "chain operated type geared pulley hoist system" •Hand chain Material GMS •GMS Hoist Load chain	Sum	1		
	GIBB 008.10.2		Installation of Equipment, commissioning and testing				
6.1.2.2			Installation / Erection, testing, Commissioning preparation of O&M manuals of manually operated overhead travelling crane as listed above	Sum	1		
6.2			**PUMPSTATION PIPE AND PUMPING EQUIPMENT**				
6.2.1	*SABS 1200 L*		*PIPEWORK*				
			Supply, install, lay, and test steel pipes, valves, meters and specials (short pipe runs), including all corrosion protection, jointing, fastening, welding, making good of joints and wrapping of joints as specified. Rates to include for shop drawings and the design of crotch and/or wrapper plates and/or gusseted tees and pipe wall thicknesses Abstraction Works main delivery Pipe Work, Drawing. No. J40044-400 and J40044-404. Flange specification as indicated on drawings				
	PSL 8.2.2		Hot Dipped Galvaised Mild Steel Pipework, bends & specials to ISO1461				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
6.2.1.1			Item 1A: DN100 flanged duck foot bend and drilled base footing including holding down bolts and ancillary pump guide rail to suit delivery pipework for submersible pumpset as designed and tendered for in accordance to GIBB 020	No	1		
6.2.1.2			Item 2: DN100 xDN150 flanged reducer	No	3		
6.2.1.3			Item 3: DN150 spool pice flanged both ends	No	3		
6.2.1.4			Item 4: DN150 spool pice flanged both ends	No	9		
6.2.1.5			Item 6: DN 150 equal flanged tee, barrel 460mm f/f, branch 440mm c/f; including 4 equidistant DN 25 stub flanges 250mm c/f; Ftting to include: 4 no. DN25 flanged stub and blank flange for instrumentation (length to suit bolting minimum 50mm long) · (instruments to include 1 x pressure gauge, 1 x pressure switch and 1 x flow switch measured elsewhere)	No	3		
6.2.1.6			Item 7: DN150 blank flange; with hole drilled centrally to suit id of DN80 pipe welded over opening; DN80 pipe to be flanged	No	3		
6.2.1.7			Item 13: Special: DN300 flanged manifold with 3 x DN150 flanged branches 340mm c/f and 1 x dn50 flanged branch 390mm c/f. all dimensions to be determined on site	No	1		
6.2.1.8			Item 14: Special: DN300 flanged long radius steel bend with one long leg 1780mm, welded to DN300 x DN250 flanged concentric reducer at 8 deg angle. including 2 equidistant DN25 stub flanges 1000mm from reducer flange; fitting to include: 2 no.DN25 flanged stub and blank flange for instrumentation (length to suit bolting minimum 50mm long) (instruments to include 1 x flow switch and 1 x pressure switch measured elsewhere)	c	1		
6.2.1.9			Item 17: DN300 x DN250 flanged concentric reducer welded to one long leg, DN250 flanged reducer at 8 deg angle	No	1		
6.2.1.10			Item 19: DN300 flanged equal tee	No	1		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
6.2.1.11			Item 20: DN300 flanged long radius steel 90 deg "s" bend 1260mm c/c and f/f. special flange on one side: DN350 flange (520mm) on 323mm od pipe (steel to hdpe connection). all dimensions to be confirmed on site.	No	1		
6.2.1.12			Item 22: DN300 blank flange; with hole drilled centrally to suit ID of DN80 pipe welded over opening; DN80 pipe to be flanged,	No	1		
6.2.1.13			Item 24: DN300 blank flange	No	1		
6.2.1.14			Item 25: DN25 blank flange; provision to be made for instrumentation tappings to suit provided instruments, instruments measured elsewhere	No	14		
	PSL 8.2.2		Couplings:				
6.2.1.15			Item 5: DN150 flanged dismantling joint Nominal face to face approx. 200mm	No	3		
6.2.1.16			Item 18: DN250 flanged dismantling joint Nominal face to face approx. 200mm	No	1		
6.2.1.17			Item 26: DN300 flanged dismantling joint Nominal face to face approx. 200mm	No	1		
	PSL 8.2.3		Valves:				
6.2.1.18			Item 9: DN80 flanged Triple-Acting stainless steel Air Valve with "anti-shock" function and anti theft type with inclusive quater turn wafer butterfly valve, "Variant 080LT16" Or Similar Approved	No	4		
6.2.1.19			Item 11: DN150 flanged nozzle check valve; f/f dimensions to en 558/iso 5752 series 14	No	3		
6.2.1.20			Item 12: DN150 flanged resilient seal valve to suit sabs 664, with handwheel and rising spindle	No	3		
6.2.1.21			Item 16: DN250 flanged magnetic flow meter; complete with MCC mounted transmitter and gms conduit, approx. 480mm f/f "krohne waterflux 3000" or similar approved	No	1		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
	PSL 8.2.2		HDPe Specials Supply and install the following fitting complete including all welding, labour, materials, plant etc as decribed below				
6.2.1.22			Item 23: 355mm NB Reinert-Ritz (or similar approved) HP flange with PE100 welding stub and permanently fitted backing flange, designed for full pressure resistance, drilled in accordance with SANS 1123 1600/3. The body of the PE fitting must be manufactured in the injection moulding process or from a piece of homogeneous semi-finished material. SEMI-FINISHED MATERIALS MANUFACTURED FROM WOUND RODS OR THE SUBSEQUENT APPLICATION OF OTHER FORMS OF REINFORCING ARE NOT PERMITTED	No	1		
	PSL 8.2.2		Abstraction Works ancillary Pipe Work, Drawing. No. J40044-400/404-T-A. Flange specification as indicated on drawings Hot Dipped Galvaised Mild Steel Pipework, bends & specials to ISO1461				
6.2.1.23			Item 31: DN50 spool piece flanged both ends	No	2		
6.2.1.24			Item 34: DN50 x 90 degree long radius bend both ends flanged	No	1		
6.2.1.25			Item 41: DN50 flanged long radius steel 90 deg "s" bend 240mm c/c and f/f. All dimensions to be confirmed on site.		1		
6.2.1.26			Item 43: DN50 x 90 degree long radius flanged bend	No	1		
6.2.1.27			Item 44: DN50 spool piece flanged both ends	No	2		
6.2.1.28			Item 45: DN50 spool piece flanged both ends	No	1		
6.2.1.29			Item 46:DN50 flanged 45 deg bend	No	2		
6.2.1.30			Item 47: DN50xDN80 FL/PE reducer	No	2		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
	PSL 8.2.2		Couplings				
6.2.1.31			Item 32: DN50 flanged dismantling joint nominal 200mm f/f	No	2		
	PSL 8.2.3		Valves:				
6.2.1.32			Item 33: DN50 flanged ball valve with quarter turn handle, CI body, ss ball, teflon seal	No	1		
6.2.1.33			Item 40: DN50 flanged wedge gate valve to suit SABS 664, with handwheel and rising spindle	No	1		
	PSL 8.2.15 c)		Corrosion Protection: Wrapping of Permanentley exposed and cast-in pipes and fittings extending 150 mm beyond the face of the wall each side and 75 mm into the concrete (minimum 55%) overlapping.				
6.2.1.34			DN300 pipe	No	1		
6.2.1.35			DN50 pipe	No	1		
6.2.2	GIBB 020		PUMPING EQUIPMENT				
6.2.2.1	GIBB 020		ABSTRACTION PUMPS				
6.2.2.1.1	GIBB 020 6.1		Pumpsets to deliver the required discharge as per project specifications, complete with base plate, anchor bolts, couplings etc. Design, select, supply, handle, deliver, complete with necessary flow switches, pressure switches level probes/ sensors, common instrumentation and inline pipeline instrumentation ect. for the following pumpsets:				
6.2.2.1.2			i) Abstraction Submersible pumpset complete including control instrumentation etc	No	2		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
6.2.2.1.3			ii) Sump Submersible pumpset complete including control instrumentation etc	No	1		
6.2.2.1.4	GIBB 020 6.2		Install, test and commission complete with necessary flow switches, pressure switches level probes/ sensors, common instrumentation and inline pipeline instrumentation ect. for the following pumpsets:				
6.2.2.1.5			i) Abstraction Submersible pumpset complete including control instrumentation etc	No	2		
6.2.2.1.6			ii) Sump Submersible pumpset complete including control instrumentation etc	No	1		
			Common Instrumentation				
6.2.2.1.7	GIBB 020 6.1		Design, supply, and delivery of common instrumentation excluding radar level sensor and magflow meter both measured elsewhere. The scope shall include cabling to control panel, pipework and valves (if applicable) and supports /mountings. It shall exclude all instrumentation inherent to the pump or the motor. It shall include electrical installation and telemetry thereof.	Sum	1		
6.2.2.1.8	GIBB 020 6.2		Installation, Testing and Commissioning of common instrumentation excluding radar level sensor and magflow meter both measured elsewhere. The scope shall include cabling to control panel, pipework and valves (if applicable) and supports /mountings. It shall exclude all instrumentation inherent to the pump or the motor. It shall It shall include electrical installation and telemetry thereof.	Sum	1		
6.2.3			*LEVEL SENSORS*				
6.2.3.1			Radar level sensors				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
			Supply, deliver and install complete including all materials, consumables, mounting brackets, labour etc. Radar level sensors "KROHNE OPTIWAVE 7500C" or similar approved. 80 GHz Radar Level Meter FMCW non-contact transmitter, 4 GHz bandwidth sweep, Process pressure range: -1 to 40 barg with removable and repositionable display, Non linearity zone down to 70 mm under lens, Measuring range: 0 to 30 m, Measuring accuracy: ±0.02 % of end value or ±2 mm for the first 10m : repeatability ±1 mm, Beam Angle: 4° approx. DN70 (concave) lens antenna , Signal output: 4 to 20 mA / 2-wire, Registered FDT/DTM, Housing in 316L S/S, IP68 | NEMA 4X/6P,The beam shall not be interrupted by high structure walls				
6.2.3.1.1			Abstraction works mounted to wall within wet well	No	1		
6.2.4			*PIPE SUPPORTS*				
	GIBB 007, GIBB 002		Pipe supports Type 2 as per drawing J40044-906. Rate to include, design, manufacture, supply, deliver, erect, construct, load test pipe supports inclusive of all steel materials, pipe wrapping material, nuts, bolts, shop fitting drawings and Corrosion protection as per spec to suit pipe diameter:				
6.2.4.1			DN300 delivery pipework	No	3		
6.2.4.2			DN150 vertical delivery pipework (for hieghts from 0 to up to and including 5m)	No	3		
6.2.4.3			DN150 vertical delivery pipework (for hieghts over 5 to up to and including 10m)	No	6		
6.2.4.4			DN150 vertical delivery pipework (for hieghts over 10 to up to and including 15m)	No	3		
	GIBB 007, GIBB 002		Valve supports Type 3 as per drawing J40044-906. Rate to include, design, manufacture, supply, deliver, erect, construct, load test pipe supports inclusive of all steel materials, pipe wrapping material, nuts, bolts, shop fitting drawings and Corrosion protection as per spec to suit pipe diameter:				
6.2.4.5			Valve supports to DN150 RSV	No	3		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
6.2.4.6			Valve supports to DN50 wedge gate valve	No	1		
6.2.4.7			Valve supports to DN150 nozzle check valves	No	3		
6.2.4.8	GIBB 007, GIBB 002		Thrust supports Type 4 as per drawing J40044-907. Rate to include, design, manufacture, supply, deliver, erect, construct, load test pipe supports inclusive of all steel materials, pipe wrapping material, nuts, bolts, shop fitting drawings and Corrosion protection as per spec to suit pipe diameter:				
6.2.4.9			Thrust support to DN300 delivery line	No	1		
	GIBB 007, GIBB 002		Small Diamter pipe supports as per drawing J40044-907. Rate to include, design, manufacture, supply, deliver, erect, construct, load test pipe supports inclusive of all steel materials, pipe wrapping material, nuts, bolts, shop fitting drawings and Corrosion protection as per spec to suit pipe diameter:				
6.2.4.10			Pipe support (type 6) DN50 scour pipework (for hieghts over 5 to up to and including 10m)	No	2		
6.2.4.11			Pipe support (type 6) DN50 scour pipework (for hieghts over 10 to up to and including 15m)	No	1		
6.2.4.12			Pipe support (type 7) DN50 scour pipework (for all support hieghts)	No	2		
TOTAL FOR SECTION 6 CARRIED FORWARD TO SUMMARY							

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
7.1			**LV DISTRIBUTION BOARD**				
	GIBB 020 6.3		New MCC - Panels complete as specified in Electrical Data Schedule1 and 2, including connection to SCADA,PLC, Motors, Junction Boxes, Genset, Auxillary Control Panels, etc. and drawing number J40044-410. All control wiring to be glanded, terminated and marked on both conductor ends using Electrical Data Schedule 3 Type K, L, and M Items.				
7.1.1			Supply	sum	1		
7.1.2			Install	sum	1		
7.2	**GIBB-011**		**LV CABLES, JOINTS AND TERMINATIONS**				
7.2.1	GIBB-011		*TERMINATIONS*				
			Gland; shroud; lug and terminate 75 kW main pumpset motor cabling to MCC panel inclusive of fasteners				
7.2.1.1			Supply	no.	2		
7.2.1.2			Install	no.	2		
			Gland; shroud; lug and terminate drainage pumpset motor cabling to MCC panel inclusive of fasteners				
7.2.1.3			Supply	no.	1		
7.2.1.4			Install	no.	1		
7.2.2	GIBB-011		PVC WIRING				
			WIRING - PVC insulated copper wire of the following sizes drawn into conduit and terminated: 2,5 mm²				
7.2.2.1			Supply	m	30		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
7.2.2.2			Install	m	30		
			1,5mm²				
7.2.2.3			Supply	m	200		
7.2.2.4			Install	m	200		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
7.3	GIBB-011		**EARTHING AND LIGHTNING PROTECTION**				
7.3.1			Conduct earth resistance testing and provide report, as required. rate is per test site.	no.	1		
7.3.2			*INSULATED COPPER EARTH WIRE*				
			70 mm² Insulated copper earth wire cabling supply, secure/ lay				
7.3.2.1			Supply	m	30		
7.3.2.2			Install	m	30		
			6 mm² Insulated copper earth wire cabling supply, secure/ lay				
7.3.2.3			Supply	m	40		
7.3.2.4			Install	m	40		
			6 mm² bonding strapping with prepunched hole, supply				
7.3.2.5			Supply	m	3		
7.3.2.6			Cut and terminate onto point of connection	no.	10		
7.3.3			*EARTH LUGS AND TERMINATIONS*				
			Lug and terminate 70mm² Cu cable inclusive of fasteners.				
7.3.3.1			Supply	no.	8		
7.3.3.2			Install	no.	8		
			Lug and terminate 6mm² Cu cable inclusive of fasteners.				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
7.3.3.3			Supply	no.	20		
7.3.3.4			Install	no.	20		
			Lug and terminate 2.5mm² Cu cable inclusive of fasteners.				
7.3.3.5			Supply	no.	2		
7.3.3.6			Install	no.	2		
7.3.4			*MAIN EARTH*				
			Ø16 mm x 1.8m earth electrode				
7.3.4.1			Supply	no.	5		
7.3.4.2			Install	no.	5		
7.3.4.3			Drill hole in to hard rock for Ø16 mm x 1.8m earth electrode	no.	5		
7.3.4.4			Install compound to improve resistivity contact to earth Ø16 mm x 1.8m earth electrode	no.	5		
7.3.5			*CAD WELD*				
			4- way CAD weld of 70 mm² BCEW to Ø16 mm earth electrode				
7.3.5.1			Supply	no.	2		
7.3.5.2			Install	no.	2		
			3- way CAD weld of 70 mm² BCEW to Ø16 mm earth electrode				
7.3.5.3			Supply	no.	2		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
7.3.5.4			Install	no.	2		
			2- way CAD weld of 70 mm² BCEW to Ø16 mm earth electrode				
7.3.5.5			Supply	no.	1		
7.3.5.6			Install	no.	1		
			70 mm² BCEW				
7.3.5.7			Supply	m	100		
7.3.5.8			Install	m	100		
7.3.6	*GIBB 011*		*LIGHTNING PROTECTION*				
7.3.6.1			MCC Building				
7.3.6.1.1			Supply	sum	1		
7.3.6.1.2			Install	sum	1		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
7.4			**CONDUIT, WIRE WAYS & ANCILLARIES**				
7.4.1			*CONDUITING*				
			SABS Approved PVC or Bosal (or approved equal or equivalent) conduit, complete with all adapters, couplings, saddles etc. (On surface, build and cast in) 20 mm Ø. Steel galvanised bosal or equivalent				
7.4.1.1			Supply	m	30		
7.4.1.2			Install	m	30		
7.4.2			*FLEXIBLE CONDUIT*				
			Refer to Electrical Data Schedule 3. The following shall also include for all cutting, mounting and fixing with adapters, couplers, non-ferrous metal fasteners, and washers etc, Protective SS cable flexible conduit Ø 10mm-Type O				
7.4.2.1			Supply	m	5		
7.4.2.2			Install	m	5		
			Protective SS cable flexible conduit Ø 16mm-Type P				
7.4.2.3			Supply	m	5		
7.4.2.4			Install	m	5		
			Protective SS cable flexible conduit Ø 20m- Type Q				
7.4.2.5			Supply	m	5		
7.4.2.6			Install	m	5		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
			Protective SS cable flexible conduit Ø 10mm adapter with cap nut-Type O				
7.4.2.7			Supply	no.	4		
7.4.2.8			Install	no.	4		
			Protective SS cable flexible conduit Ø 16mm adapter with cap nut-Type P				
7.4.2.9			Supply	no.	4		
7.4.2.10			Install	no.	4		
			Protective SS cable flexible conduit Ø 20mm adapter with cap nut-Type Q				
7.4.2.11			Supply	no.	4		
7.4.2.12			Install	no.	4		
7.4.3	*GIBB 011*		*CABLE WAYS, TRUNKING AND DUCTING*				
			Refer to Electrical Data Schedule 3. The following shall include for all covers, cutting, drilling, mounting and fixing with adapters, couplers, non-ferrous metal fasteners, and washers etc,				
7.4.3.1	*GIBB 011*		*DUCTING*				
			P9000 galvanised wiring duct; 0.8mm thickness, supply and install including all galvanised fasteners and cover plate.				
7.4.3.1.1			Supply	m	40		
7.4.3.1.2			Install	m	40		
			P9000 galvanised wiring duct standard internal cross over; 0.8mm thickness, supply and install including all galvanised fasteners.				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
7.4.3.1.3			Supply	no.	1		
7.4.3.1.4			Install	no.	1		
			P9000 galvanised wiring duct standard internal elbow; 0.8mm thickness, supply and install including all galvanised fasteners.				
7.4.3.1.5			Supply	no.	4		
7.4.3.1.6			Install	no.	4		
			P9000 galvanised wiring duct standard external elbow; 0.8mm thickness, supply and install including all galvanised fasteners.				
7.4.3.1.7			Supply	no.	4		
7.4.3.1.8			Install	no.	4		
			P9000 galvanised wiring duct standard internal tee; 0.8mm thickness, supply and install including all galvanised fasteners.				
7.4.3.1.9			Supply	no.	1		
7.4.3.1.10			Install	no.	1		
7.4.4	*GIBB 011*		*OUTLET AND ROUND BOXES*				
			Complete with all covers, SS fasteners, adapters, couplings, saddles etc. 20 mm Round steel galvanised box built, chased in or surface mount				
7.4.4.1			Supply	no.	15		
7.4.4.2			Install	no.	15		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
7.4.5	*GIBB 011*		*CABLE BASKETS & WIRE WAYS*				
			Galvanized cable basket and ladder wire ways including all bracings, galvanised fasteners, clamps etc. 100 mm Wire basket 100mm Wire mesh medium duty				
7.4.5.1			Supply	m	30		
7.4.5.2			Install	m	30		
			100 mm Horizontal bend medium duty				
7.4.5.3			Supply	no.	2		
7.4.5.4			Install	no.	2		
			100 mm Internal elbow medium duty				
7.4.5.5			Supply	no.	2		
7.4.5.6			Install	no.	2		
			100mm External elbow medium duty				
7.4.5.7			Supply	no.	2		
7.4.5.8			Install	no.	2		
			100mm Tee medium duty				
7.4.5.9			Supply	no.	1		
7.4.5.10			Install	no.	1		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
7.4.6	*GIBB 011*		*CABLE LADDERS & WIRE WAYS*				
			Galvanized cable basket and ladder wire ways including all bracings, galvanised fasteners, clamps etc. 400 mm cable ladder horizontal bend heavy duty				
7.4.6.1			Supply	no.	30		
7.4.6.2			Install	no.	30		
			400 mm Cable ladder internal elbow heavy duty				
7.4.6.3			Supply	no.	2		
7.4.6.4			Install	no.	2		
			400 mm cable ladder external elbow heavy duty				
7.4.6.5			Supply	no.	2		
7.4.6.6			Install	no.	2		
			400 mm cable ladder tee heavy duty				
7.4.6.7			Supply	no.	1		
7.4.6.8			Install	no.	1		
			1m Hot dipped galvanized threaded rod M10				
7.4.6.9			Supply	no.	4		
			P2000; 2.5mm thick; 6m length hot dipped galvanised channel				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
7.4.6.10			Supply	no.	2		
7.4.7	*GIBB 011*		*CABLE FASTENERS*				
			UV resistant black cable ties for communication and transducer cables only, to secure cables to cable baskets and cable ladders				
7.4.7.1			Supply	sum	1		
7.4.7.2			Install	sum	1		
			Stainless steel cable strapping to secure power cables to cable trays, cable baskets and cable ladders.				
7.4.7.3			Supply	sum	1		
7.4.7.4			Install	sum	1		
7.5	**GIBB 011**		**ISOLATORS, SOCKET OUTLETS AND DATA CONNECTION**				
			Refer to Electrical Data Schedule 3. The following shall include all mounting and fixing with couplers, non-ferrous metal fasteners, and washers etc, Typical Sockets Industrial Socket outlet-Type H				
7.5.1			Supply	no.	2		
7.5.2			Install	no.	2		
			RJ45-Type N				
7.5.3			Supply	no.	2		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
7.5.4			Install	no.	2		
			Emergency stop complete with enclosure: Type I				
7.5.5			Supply	no.	1		
7.5.6			Install	no.	1		
			16A; 2-Pole Isolator-Type-S				
7.5.7			Supply	no.	1		
7.5.8			Install	no.	1		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
7.6	**GIBB 011**		**LUMINAIRES**				
			Complete with all covers, SS fasteners, couplings, saddles, lamps etc. complete. Refer to Electrical Data Schedule 3 for reference to the following Luminaire: Type A				
7.6.1			Supply	no.	4		
7.6.2			Install	no.	4		
			Luminaire: Type B				
7.6.3			Supply	no.	1		
7.6.4			Install	no.	1		
			WallMounted Self Contained Battery Exit Signs: Type C				
7.6.5			Supply	no.	1		
7.6.6			Install	no.	1		
			Luminaire: Type D				
7.6.7			Supply	no.	1		
7.6.8			Install	no.	1		
			Photo electric cell: Type E				
7.6.9			Supply	no.	1		
7.6.10			Install	no.	1		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
			3 Position Rotary Switch: Type F				
7.6.11			Supply	no.	2		
7.6.12			Install	no.	2		
			Occupancy Sensor : Type G				
7.6.13			Supply	no.	2		
7.6.14			Install	no.	2		
7.7			**SIGNAGE**				
7.7.1			*SIGNAGE*				
			Supply and install all signage and notices as to comply with the Occupational Health and Safety Act (Act 85 of 1993) for the HLPS				
7.7.1.1			Supply	sum	1		
7.7.1.2			Install	sum	1		
7.8			**INSTRUMENTATION AND CONTROL**				
			All control wiring to be glanded, terminated and marked on both conductor ends as per Electrical Data Schedule 3 Items				
7.8.1			HARDWARE				
7.8.1.1	4.1		Supply	no.	1		
7.8.1.2	4.2		Install	no.	1		
TOTAL FOR SECTION 7 CARRIED FORWARD TO SUMMARY							

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
8.1			**PIPELINES**				
8.1.1	*SABS 1200C*		*SITE CLEARANCE*				
8.1.1.1	8.2.1		Clear and grub along pipeline route (up to 4m wide)	m	300		
	8.2.2		Remove and grub large trees and tree stumps of girth:				
8.1.1.2			Over 1.0 m and up to and including 2.0 m	No.	2		
8.1.2	SABS 1200 D		REINSTATE VEGETATION				
8.1.2.1	PSD 5.2.4.3		Grassing by means of hydro-seeding or other approved method using relevant grass mix 4m wide strip	m	300		
8.1.3	*SABS 1200 DB*		*TRENCH EXCAVATION*				
	8.3.2. a) & PSDB 8.3.1		Excavate in all materials for trenches, backfill, compact and dispose of surplusmaterial. Including topsoil striping andreinstatement 150mm thick layer by 8mwide.(*Backfilling, compacting, topsoil stripping and reinstatement are to be done in-line with labour intensive construction methods) For 355mm NB pipelines : Over and Up to				
8.1.3.1		LI	0,0m 1.5m	m	330		
8.1.3.2		LI	1.5m 2.5m	m	180		
8.1.3.3			2.5m 3.5m	m	10		
			Extra over Items 8.1.3.1 to 8.1.3.3 for excavation in:				
8.1.3.4	PSDB 3.1 b(ii)		i) Hard rock	m^3	490		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
8.1.3.5	8.3.2		ii) Trenching through previously stabilised road layer works	m	146		
8.1.3.6	8.3.2 (c)		iii) Excavate and dispose of unsuitable material from trench bottom	m³	30		
8.1.4	*SABS 1200L*		*MEDIUM-PRESSURE PIPELINES*				
	PSL 8.2.1 a)		Supply, handle, lay, bed, joint, disinfect and test the following: All flanges are to conform with SABS 1123 Table 1600/3. Pipes of this material and diameter will undergo butt welding connections, The rate shall include supply, handling, connecting as well as cutting and waste for jointing of bends, elbows and tieing into manholes an, for pipes below.				
8.1.4.1		LI	355mm Ø HDPe PE 100 PN 12.5	m	516		
			BENDS Extra Over 8.1.4.1 above for the fabricating, welding, laying, bedding and testing the following HDPe bends				
	PSL 8.2.2		355mm PE100 PN 12.5 Bends fabricated from above pipe as per drawings				
8.1.4.2		LI	Scarfing of pipe to form 0° to 3° deflection	No	2		
8.1.4.3		LI	Mitre bends above 3° up to 15° (No segments + 2 end segments	No	3		
8.1.4.4		LI	Mitre bends above 15° up to 30° (1 segments + 2 end segments	No	3		
8.1.4.5		LI	Mitre bends above 30° up to 45° (2 segments + 2 end segments	No	1		
8.1.4.6		LI	Mitre bends above 45° up to 60° (3 segments + 2 end segments	No	1		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
8.1.4.7		LI	Mitre bends above 60° up to 75° (4 segments + 2 end segments	No	2		
8.1.4.8		LI	Mitre bends above 75° up to 90° (5 segments + 2 end segments	No	2		
			Cement Stabalisation Under Roads				
8.1.4.9			Extra over Items 8.1.4.1 to 8.1.4.8 for 4% Cement Stabalisation of bedding, selected fill and general backfill where shown or instructed.	m³	190		
8.1.5	*PSLB*		*BEDDING (PIPES)*				
			provision of flexable bedding				
8.1.5.1	SABS 1200 LB 8.2.2.3 a)		a) Imported Granular material from Commercial Sources	m³	225		
8.1.5.2	SABS 1200 LB 8.2.2.1 b)		b) Selected Fill material free of any deleterious materials provided from other excavations on site, rate to include for sieving ot other required processing	m³	100		
	PSLB 8.2.6		Drainage Layer (Provisional)				
8.1.5.3	PSLB 8.2.6(a)	LI	Supply and place in trench bottom, 150 mm layer of crushed stone as pipe drainage layer beneath DN 355 diameter pipe (Provisional)	m³	6		
8.1.5.4	PSLB 8.2.6(b)	LI	Supply and installation of geofabric filter material (BIDIM Grade A4 or similar) around stone (Provisional)	m²	40		
			Pipeline Markers				
8.1.5.5	PSL8.2.16	LI	Supply and install concrete pipe markers as detailed on standard Drawing No J40044-905 at 50m intervals along pipe route or at changes in direction	No	16		
8.2			**MINOR STRUCTURES AND CHAMBERS**				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
8.2.1			*CONCRETE/SUNDRIES/PRECAST ELEMENTS /PIPEWORK*				
			Air Valve Chamber 355mm by 80mm air valve assembly and chamber as per dwg J40044-904 complete including supply, deliver, handle, lay, bed, joint, test including all labour, materials, bolts, nuts, washers gaskets ect. All flange and pipe classes as described on drawing				
	PSL 8.2.2		Pipework				
8.2.1.1		LI	Item 1: 355mm NB Reinert-Ritz (or similar approved) HP flange with PE100 welding stub and permanently fitted backing flange, designed for full pressure resistance, drilled in accordance with SANS 1123. The body of the PE fitting must be manufactured in the injection moulding process or from a piece of homogeneous semi-finished material. SEMI-FINISHED MATERIALS MANUFACTURED FROM WOUND RODS OR THE SUBSEQUENT APPLICATION OF OTHER FORMS OF REINFORCING ARE NOT PERMITTED	No	2		
8.2.1.2		LI	Item 2: DN350 flanged equal tee, barrel 816mm F/F, branch approx. 528mm C/F	No	1		
8.2.1.3		LI	Item 3: DN350 blank flange; with hole drilled centrally to suit ID of DN80 pipe welded over opening; DN80 pipe to be flanged, and flange to suit DN80 flanged air valve	No	1		
8.2.1.4		LI	Item 4: DN80 flanged triple-acting SS air valve with "anti-shock" function and of an anti-theft type with integrated full bore quarter turn wafer butterfly valve F/F to ISO 5752-13, "VARIANT 080LT16" or similar approved	No	1		
		LI	Chamber				
8.2.1.5		LI	Construct circular precast concrete air valve chamber complete as per detail on above drawing including all Excavation, labour, materials, Rings, Lids, etc	Sum	1		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
8.2.1.6		LI	Chamber name, number, and pressure class painted in 150 mm high stencilled lettering to side of chamber roof slabs, complete including stenciles, labour, blck paint ect e.g "Mnqumeni Bulk Rising main AV1 PN10"	Sum	1		
		LI	Isolation Valve Chamber				
		LI	355mm isolation valve assembly and chamber as per dwg J40044-908 complete including supply, deliver, handle, lay, bed, joint, test including all labour, materials, bolts, nuts, washers gaskets ect. All flange and pipe classes as described on drawing				
	PSL 8.2.2	LI	Pipework				
8.2.1.7		LI	Item 1: 355mm NB Reinert-Ritz (or similar approved) HP flange with PE100 welding stub and permanently fitted backing flange, designed for full pressure resistance, drilled in accordance with SANS 1123. The body of the PE fitting must be manufactured in the injection moulding process or from a piece of homogeneous semi-finished material. SEMI-FINISHED MATERIALS MANUFACTURED FROM WOUND RODS OR THE SUBSEQUENT APPLICATION OF OTHER FORMS OF REINFORCING ARE NOT PERMITTED	No	2		
8.2.1.8		LI	Item 2: DN350 RSV PN 16 to SABS 664	No	1		
8.2.1.9		LI	Item 3: uPVC pipe diameter to suit bonnet PN9 min (or similar approved) from valve bonnet to NGL	Sum	1		
		LI	General				
8.2.1.10		LI	Construct circular precast concrete Isolation valve chamber complete as per detail on above drawing including all Excavation, labour, materials, Rings, Lids, etc	Sum	1		
8.2.1.11		LI	Chamber name, number, and pressure class painted in 150 mm high stencilled lettering to side of chamber roof slabs, complete including stenciles, labour, blck paint ect e.g "Mnqumeni Bulk Rising main IV1 (PN10)"	Sum	1		
TOTAL FOR SECTION 8 CARRIED FORWARD TO SUMMARY							

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
9.1			**POWER FEEDER CIRCUIT FROM ESKOM KIOSK TO MCC**				
9.1.1			*POWER CABLING*				
			120mm²;4C;Cu; XLPE; PVC;ECC;PVC; 600/1000V cabling, supply and lay				
9.1.1.1			Supply	m	30		
9.1.1.2			Install	m	30		
9.1.2	GIBB-011		*TERMINATIONS*				
			Gland; earth tag washer, shroud; lug and terminate 120mm²;4C;Cu; XLPE; PVC;ECC;PVC 600/1000V cable inclusive of fasteners				
9.1.2.1			Supply	no.	4		
9.1.2.2			Install	no.	4		

CARRIED FORWARD							

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
9.1.3			*OVERHEAD BUNDLE CONDUCTOR POWER SUPPLY*				
9.1.3.1			*SUPPLY AND INSTALLATION OF WOODEN POLES AND STAYS*				
			Carry out site survey by registered land surveyor, identify suitable pole assembly, mark and peg out where structures are to be planted.				
9.1.3.1.1			Materials	Sum	1		
9.1.3.1.2			Labour	Sum	1		
			Ø160-200 mm X 11m length creosote treated pole to SANS 754: 2015 complaint in all aspects				
9.1.3.1.3			Supply	ea	15		
9.1.3.1.4			Install	ea	15		
			Excavation into hard rock to a depth of 1.8m; plant Ø160-200 mm X 11m length creosote treated pole pole, backfill and compact to 95%				
9.1.3.1.5			plant	ea	15		
9.1.3.1.6			Labour	ea	15		
9.1.3.1.7			Compaction test and report	ea	15		
			Excavation of stay holes into hard rock as per engineers drawings and bacfill and compac to 95%				
9.1.3.1.8			plant	ea	10		
9.1.3.1.9			supply	ea	10		
9.1.3.1.10			Labour	ea	10		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
9.1.3.1.11			Compaction test and report	ea	10		
9.1.4			*LOW VOLTAGE AERIAL BUNDLE CONDUCTOR AND ASSEMBLIES WITH REFERENCE AND IN COMPLIANCE TO DRAWINGS*				
9.1.4.1			*AERIAL BUNDLE CONDUCTOR* Self supporting German System Aerial XLPE aluminium Bundle Conductor 3Phase + Neutral; 120mm² manufactured to SANS 1418-1 and SANS 1418-2				
9.1.4.1.1			Supply	m	250		
9.1.4.1.2			Install	m	250		
9.1.4.2			*ASSEMBLIES 3 PHASE + NEUTRAL* ABC Strain assembly 60-90 degrees complete as per drawings				
9.1.4.2.1			Supply	ea	8		
9.1.4.2.2			Install	ea	8		
			In-line fuse unit assembly complete as per drawings				
9.1.4.2.3			Supply	ea	1		
9.1.4.2.4			Install	ea	1		
			ABC cross intermediate-intermediate assembly complete as per drawings				
9.1.4.2.5			Supply	ea	5		
9.1.4.2.6			Install	ea	5		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
			ABC cross intermediate strain assembly as per darwings				
9.1.4.2.7			Supply	ea	1		
9.1.4.2.8			Install	ea	1		
			ABC dead end including termination assembly complete as per darwings				
9.1.4.2.9			Supply	ea	2		
9.1.4.2.10			Install	ea	2		
			120mm² Al ABC to Cu120mm²XLPE ECC IP 55 Cable Pole Mounted Joint box with Al-Cu infused Al-Cu ferruls joint kit inclusive of fastensers complete.				
9.1.4.2.11			Supply	ea	1		
9.1.4.2.12			Install	ea	1		
			120mm² Al ABC to Cu120mm²XLPE ECC IP 55 Cable Wall Mounted Joint box with Al-Cu infused Al-Cu ferruls joint kit inclusive of fastensers complete.				
9.1.4.2.13			Supply	ea	1		
9.1.4.2.14			Install	ea	1		
9.1.5			SIGNAGE				
			Supply and install all signage and notices as to comply with the Occupational Health and Safety Act (Act 85 of 1993) for the HLPS				
9.1.5.1			Supply	sum	1		
9.1.5.2			Install	sum	1		
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
			trench for single Pipes/Cables for sizes up to and including 160mm Over and Up to				
9.1.5.3			0,0 m 1,0 m	m	20		
9.1.5.4			1,0 m 2,0 m	m	20		
			Extra-over Items 9.1.5.3 to 9.1.5.4 for excavation in:				
9.1.5.5	8.2.2(b)		i) Hard Rock	m³	50		
9.1.5.6	PSA8.12		Supply and install Cable Marker Tape - 450mm wide overlapping	m	500		
9.1.6	*SABS1200 LC*		*CABLE MARKERS*				
9.1.6.1	8.2.8 a)		Route markers	No	5		
9.1.6.2	8.2.8 a)		Kerb markers	No	5		
9.2	8.2.8 a)		TESTING AND COMMISIONING				
9.2.1			Testing and Commissiong of complte works and issuing elecrical CoC in terms of SANS 10142-1, SANS 1973-1, SANS 1973-3; SANS 61439-1 and SANS 10103.	Sum	1		
TOTAL FOR SECTION 9 CARRIED FORWARD TO SUMMARY							

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
10.1			**COMMISSIONING, TRAINING AND OPERATION**				
			Commissioning				
10.1.1	5.6.1		Coordination and commissioning of complete scheme and all components	Sum	1		
			Operations and Maintenance, Including training of Employer's Operators				
10.1.2	5.6.2		Operations and Maintenance, including training of Employer's Operators for months 1 - 2 of the 6 month period.The Contractor shall provide at least one competent plant operator for the first two months ofthe Operation and Maintenance period. Thereafter, the Contractor shall be required to visit the works for at least two days per week for the next two months and at least two concurrent days twice a month for the final two months to ensure that the operating procedures, established during the first two months, are being maintained.	month	2		
10.1.3	5.6.2		Operations and Maintenance, including training of Employer's Operators for months 3 - 4 of the 6 month period.The Contractor shall provide at least one competent plant operator for the first two months ofthe Operation and Maintenance period. Thereafter, the Contractor shall be required to visit the works for at least two days per week for the next two months and at least two concurrent days twice a month for the final two months to ensure that the operating procedures, established during the first two months, are being maintained.	month	2		
10.1.4	5.6.2		Operations and Maintenance, including training of Employer's Operators for months 5 - 6 of the 6 month period. The Contractor shall provide at least one competent plant operator for the first two months ofthe Operation and Maintenance period. Thereafter, the Contractor shall be required to visit the works for at least two days per week for the next two months and at least two concurrent days twice a month for the final two months to ensure that the operating procedures, established during the first two months, are being maintained.	month	2		
10.2	**GIBB 019**		**EQUIPMENT MAINTANENACE DURING DEFECTS LIABILITY PERIOD**				
			Essential Tools				
			CARRIED FORWARD				

ITEM	PAYMENT REFERS	LIC	DESCRIPTION	UNIT	QUANTITY	RATE R	AMOUNT R
			BROUGHT FORWARD				
10.2.1	GIBB 002 30.5		Supply to site one complete set of all specialised tools required for the operation and maintenance of the equipment supplied as part of this contract	Sum	1		
10.2.2			All costs, travel, labour, materials, consumables etc for the routine maintanenance and servicing of all mechanical equipment , hydro-mechanical equipment, electrical equipment, lifting equipment, HVAC equipment, filters, etc for the entire plant as per the manufactures requirements and divided per area as follows for 12 months after issue of certificate of completion.				
10.2.3			i) Abstraction Works	Sum	1		
10.3	**GIBB 019**		**SUPPLY OF OPERATION AND MAINTANENACE MANUALS**				
10.3.1	5,7		Compilation and Supply of 4 No. O&M manuals as per the specifications	Sum	1		
10.4			**GRASSING**				
10.4.1	PSD8.3.6		Maintain (water and weed and cut) grass so that at least 80% coverage is achieved	months	6		
10.5			**SPARES**				
10.5.1			Abstraction Hydro-Mechanical spares				
	GIBB 006. 11.6		Design, Manufacture, Supply, Delivery and store to site the following spares: Sluice Gates				
10.5.1.1			Bottom, top, side seals for Sluice Gates	Sum	1		
TOTAL FOR SECTION 10 CARRIED FORWARD TO SUMMARY							

SUMMARY OF SCHEDULE OF PRICES

ITEM	DESCRIPTION	AMOUNT	
		R	c
1	PRELIMINARY AND GENERAL		
2	PROVISIONAL SUMS, DAY WORKS, ADDITIONAL ITEMS AND TEMPORARY WORKS		
3	DEMOLISH EXISTING STRUCTURES		
4	ABSTRACTION WORKS ACCESS ROAD		
5	ABSTRACTION WORKS - CIVIL		
6	ABSTRACTION WORKS - MECHANICAL		
7	ABSTRACTION WORKS - ELECTRICAL		
8	RISING MAIN		
9	ANCILLARY WORKS - ELECTRICAL		
10	COMMISSIONING, OPERATION AND MAINTENANCE OF ALL WORKS, AND TRAINING OF EMPLOYERS STAFF		
SUB-TOTAL 1 – BILL OF QUANTITIES			
ADD: Allowance for Contingincес and Dayworks		R 1 000 000	00
SUB-TOTAL 2			
ADD: Allowance for Contract Price Adjustment		R 750 000	00
SUB-TOTAL 3			
ADD: VALUE ADDED TAX @ 15%			
TOTAL CARRIED FORWARD TO FORM OF OFFER			

Signature _____ Date _____

Name _____ Capacity _____

Tenderer _____

C2.3 DATA SHEETS

DETAILS OF THE PLANT AND EQUIPMENT OFFERED ARE TO BE SUPPLIED BY THE TENDERER.

ALL RELEVANT INFORMATION CAN BE SUPPLIED IN A COVERING LETTER ACCOMPANYING THE TENDER DOCUMENTS OR ATTACHED BEHIND THIS PAGE

Scope of Works

TABLE OF CONTENTS

C3.1 DESCRIPTION OF THE WORKS

1.1. EMPLOYER'S OBJECTIVES

The employer's objective for this project is to provide a reliable source of raw water to supply the distribution network for bulk potable water to the settlements with in the Mnqumeni Bulk Water supply scheme footprint.

1.2. OVERVIEW OF THE WORKS

The Harry Gwala District Municipality (formerly Sisonke District Municipality) undertook the Mnqumeni/Santombe Water Supply project in 2009. The scheme was implemented in four phases, 1-4, with some of the phases comprising sub-phases implemented as separate contracts. The project comprised the development of a water supply scheme for the villages of Masameni, Mnqumeni, Ndlovini and Ehlanzeni in the Umzimkhulu Local Municipality. The scheme was developed to incorporate these villages into a single centralised scheme as the existing independent schemes did not have a reliable water supply. Most of the incorporated villages were supplied either by public standpipes or yard taps supplied from borehole schemes, which dried up seasonally and experienced significant vandalism. The new scheme is now supplied via a run of river abstraction on the Ibisi River and a 2Mℓ/day Water Treatment Works (WTW) located approximately 450m from the river abstraction site.

Subsequently during a flood event the existing run of river abstraction works failed, due to this failure the supply of potable water to the entire scheme has been inconsistent. A such this project aims to address the immediate limitations of the current scheme by, the construction of a new river abstraction works and pumping station, a new raw water rising main and refurbishment of the of the existing WTW, pipelines, pumping stations and reservoirs.

1.3. EXTENT OF THE WORKS

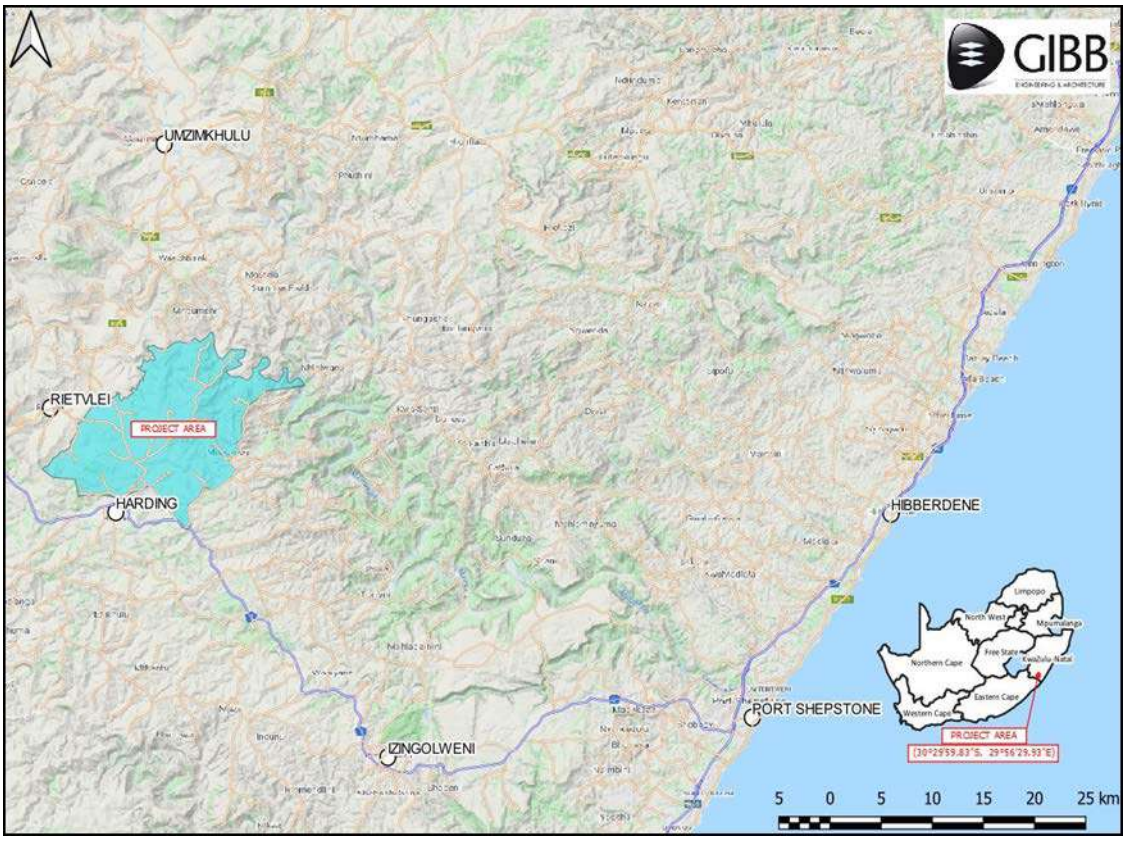
The scope and extent of work comprises the followings:

- Establishment of the Contractor's camp and plant on Site and the removal of all site establishment on completion of the Contract.
- Temporary works to enable construction of the abstraction tower
- Doweling of anchors into the foundation rock
- Construction of approx. 11m high reinforced concrete abstraction tower and access bridge
- Construction of brick with concrete frame pumping station building on abstraction tower
- The supply and delivery to site of all pumping equipment, pipework and ancillary specials
- Installation of all pumping equipment, pipework and ancillary specials
- The supply and delivery to site of approx. 515m of 355mm PN 12.5 PE100 HDPe pipe
- The clearing of vegetation and trees along the access road and pipeline routes.
- The excavation of approx. 515m of pipeline trench.
- The handling, laying, butt welding, bedding, testing and disinfecting of 355mm diameter approx 515m long of HDPe pipeline.
- The construction of valve, air valve, scour and meter chambers.
- The construction of approx. 180m long 3.5m wide access road.
- The construction of gabion Retaining wall
- The demolition of the existing abstraction works
- The recovery and stockpiling for reuse of existing gabion rock within the existing abstraction structure
- The refurbishment and repair of the existing water treatment plant
- The refurbishment and repair of the existing high lift pumping stations
- The refurbishment and repair of the existing rising mains
- The refurbishment and repair of the existing reinforced concrete reservoirs.
- Maintaining the whole of the works constructed for a period of 12 calendar months after a Certificate of Completion has been issued.

1.4. LOCATION OF WORKS

The centre of the project area is located approximately 10km northeast of Harding and 25km south of Umzinkhulu, in the southern area of KwaZulu-Natal. The project falls within the Umzinkhulu Local Municipality with the water service authority being the Harry Gwala District Municipality (HGDM). A locality plan of the project area is shown below. With a detailed location of the abstraction works shown on the Locality Plan included in Section C4.1.

The site is accessible by existing gravel and tarred roads and the Contractor shall familiarise himself with the site conditions and requirements for transport of plant and materials. Under no circumstances will any claims be allowed on account of difficulties experienced with access to any part of the Works. The consultant shall supply road markers and directions to contractors wishing to visit the site.



C3.2 ENGINEERING

2.1. DESIGN SERVICES AND ACTIVITY MATRIX

Responsibility for design of works, per design stage:

DESCRIPTION	RESPONSIBLE
Concept, feasibility and overall process	Employer
Basic Engineering and detail layout to tender stage, including drawing up of necessary specifications and performance specifications.	Employer's Representative
Tendering and providing the necessary information required in terms of the Tender Documents including compliance with the Specifications.	Tenderers
Adjudication of tenders and submission of results of adjudication to the Employer	Employer's Representative
Final design to approval for construction stage	Employer's Representative
Construction of the Works including necessary Temporary Works	Contractor
Commissioning of the Whole of the Works	Contractor
Preparation of record drawings	Contractor & Employer's Representative
Preparation of Operation and Maintenance Manuals	Contractor
Training of Employer's staff in the correct managing and operation of the scheme.	Contractor
Maintaining of the Works during the Defects Liability Period	Contractor

2.2. DRAWINGS

The drawings as listed in the table below form part of the tender documents and shall be used for tender purposes only.

The drawings issued to tenderers as part of the tender documents must be regarded as provisional and preliminary for the tenderer's benefit to generally assess the scope of work. The drawings are issued separately to this document. The drawings issued at tender stage are all Rev A. Any drawing issued as part of an Addendum issued during the tender period will be Rev B etc (if amending a Rev A drawing). The drawings issued for construction are first issued as Rev 0. Subsequent amendments to these drawings will be labelled Rev 1, Rev 2 etc.

At commencement of the contract, the Engineer will deliver to the Contractor three unreduced copies of the construction drawings and any instructions required for the commencement of the works. These prints will be issued free of charge and the Contractor shall make any additional prints he may require at his own cost. From time to time thereafter during the progress of the works, the Employer/Engineer may issue further drawings or revisions for construction purposes as may be necessary for construction, completion and defects correction of the works. The work shall be carried out in accordance with the latest available revision of the drawings approved for construction.

The Contractor will be required to mark up one complete set of prints of the construction drawings with all relevant as-built information and to submit these to the Engineer's Representative prior to issue of the Certificate of Practical Completion.

Only figured dimensions shall be used and drawings may not be scaled unless so instructed by the Engineer. The Engineer will supply any figured dimensions, which may have been omitted from the drawings. The levels given on the structural drawings are subject to confirmation on the site, and the Contractor shall submit all levels to the Engineer for confirmation before he commences any structural construction work. The Contractor shall also check all clearances given on the drawings and shall inform the Engineer of any discrepancies.

All drawings and specifications and copies thereof remain the property of the Employer and the Contractor shall return all drawings and copies thereof to the Employer at the completion of the Contract.

The following drawings are included in Volume 2.

Drawing Number	Description	Revision
J40044-001-A	Abstraction River GA	A
J40044-100-A	Road Plan and Longitudinal Section	A
J40044-101-A	Road Cross Sections	A
J40044-103-A	Road Typical and Standard Details	A
J40044-200-A	Rising Main Plan and Longitudinal Section	A
J40044-300-A	Abstraction Works Plan Layouts	A
J40044-301-A	Abstraction Works Sections Layout Sheet 1 of 2	A
J40044-302-A	Abstraction Works Sections Layout Sheet 2 of 2	A
J40044-303-A	Abstraction Works General Notes	A
J40044-305-A	Abstraction Works 3D Views	A
J40044-400-A	Main Pumps and Pipework	A
J40044-401-A	Ancillary Civil and Mechanical Equipment	A
J40044-402-A	Main Pumps and Pipework Details	A
J40044-403-A	Pipe Step Ladder and Platform Details	A
J40044-404-A	Main Pumps and Pipework Schedule	A
J40044-405-A	Abstraction Works Finishing Schedule	A
J40044-410-A	Electrical Panel and Electrical Panel SLD	A
J40044-411-A	Electrical Power and Lighting Layout	A
J40044-900-A	Galvanised Handrails	A
J40044-901-A	Handrail Reclosures	A
J40044-902-A	Galvanised Internal Ladder	A

Drawing Number	Description	Revision
J40044-903-A	Galvanised External Ladder	A
J40044-904-A	Reticulation air valve detail	A
J40044-905-A	Pipe marker	A
J40044-906-A	Pipe support details Sheet 1 of 2	A
J40044-907-A	Pipe Support details Sheet 2 of 2	A
J40044-908-A	Isolation Valve Detail	A
J40044-909-A	HDPe Welded Bend Details	A
J40044-9010-A	Wedge Wire Screen Details	A

2.3. DESIGN PROCEDURES

The Contractor shall be responsible for the design and specifications for the following aspects of the Works.

2.3.1. Design of Alternatives

Should the Contractor, at tendering stage or following appointment, propose any alternative to the Employer's design, such proposal shall only be deemed valid if it is accompanied by adequate and suitable sketches or drawings detailing the extent of the alternative and the component, sufficient to establish the means of execution the work, applicable fabrication drawings, etc. and provided that such submission is also accompanied by Method Statements, and specifications where appropriate, detailing how the Contractor proposes to go about the work from the ordering of materials, organizing of plant, steps in executing the alternative proposal, together with proposed list of personnel involved, tools, health and safety measures and measures for environmental compliance.

Such alternative shall be provided adequately in advance of the proposed work to allow for sufficient consideration and consultation and shall be subject to the Engineer's approval.

2.3.2. Design of Temporary Works

The Contractor will be responsible for the design of all temporary works and all construction methods, including those for tie-ins and interconnecting works and all shoring and lateral support that may be required for trenching. The Contractor will also be responsible for the preparation of method statements as required and for preparing designs for the removal, relocation and/or reconstruction of certain existing facilities on privately owned properties that may be affected by the construction activities.

The Contractor shall be responsible for the layout of his site camp and fabrication areas, construction and other working areas, management of the pipe yards and all temporary works, including construction access, culverts and drainage. Where applicable, the Contractor shall also be responsible for providing and maintaining suitable access to and within the pipe yards designated for the collection of 'free issue' pipe together with the fencing and control of vegetation of the pipe yards.

The Contractor is referred to the Employer's Environmental Specification and Environmental Management Programme (EMPr) in regard to all aspects of the temporary works.

2.3.3. Other Documentation Required from Contractor

<u>Construction Dossier</u>

In the case of the use of welded steel pipe, the Contractor shall be responsible to produce a Construction Dossier for the entire pipe laying operation. The Construction Dossier shall track the entire process of pipe handling, testing, repairs, laying and welding through to completion and commissioning of the works and shall incorporate and integrate the construction records with the Independent Inspection Reports from the pipe supply contracts as provided by the Engineer.

<u>Operation and Maintenance Manual</u>

The Contractor shall be responsible to produce the Operations & Maintenance (O & M) Manual for the Works. The O & M Manual shall document all requirements for correct operation and maintenance of the works.

2.3.4. CONSTRUCTION AND MANAGEMENT REQUIREMENTS

2.3.4.1. Specification Data associated with SANS 1921 1-6

The following parts of SANS 1921 Construction and management requirements for works contracts and associated specification data are applicable:

SANS 1921 Part 1: General Engineering and Construction Works;
SANS 1921 Part 2: Accommodation of Traffic on Public Roads Occupied by the Contractor;
SANS 1921 Part 3: Structural Steel Work
SANS 1921 Part 6: HIV AIDS Awareness

The associated specification data are as follows:

Clause	Specification data associated with SANS 1921- 1
	Essential Data
4.1.7	The requirements for drawings, information and calculations for which the Contractor is to be responsible is detailed in the project specifications.
4.1.8	The Software used for programming **shall** be Microsoft project (2019)
4.2.1	The responsibility strategy assigned to the Contractor for the works is as per the table in C3.2.1.
4.3	The planning, program and method statements are to comply with the following: 1) The program shall be prepared in bar (Gantt) chart form, *and* shall be issued to the Employer's Agent in both hard copy and electronic format. The program shall be structured to cover all items of work conceivable including all work to be done by Sub-Contractors and shall clearly indicate the critical path 2) The program must clearly show the intermediate milestone dates to be achieved taking the indicative construction sequences into account. 3) In addition to any other constraints the construction sequence and timing shall take into account the contract end date as well as all information and constraints mentioned in section C3.2.3.5 4) Regular meetings must be held with the Employer's Agent. 5) Method statements shall be prepared in accordance with the requirements of the project specifications. See also C3.2.3.5 for program allowances
4.3.3	The period of notice shall be a minimum of two working days.
4.12.2	To be provided as per the Project Specifications.
4.15	In addition see PSA 5.1.2
4.14.3	To be provided as per the Project Specifications.
4.14.6	Sign boards to be provided as per the Project Specification, Drawings and/or schedule of quantities
4.17.3	All Known services have be shown on the relevant Drawings or will be indicated to the contractor on site.
4.17.4	To be conducted as per relevant specifications
4.18	As specified in the Project Specific Health and Safety Specification

Clause	Specification data associated with SANS 1921- 1
4.22	As per standard clause.
	Variations
All relevant	In all clauses where it appears, replace the word “Employer” with “Employer’s Agent”
4.1.10	Where reference is made to “SANS 2001”, substitute with “SABS 1200”
	Additional Clauses
4.6 (e)	Managing and disposing of water will include for by-pass arrangements, of temporary earthworks, cofferdams, pumping equipment, well-pointing, de-watering equipment etc. for dealing with all possible flows whether or not the existing flow path is being interfered with during installation of pipework. The Contractor shall manage and dispose of water, whatever its origin, on the site so that the works are kept sufficiently dry for their proper execution and to ensure no employee or community member is at risk of drowning in any excavation undertaken under this Contract. The Contractor shall ensure that, where it is not practically possible to make deep excavations free-draining, diversion berms are constructed to divert stormwater runoff from entering the excavations and all standing water will be removed as soon as possible after each rain event
4.7.4	No blasting will be permitted within 10m of any structure, pipeline or service unless the Contractor can satisfy the Employer’s Agent that his proposed blasting methods and controls are such that no damage will be caused to the adjoining structure, pipeline or service. The Contractor will be required to provide equipment for and take vibro-recordings at no additional cost to the Employer.
4.8.1	The Contractor shall be responsible for protection from damage to any structures or services that might be affected by the excavations or works. The Contractor shall, before submitting his tender, carefully study the tender drawings and inspect on site the routes of the proposed pipelines and structures to be constructed in close proximity to existing structures and services and make due allowance in his rates for protection of structures and services by use of special construction methods such as close shoring, sheet piling.

Clause	Specification data associated with SANS 1921- 2
	Essential Data
4.6.1	The contractor will make provision for local commuter traffic to pass. The length of half width road is not limited. However, the road shall be safe for passage at all times
4.10.1	The Contractor at a minimum will use the following or combination of the following traffic control facilities: • Traffic-control devices • Road signs and barricades • Channelizarion devices • Barriers
4.3.2	The Contractor shall design all temporary culverts.

Clause	Specification data associated with SANS 1921- 3
	Essential Data
4.2.1	The responsibility strategy assigned to the Contractor for the works is “C” on Table 1 (Design and build).
4.2.2	To be appointed by the Contractor

Clause	Specification data associated with SANS 1921- 3
4.3.2.1	As per the Main contractors approved program.
4.5.1.1	All drawings will be provided at hard copy paper prints, as well as electronically in both PDF and DXF formats. Additionally all calculations will be provided as hard copy paper prints and electronically in PDF format.
4.5.1.2	All drawings will be provided at hard copy paper prints, as well as electronically in both PDF and DXF formats. Additionally all calculations will be provided as hard copy paper prints and electronically in PDF format.
4.5.3.4	The contractor shall submit drawings as well as all supporting calculations an documentation for approval at the following stages: • General arrangement drawings. • Shop Drawings. • As erected drawings.
4.7.6	The contractor is required to make arrangements as detailed under the project specifications.
4.10.4	All known services have been shown on the relevant drawings or indicated to the contractor on site.
4.11.1	As specified in the Project Specific Health and Safety Specification
	Variations
4.5.3.4	Within 10 Working days of receiving hard copy paper drawings and supporting documentation and calculations the employers agent will state his approval or otherwise thereof.
	The employer is the contractor and the contractor is the sub-contractor as identified in the contract data.

Clause	Specification data associated with SANS 1921- 6
	Essential Data
4.2.1 a)	A qualified service provider is a service provider that is accredited by the South African Department of Health and appears on their list of recognized service providers.
4.2.1 a)	The HIV/AIDS awareness program is to be repeated at twelve month intervals throughout the duration of the contract.

2.3.5. CONSTRUCTION PROGRAM (Read with SANS 1921-1:2004 Clause 4.3)

2.3.5.1. Preliminary Program

The preliminary program submitted as part of the Tender Returnable Documents shall be in the form of a simplified bar chart with sufficient details to show clearly how the works will be performed within the time for completion as stated in the Contract Data.

Tenderers may submit tenders for an alternative Time for Completion in addition to a tender based on the specified Time for Completion. Each such alternative tender shall include a preliminary program similar to the program above for the execution of the works, and shall motivate his proposal clearly by stating all the financial implications of the alternative completion time.

The Contractor shall be deemed to have allowed fully in his tendered rates and prices as well as in his program for all possible delays due to normal adverse weather conditions and special non-working days as specified in the Special Conditions of Contract, in the Project Specifications and in the Contract Data.

2.3.5.2. Program in Terms of Clause 5.6 of the General Conditions of Contract

It is essential that the construction program, which shall conform in all respects to Clause 5.6 of the General Conditions of Contract, be furnished within the time stated in the Contract Data. The preliminary program to be submitted with the tender shall be used as basis for this program. The Contractor's attention is also drawn to Clause 5.7.3 of the General Conditions of Contract 2015.

The Contractor shall indicate on the program the dates by which access, permissions and information from other parties is required and should show all activities (including temporary and permanent works) the inter-dependencies between activities and must highlight which are critical path activities. In this regard, the Contractor's attention is drawn to Clause 5.12 of the General Conditions of Contract, where consideration will only be given to claims for extension of time associated with critical path activities.

The programme shall be fully resourced with main activities and sub-tasks, subconsultants' and subcontractors' activities and sub-tasks (where applicable) and, lead times of major items of mechanical and electrical equipment and shall include an estimate of the anticipated cashflow.

The Contractor's attention is drawn to Specification data associated with SANS 1921- 1 Clause 4.3.

2.3.5.3. Program Updates during Construction

Should the Contractor wish to work outside normal working hours (as defined in the Contract Data) for any reason, he shall first seek permission to do so from the Employer's Agent. Attending to emergency situations or making-safe the Works are exempt from requiring prior approval, but notification shall still be sent to the Employer's Agent.

The program shall be agreed between the Employer and the Contractor prior to the implementation of the construction works.

The program shall be updated monthly, for discussion at the monthly progress (site) meeting, to indicate planned versus actual progress.

The Contractor shall review his progress each month and should progress lag behind the latest accepted program, by more than 2 weeks, he shall submit a revised program and method statement of how he proposes to make up the lost time. If, in the opinion of the Employer's Agent, such revised program will not make up the lost time, the Employer's Agent shall have the right to request the Contractor to reorganize his work in a manner which will ensure an acceptable program. Claims for additional payment to meet any costs incurred due to such reorganisation will not be accepted.

The Contractor shall not depart from the order in which the various items of work have been agreed without the prior written consent of the Engineer. If the programme is to be revised by reason of the Contractor falling behind he shall produce a revised version (Within one week of the failure becoming evident) showing the modifications to the original programme necessary to ensure completion of the Works or any part thereof within the time for completion as defined, or any extended time granted, as well as a revised schedule of the forecast value of completed work, month by month.

Failure on the part of the Contractor to submit or to work according to the programme or revised programme/s shall be sufficient reason for the Employer to take steps as provided for in the Conditions of Contract.

The approval by the Engineer of any programme shall have no Contractual significance other than that the Engineer would be satisfied if the Work is carried out according to such programme and that the Contractor undertakes to carry out the Work in accordance with the programme. It shall not limit the right of the Engineer to instruct the Contractor to vary the programme should circumstances make this necessary. Cognisance shall be taken of the frequency of rain days, inclement weather and material delivery delays when formulating a programme of works.

2.4. PERMITS AND WAYLEAVES

The Contractor shall be responsible for obtaining all necessary permits for site establishment and to transport materials and equipment to and from and around the site of the works and all costs and charges in this regard will be deemed to be included in the tendered rates.

The Employer will obtain the necessary approvals and the Contractor will be required to comply with the authorities and landowners' / occupiers' requirements at all times.

The Contractor will be required to take cognisance of, and comply with, the general wayleave and 'permission to occupy' requirements of the authorities and land owners / occupiers during the construction of the works.

The Contractor will be required to confirm that permission has been granted and that the occupiers and all affected parties have been informed of the Contractor's intentions before commencing work on each property.

2.5. OCCUPATIONAL HEALTH AND SAFETY

Read with SANS 1921 - 1: 2004 Clause 4.18, the Particular Specification for Construction Health and Safety and the Baseline Risk Assessment provided with the Particular Specification

2.5.1. General Statement

It is a requirement of this Contract that the Contractor shall provide a safe and healthy working environment and to direct all his activities in such a manner that his employees and any other persons, who may be directly affected by his activities, are not exposed to hazards to their health and safety. To this end, the Contractor shall assume full responsibility to conform to all the provisions of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) (OHASA), and the Construction Regulations 2014 issued under Section 43 of the OHASA by the Minister of Labour.

For the purpose of this Contract, the Contractor is required to confirm his status as mandatary of the Employer for the execution of the Contract by entering into an agreement with the Employer in terms of the OHASA by executing the Agreement under C1.3 FORM G included in Section C1: Agreements and Contract Data.

Time lost due to delayed commencement or suspension of the work as a result of the Contractor's failure to obtain approval for his safety plan, or any failure on the part of the Contractor to submit the required information or documentation in support of the application for a construction work permit (in terms of Construction Regulation 3), or failure to give notification of construction work (in terms of Construction Regulation 4), as applicable, shall not be used as a reason to claim for extension of time or standing time and related costs.

2.5.2. Cost of Compliance with the OHASA and Construction Regulations 2014

The rates and prices tendered by the Contractor shall be deemed to include all costs for conforming to the requirements of the Occupational Health and Safety Act, 1993 (Act 85 of 1993) (OHASA), the Construction Regulations 2014, and the Employer's Health and Safety Specification as applicable to this Contract. Specific items in the Value-related and Time-related Preliminary & General portion of the Bill of Quantities have been provided for pricing.

Should the Contractor fail to comply with any of the provisions of the OHASA, Construction Regulations 2014, or Employer's Health and Safety Specification, he shall be liable for penalties as provided for in any of the aforementioned documents.

C3.3 PROCUREMENT

3.1. PREFERENTIAL PROCUREMENT PROCEDURES AND REQUIREMENTS

The system of measurement of preferential procurement points shall be as defined in the Tender Data.

3.2. RESOURCE STANDARD PERTAINING TO TARGETED PROCUREMENT

The Employer has determined that 100% of the Contractor's unskilled labour force shall be made up from the Local Municipality area. Local labour employed on the contract shall be paid in accordance with the National minimum wage rates provided in the latest government gazette. All statutory EPWP conditions of employment (other than the Stipulated Wage Rate) shall be met and be in line with the guidelines including PPE and relevant branding.

3.2.1. Contracts of Employment

All employees of the Contractor shall be issued with a written contract of employment which shall be signed by the Contractor and the employee. The contracts shall be in isiZulu and in English.

Contracts of employment shall incorporate, *inter alia*, the following:

- personal particulars;
- job title and job description;
- employment period, including any probation period, which probation period shall not exceed 13 weeks;
- hours of work, statutory holidays, vacation, sick leave;
- remuneration, including wage rates for overtime, and any monetary allowances and deductions applicable to any probationary period and the time after its satisfactory completion;
- method of payment;
- medical and any other social benefits;
- conditions precedent to termination of employment;

Contracts of employment shall be accompanied by a written statement of company procedures covering such matters as training, promotion and redundancy policies, procedures for dealing with grievances, disciplinary procedures, protective clothing and occupational safety, and the like.

3.2.2. Induction Programme

Before starting training or regular working, all employees shall attend an induction programme at which, *inter alia*, methods of working, site safety procedures, environmental policies, and the employees' role in relation to them shall be addressed. The employees shall be given an introduction to the Contractor's general industrial relations policy and procedures, covering such subjects as selection for promotion and redundancy, any bonus schemes, procedures for dealing with grievances, disciplinary procedures, and the like. The Contractor shall be responsible for compiling, organising and executing this induction programme.

3.2.3. In-task Training

In-task training of the workforce is a general responsibility of the Contractor to ensure that his workforce is sufficiently skilled, Health and Safety aware and environmentally compliant as per the Employer’s Environmental Specification. The Contractor shall provide in-task training of local labour during the construction of the works and at this own cost. In-task training shall consist of training and guidance of team leaders, assistants, and labour in those construction activities where the labour is engaged. The in-task training shall cover all training and guidance required to ensure that the leaders and labour are able to carry out the project tasks in accordance with the requirements of the project specification.

All personnel involved in construction shall also be trained in the Employer’s Environmental Management System. The in-task training shall be carried out by the Contractor’s own key and skilled personnel or by a mentor appointed for the purpose and approved by the Employer.

3.2.4. Enhancing Participation through Labour Intensive Construction

It is a requirement of the Employer that the maximum possible use is made of local labour.

The Contractor is therefore required to limit the use of non-local labour to key personnel only and to employ only local labour on this Contract.

The Contractor shall fill in the relevant forms regarding “Key Personnel” and state how many non-local key personnel he intends to employ in the various categories.

The numbers stated in the “Key Personnel” forms shall be strictly controlled during the Contract Period and any increase in numbers shall be subject to the approval of the Engineer.”

3.3. SUBCONTRACTING

This sub-section covers the subcontracting of specialist work at the Contractor’s choice, mandatory sub-contracting to local SMMEs and the use of selected subcontractors identified by the Employer.

3.3.1. Subcontracting at Contractor’s choice

Subcontracting of specialized portions of the work is permitted in principle up to a maximum of twenty five percent (25%) in total of the approved contract value. Should the Tenderer wish to employ Sub-Contractors of his own choice for part of the works, this is to be clearly indicated in Form W of the Returnable Schedules, showing the full names and addresses of all proposed Subcontractors for which approval of the Engineer is sought and stating the section of the works that each will be handling.

Subsequent to contract award the written approval of the Employer shall be required prior to the engagement of any subcontractor not proposed in the tender and accepted by the Employer. The appointment of subcontractors shall only be formalized on the basis of the presentation of a suitable and compliant subcontracting agreement in the CIDB format or other acceptable format.

3.3.2. Selected Subcontractors

Selected Specialist Sub-Contractors (refer to GCC 2015 Clause 4.4) shall be chosen and appointed as follows:

The Employer will prepare a detailed scope of work and/or specification for work to be done or goods to be supplied by a Selected Specialist Sub-Contractor.

The Employer and the Contractor will compile a list of firms or persons acceptable to both and who will be invited by the Contractor to submit tenders for the requisite work to be carried out or goods to be supplied by Selected Sub-Contractors. When the tenders are received they will be evaluated and the Employer will then indicate which tender he requires the Contractor to accept and he will advise the Contractor accordingly. The Contractor shall then accept that Tenderer and appoint him/her as a Selected Sub-Contractor.

The Contractor shall incorporate in the sub-contract, provisions that:

In respect of the work carried out or the goods that are the subject of the sub-contract, the Selected Sub-Contractor undertakes to the Contractor mutatis mutandis the obligations and liabilities as are imposed upon the Contractor to the Employer in terms of the Contract, and holds the Contractor harmless from and indemnifies him against the same and in respect of all claims, demands, lawsuits, damages, costs, charges and expenses whatsoever arising out of or in connection therewith, or arising out of or in connection with any failure to perform such obligations or to fulfil such liabilities, and

The Selected Sub-Contractor shall also hold the Contractor harmless from and indemnify him against:

- Shortcomings in the sub-contract work if and where the work was designed by the Selected Sub-Contractor;

- Defects in the goods if and where the goods were manufactured and / or supplied by the Selected Sub-Contractor;
- Any negligence by the Selected Sub-Contractor, his / her Agents, workmen and servants;
- Any misuse by the Selected Sub-Contractor of any Constructional Plant, Temporary Works or materials provided by the Contractor for the purposes of the Contract; and
- Any claims as aforesaid.

3.3.3. Mandatory Subcontractors in terms of the PPPFA

The contractor will subcontract no less than the percentage stated in the contract data. For this purposed Work will be defined as the value of the contract works excluding any PC Sum or Prov. Sum items including mark-ups and all preliminary and general charges. The work will be subcontracted to subcontractors who reside within the District Municipal Area. The main aim is to transfer skills.

The contractor will be required to provide mentoring and management of the subcontractor throughout the duration of their works. The contractor will not be compensated for this and must make allowances for such in his tendered rates for this function. Further the contractor will take full responsibility of the works done by the subcontractors. Some of the aspects of mentorship will include:

- Pricing/calculating a rate
- Business Management
- Basic contractual matters
- Transfer of some construction skills
- Calculation of quantities
- Preparing payment certificates

Monthly measurement and payment will be according to the following guideline:

- Submission of payment certificate by the Contractor, the submission from the Contractor shall include the signature of the Sub-contractor indicating agreement with the measurements and rates applicable to the work undertaken by the Sub-contractor.
- Payment to the Contractor in line with the timeframes give in the conditions of contract
- The Subcontractor is then to be paid within reasonable time but no later than 5 working days after the Main Service Provider has been paid by the Employer
- The submission from the Contractor must include a schedule that clearly shows the following:
  - Total Contract Sum
  - Total amount payable to CPG Partner/s excluding current month
  - Amount payable to CPG Partner for current month
  - % split of Total amount payable to Main Service Provider and CPG Partner/s

C3.4 CONSTRUCTION SPECIFICATIONS

C3.4.1 PART A: GENERAL

A1 NATURE OF THE GROUND

No Geotechnical Investigation has been undertaken.

The Contractor is to make his own assessment of the materials to be excavated from inspection and from the information available for the area.

The Contractor may undertake any investigations or trial excavations he may require for his tender purposes provided that the prior approval of the Engineer is obtained.

A2 SITE FACILITIES

A2.1 Water Supply

The Contractor will have to make his own arrangements for the provision of potable water for human consumption as well as water required for construction, testing and disinfecting of pipelines and structures, commissioning etc. and his tender will be deemed to include for all costs in this regard.

The Contractor will be required to supply, install, operate and maintain at his cost, such temporary conveyance systems, pipework, pumping, and storage facilities as may be necessary to ensure sufficient supplies of water are available at all times throughout the works area and for the orderly control of supply and disposal of used water.

Water for human consumption shall be required to conform to SABS 241 for potable water. The Contractor shall be responsible for his arrangements for supply and treatment of water to required quality standards and to demonstrate the acceptable quality of the water by means of an analysis certificate from an accredited laboratory.

No water shall be abstracted from any source without the prior written approval of the relevant authorities.

A2.2 Electricity Power Supply

The Contractor will have to make his own arrangement for electricity power supply to his construction camp and construction site and his tender will be deemed to include for all costs in this regard.

A2.3 Camp Sites

Possible sites for establishment will be indicated at the pre-tender site visit. The Contractor shall determine his space requirements and shall be responsible to negotiate permission and terms of use of the site(s) in agreement with the respective land owner(s). The Contractor must not cut down or damage any trees nor make any excavation without the written permission of the Engineer and will be required to restore the site to its original condition on completion of the Works.

The Contractor shall provide and maintain, at his own cost, all sheds and housing necessary for the convenience of his workmen and for the accommodation and proper protection of his plant, materials and equipment from damage or loss. These are to be erected only on sites which shall have been approved by the Engineer and they shall be removed as soon as they are no longer required for the Works; and the site thereof restored to its original condition and the ground left clean and sanitary.

The Contractor shall provide the necessary ablution facilities at his camp site and the site of the Works for the use of his employees. Separate toilet facilities shall be available for the sole use of the Engineer or his representative(s). Buildings and fencing are to be neat and presentable and the surrounding areas must at all times be kept in a neat, clean and orderly condition. All buildings and latrines shall be in accordance with the Local and National Health Regulations and shall be kept in a clean, sanitary condition.

The Contractor shall provide security watchmen adequate to safeguard the works, plant, personnel and materials for the contract as he deems fit at no extra cost for the Employer. The Contractor must ensure that all his employees as well as the employees of his subcontractors are able to identify themselves as members of the construction team.

The Contractor shall pay special attention to the management and disposal of all water on site, from whatever source. It is essential that all completed works or parts thereof are kept dry and properly drained. Claims for delay and for repair of damage caused to the works as a result of the Contractor's failure to properly manage rain and surface water, will not be considered.

The Contractor shall dispose of solid waste by disposal at the municipal dump site, all cost associated with such shall be for the contractors account. The Contractor shall dispose and cover up all surplus and unsuitable material in legal spoil areas of his own choice. He shall be responsible for all arrangements necessary to obtain access to such spoil sites.

The Contractor's Establishment shall not be considered as being complete until such time as the facilities to be provided for the Engineer are fully in place.

A2.4 Equipment for Determination of Labour-Intensive Excavation

The Contractor shall provide and maintain in good condition a Dynamic Cone Penetrometer (DCP) and all associated equipment for the determination of areas for Labour-Intensive excavation methods for the classification of excavated materials as per Annexure B of SANS1921 Part 5.

A2.5 Telephone Facilities

The Contractor will have to make his own arrangements with Telkom if so desired.

A2.6 Accommodation of Employees

No housing is available for the Contractor's employees. The Contractor shall make his own arrangements to house his employees and transport them to the site of the Works. No informal housing or accommodation on the site will be allowed.

A2.7 Laboratory Facilities

The Contractor shall arrange for all tests required for process control to be done by a laboratory acceptable to and approved by the Engineer.

The Contractor may establish his own laboratory on site or he may employ the services of an independent commercial laboratory. Whatever method is used, the Contractor must submit the results of tests carried out on materials and workmanship when submitting work for acceptance by the Engineer. The costs for these tests shall be deemed to be included in the relevant rates and no additional payment will be made for testing as required.

A2.8 Engineer's Office

The Contractor shall provide facilities for use of the Engineer as detailed in Section PSAB of the Variations to the Standard Specification.

A2.9 Engineer's Accommodation, Vehicles and Equipment

If required, separate items will be included in the Bill of Quantities to cover any accommodation cost of the Engineer and transport and equipment requirements of the Engineer shall be as detailed in Section AB of the Variations to the Standard Specification.

A2.10 Engineer's Laboratory

No testing laboratory is required for use by the Engineer, but all quality control testing shall be carried out by the Contractor at his own cost.

The process control test results submitted by the Contractor for approval of materials and workmanship may be used by the Engineer for acceptance control. However, before accepting any work, the Engineer may have further control tests carried out by a laboratory of his choice. The cost of such additional tests will be paid for in the contract, but tests that failed to confirm compliance with the specifications, will be for the account of the Contractor.

A provisional sum will be allowed for in the schedules to allow for the use of an independent laboratory to effect check tests as detailed by the Engineer.

A2.11 Sanitary Facilities

The Contractor shall provide adequate ablution and toilet facilities for all workmen on site.

All latrines shall comply with the requirements of the Local Authorities and shall be placed where directed by the Engineer. All sanitary fees and costs payable shall be paid by the Contractor. All latrines must, for the duration of the contract, be kept continuously in a clean and hygienic condition by the Contractor to the satisfaction of the Engineer.

If at any time the Contractor neglects to comply with the abovementioned requirements and after he has been requested to do so by the Engineer, fails to rectify the matter about which the Engineer has complained, the Engineer shall have the right to immediately order such material, employ such workmen and take such measures as he regards necessary to ensure clean and hygienic conditions all at the expense of the contractor.

A2.12 Disposal of Waste

The Contractor shall be responsible for disposal of refuse and waste generated by his staff on a daily basis. The site is to be kept clean, neat and tidy to the Engineer's satisfaction. Refuse and waste shall not under any circumstance be buried on the site but shall rather be collected in suitable skips and disposed of at the nearest suitable landfill site.

The disposal of waste shall be carried out in accordance with the requirements of the relevant Local Authority.

A2.13 Engineer’s Survey Equipment

The Contractor shall provide equipment for use of the Engineer as detailed in Section PSAB of the Variations to the Standard Specification.

A3 FEATURES REQUIRING SPECIAL ATTENTION

A3.1 Use of Explosives

Prior to the use of explosives at any specific location, the Contractor shall obtain permission for blasting from the Engineer. The safety of existing Works and services, and of persons, etc., shall remain the responsibility of the Contractor, who shall abide by all the relevant laws and regulations. Special note is to be taken of the contents of Clause PSD 5.1.1.3.

A3.2 Existing Services and Buildings

Although the plans may show the approximate position of existing services and buildings, neither the Employer nor the Engineer will accept the responsibility for the accuracy thereof and it shall be the Contractor’s responsibility to prove the position of such services prior to commencing with the Works in the area.

The Contractor will be required to contact all service owners and ascertain the location and status of all services irrespective of whether they are shown to him/her or not.

Where the presence of underground cables is suspected the Contractor shall use such methods as necessary, including cable or metal detectors, to prevent unnecessary damage and consequent delay and cost of repair.

Where the Contractor anticipates that it will be impossible for him to carry out the work without causing damage to existing services, Works or buildings he shall forward a proposal on the method of construction for approval by the Engineer.

Where any existing services are crossed or temporarily removed, the Contractor shall be responsible for the repair and / or reinstatement of the crossings to the satisfaction of the Engineer.

Any damage done to existing Works or buildings shall be immediately notified to the owners concerned and to the Engineer.

Unless it is established by the Engineer that the Contractor exercised reasonable care and damage was unavoidable, the Contractor shall be held responsible for the damage to any existing Works or buildings and for the costs of repair, including any claims which may arise as a result thereof.

A3.3 Survey Control and Setting Out of the Works

The Contractor will be responsible for the setting out of the works.

The Contractor shall take special precautions to protect all permanent survey beacons or pegs such as bench-marks, stand boundary pegs and trigonometric beacons, regardless of whether such beacons or pegs were placed before or during the execution of the Contract. If any such beacons or pegs are disturbed by the Contractor or his/her employees, the Contractor shall have them replaced by a registered land surveyor at his/her own cost.

A3.4 Dealing with COVID-19 and its Impact on Construction Planning and Progress

Dealing with the on-going unfolding of the COVID-19 pandemic has a major impact on all aspects of construction; many of which are impossible to predict with any certainty over the duration of construction. For the purposes of construction planning, it is to be assumed that:

- At Commencement of Construction Stage, full anti-infection control construction protocols to protect all personnel on Site and the public at large (as required by National Government) will still be in force.
- By the time construction is nearing completion, the above special protocols will have largely fallen away (perhaps limited to maintaining health checks on all personnel on Site and maintaining basic hygenic conditions).

Of particular concern is the possibility that:

- The construction site has to be temporarily shut down due to excessive rate of infections of personnel on Site; and /or
- Key staff are taken ill / have to self-quarantine; and/or
- Significant numbers of other staff are taken ill / have to self-quarantine.

While infections can still occur despite the strictest observance of protocols to prevent this, no claim for an extension of time and associated temporary closure costs will be entertained by the Employer if it is deemed by the Employer's that the Contractor's efforts fall unacceptably short of 'all reasonable measures' to observe, implement and abide by the accepted protocols and address non-compliance by individuals.

A3.5 Interaction with Local Residents and work on Private Land

The construction works and associated heavyweight traffic to and from Site will directly impact on local residents' everyday access and conducting their various businesses. Special attention is to be given to close liaison and cooperation with all affected local residents and maintaining good relations with them at all times. In particular, special arrangements will need to be made with them to agree essential road closure periods (where unavoidable) and otherwise to allow them reasonable passage through such work sites at agreed times.

Additionally Given the significant volumes of heavy loads (plant, bulk materials) to be moved over steep, narrow winding gravel roads, special attention to proactively protecting the safety of the General Public along such haulage routes is mandatory (eg strict monitoring and enforcement of road safety rules and maintaining all construction vehicles in a sound, roadworthy condition at all times). To this end, the Contractor shall also keep all the gravel access roads used by him in good repair.

Additionally, the Contractor shall, within a period of 3 months of completing the construction work on any private property produce to the Engineer a certificate, signed by the landowner in question, that all the Contractor's obligations to the landowner have been completely discharged in terms of the servitude agreements and any private agreements that may have been arranged between the Contractor and the landowners.

If such evidence is not produced within the stipulated period, the Employer reserves the right to investigate any agreement entered into between the landowner in question and the Contractor and any claims made by the landowner. If the Employer is then satisfied that the Contractor is in default in terms of the contract and any private agreements made, all justifiable claims shall be paid to the landowner by the Employer from retention money held and shall be deducted from the amount payable to the Contractor.

The Contractor shall observe the following when operating within private property, roads and road reserve:

(a) The Employer will acquire servitudes from the owners of all properties crossed by new services, or has permission to occupy where the servitudes will not be obtained.

(b) At all times the Contractor shall confine his operations to the area of the servitude unless he has made prior arrangements with adjoining land owners to the Engineer's approval.

(a) No damage shall be done to buildings, dwellings, crops, cultivated lands, dams, watercourses, roads, fences and the like outside the servitude.

(d) When working within existing road reserves the Contractor shall ensure that as little inconvenience as possible is caused to residents and traffic. Extra care shall be taken with regard to the siting of the excavated material and materials to be built in to the Works so that disturbances will be minimised.

(e) The area within the road reserves and servitudes shall be restored to the same standard and state as it was before construction at the Contractor's expense.

(f) Every precaution must be taken by the Contractor to prevent any flooding and erosion damage to adjoining property resulting from uncontrolled run-off during construction.

A3.6 Temporary River Diversion Works for Construction of Abstraction Structure

It is anticipated that, being such a tall, substantial and complex structure with difficult access, the construction of the abstraction structure is anticipated to lie on the Critical Path of the Contract program.

A key feature of its construction is creating and maintaining dry working conditions, at least until the outer shell of the structure has advanced sufficiently for it not to be vulnerable to river floods. The abstraction works site is likely to be particularly vulnerable to extensive flood damage and delays for the initial period of construction. Should the river come down in flood and flood the site during this period weeks, if not months, to restore the Works to a stage where it was at before the flood. If the cofferdam structure is extensively damaged or washed away, an additional whole 'low flow' season may be required to reconstruct it (cannot be reconstructed during high river flow summer rainfall months).

The Contractor shall be responsible for the functional and structural design and construction of all temporary works associated with creating dry working conditions for constructing the permanent Works (and the subsequent removal and disposal all such temporary works).

As soon as possible after award of Contract, the Contractor shall meet with Employer's Agent to discuss how to take forward his/her preliminary design of the proposed river diversion temporary works (submitted at tender stage) and then, as soon as possible thereafter, submit a detailed functional and structural design and construction method statement to the Employer's Agent for approval. The method statement shall cover the following as a bare minimum:

- Sequencing of temporary and permanent works from commencement to removal and disposal of demolished materials and associated timelines
- Dealing with access for constructing and removing temporary works at the various stages
- Dealing with access for constructing the permanent works and dewatering arrangements
- Details of plant and equipment and key responsible staff
- Source and details of materials to be employed (including batching of concrete)
- OH&S risk assessment and mitigation measures
- Mitigation of environmental impacts on the river ecology (negative impacts on water quality)
- Method of demolishing / dismantling and disposal of cofferdam/s and other temporary works (eg access bridges).

The above approval process shall include the negotiation and agreement on staged payments of the tendered lump sum for the river diversion temporary works (generally relating to the value of work done). The final 5% will not be certified for payment until such time as the Employer's Agent is satisfied that all temporary works have been completely removed and all waste material suitably disposed of and all areas impacted by such temporary works have been made good.

The Employer's Agent will allow commencement of approved ancillary / establishment works while the abovementioned approval process is still underway (so as to not unnecessarily delay implementation), but will not allow cofferdam construction before the design and method statement has been approved.

Payment: See Amendments to SABS 1200 A: PSA8.8.6 Special Water Control in Terms of Project Specification.

A3.7 Spoil Material

No indiscriminate spoiling of material or rubble will be allowed.

The Contractor shall make his own arrangements for the disposal of excess or unsuitable materials. The disposal / spoil site shall meet with the approval of the Local Authority within whose area it falls, and the spoiling shall comply with the statutory and municipal regulations. The cost of all loading, hauling, dumping, spreading, compacting and any other costs or charges will be deemed to be included in the rates tendered for spoiling of material.

A3.8 Management & Disposal of Water and Stormwater

The Contractor shall pay special attention to the management and disposal of water and stormwater on the site. It is essential that all completed works or parts thereof are kept dry and properly drained. Discharge of water onto landowner property or onto roads that may lead to nuisance or damage shall not be acceptable. Claims for delay and for repair of damage caused to the works as a result of the Contractor's failure to properly manage rain and surface water, will not be considered.

A3.9 Finishing and Tidying and Defects Liability Period

Progressive and systematic finishing and tidying will form an essential part of this Contract. On no account must spoil, rubble, materials, equipment or unfinished operations be allowed to accumulate in such a manner as to unnecessarily impede the activities of others and, in the event of this occurring, the Employer shall have the right to withhold payment for as long as may be necessary in respect of the relevant Works in the area(s) concerned without thereby prejudicing the rights of others to institute claims against the Contractor on the Grounds of unnecessary obstruction.

Finishing and tidying must not be deferred to the end of the Contract.

All finishing and tidying shall be carried out to the best advantage of the project as a whole and in the closest co-operation with other contractors and residents.

A3.10 Quality Plans and Control

The Contractor will be solely responsible for the production of work that complies with the Specifications to the satisfaction of the Engineer. To this end it will be the full responsibility of the Contractor to institute an appropriate Quality Assurance (QA) system on site. The Engineer will audit the Contractor's quality assurance (QA) system on a regular basis to verify that adequate independent checks and tests are being carried out and to ensure that the Contractor's own control is sufficient to identify any possible quality problems which could cause a delay or failure. Any shortcomings in the quality control process shall be rectified timeously and shall be a precondition for the further approval of the affected work.

The Contractor shall ensure that efficient supervisory staff, the required transport, instruments, equipment and tools are available to control the quality of his own workmanship in accordance with specifications and his QA-system. His attention is drawn to the fact that it is not the duty of the Engineer or the Engineer's representative to act as foreman or surveyor.

A3.11 Security of Contractor's Site

The provision and sustainment of security for the Contractor's Site Establishment shall be his own responsibility, and no claims for additional security measures taken during the currency of the Contract will be considered other than as provided for in the General Conditions of Contract.

A3.12 Recording of Weather

The Contractor shall be permitted to take his own rainfall measurements on site subject to the Engineer's approval, but access to the measuring gauge(s) shall be under the Engineer's control. The Contractor is to provide and install all the necessary equipment for accurately measuring the rainfall as well as to provide, erect and maintain a security fence plus gate, padlock and keys at each measuring station, all at his own cost.

A3.13 Construction Equipment

No construction equipment will be supplied by the Employer under this Contract. All construction equipment required for the completion of the Works shall be provided by the Contractor.

Equipment to be used on site shall be well maintained and, if road going, in possession of valid roadworthy certificates. Leaking of fuel or lubricant, or excessive or objectionable noise or exhaust emissions, shall be adequate grounds for instruction to remove the plant from the site, which removal shall be done within 24 hours.

The Contractor shall not travel tracked vehicles or plant on any bituminous sealed road surface. Only rubber tyre vehicles conforming to applicable load restrictions will be permitted to use bituminous sealed roads.

The Contractor shall take note of the work activities that are subject to mandatory Labour-Intensive Construction Methods and shall make adequate allowance for hand tools and PPE sufficient to complete these work activities according to programme.

A3.14 Accredited Skills Training

Apart from the Contractor's own in-task training of his workforce it is the intention of the Employer that Accredited Skills Training will also be provided under this contract. The training may be conducted on site or at a remote training venue, at the Employer's discretion. The Employer may elect to specify on-site training. Therefore, the Contractor will be required to provide office space and associated water and sanitation facilities for training as well as construction materials for practical

training.

The Employer will notify the Contractor in writing of the name and details of an Accredited Skills Training Facilitator to be appointed by the Contractor. The Training Facilitator will conduct the training.

It is intended that Skills Training will be provided in any or all of the following disciplines:

- Trench Excavation and Supervision;
- Pipelaying;
- Steel Fixing;
- Formwork and Concreting;
- Basic Construction Hand;
- Bricklaying and block laying;
- Finishing Hand;
- Task Based Labour Administration
- Understanding the Scope of Works and Engineer's Specifications;
- Labour Recruitment and Management;
- Contractor's Responsibilities and Requirements;
- Payroll Management and Implementation;
- Basic Tender and Contract Pricing
- Community Liaison and Facilitation

Candidates for Skills Training will be identified from individuals who have a minimum schooling level of Grade 10, preferably Grade 12. Training may also be identified for those that are undergoing, or who have undergone, training at a University of Technology or FET College.

The Employer will notify the Contractor in writing of the names of candidates to be accepted for Accredited Skills Training. The Contractor shall employ such candidates according to his full and normal conditions of employment for unskilled labour for the duration of training.

Upon completion of the training the employment of the trainees shall terminate, and the Contractor shall not be obliged to keep the trained personnel in his employ. However, he may re-employ candidates on an individual basis by mutual agreement.

The Contractor shall also pay the fees and charges of the accredited trainer according to the agreed scale.

The Accredited On-Site Skills Training is further described in Particular Specification PT. The cost of Accredited On-Site Training is covered by various items in the Bill of Quantities and the costs are to be reclaimed by the Contractor via the Payment Certificates. The items shall be deemed to cover all the Contractor's costs in relation to provision of training as outlined in this section and in Particular Specification PT

A3.15 Contractor's Site Agent

a. Within 14 days of the award of Contract, the Contractor shall advise the Employer in writing of the name of the responsible person in charge of this Contract.

b. In amplification of Clause 4.12 of the General Conditions of Contract:-

It shall be noted that the Contractor shall be required to strictly observe his obligations regarding adequate full time superintendence of the Works, with particular reference to accuracy of setting out, excavations, correct steel fixing, properly constructed formwork, positioning of foundation bolts, and / or bolt pockets, placing of concrete, etc. in order to achieve the high standard of workmanship required of him.

Adequate facilities for superintendence of his work shall be provided by the Contractor and the Engineer's engineering staff must under no circumstances be expected to act in this capacity on his behalf.

A3.16 Attendance at Site Meetings

The Contractor will be required to attend site meetings as and when these are required by the Engineer. The objectives of such meetings will be to review progress and ensure compliance with the programme, discuss and, where possible, solve any problems that may arise and generally to liaise with all parties concerned with the Works.

The cost of attending such meetings shall be deemed to be included in the rates. Instructions given by the Engineer or agreement reached at such meetings and confirmed in the minutes shall be considered as a "written instruction by the Engineer" as referred to in the General Conditions of Contract.

Site meetings will generally be held every two weeks.

A3.17 Community Liaison Officer

If required in terms of the contract, the Contractor shall employ a Community Liaison Officer (CLO) for the full duration of the contract. In the event that a Liaison Officer is required, a provisional sum will be provided in the Schedule of Quantities to cover the cost of the CLO.

The Employer will identify a person to be employed by the Contractor as Community Liaison Officer (CLO) for the duration of the Contract. The CLO shall be employed on a full day basis, for the duration of the contract and shall be paid at a Gazetted Task Work Grade 5. In addition, all statutory conditions of employment in respect of UIF, Workmen's Compensation etc. shall be met.

The CLO will be required to work under the direction of the Client's ISD officer.

The primary role of the CLO will be liaison and facilitation of communication which shall include *inter alia*:

- Assist in all aspects related to the recruitment of local labour, and advise them of their rights
- Act as liaison between the Contractor and community on the application of Labour Intensive Construction Methods as set out in this document
- Act as a source of information for the community and the Ward Councilors on issues related to the Contract
- Liaise with a Project Committee, as anticipated in the EMP, for community representation
- Keep the Contractor advised on community issues
- Keep the Contractor advised on any issues pertaining to local security (where applicable)
- Assist in setting up any meetings/negotiations with affected parties
- Keep a diary and record details of labour/community issues that may arise
- Monitor and report on general Health and Safety issues on site
- Assist in HIV & AIDS awareness programme/s
- Attend contract site meetings and report on labour/community issues

The CLO shall have no authority to issue any instructions to the Contractor. The CLO shall be neutral to all parties and endeavour to remain impartial should any conflict arise.

Responsibility for identifying a pool of suitable labour shall rest with the CLO, although the Contractor shall have the right to choose from the pool. The Contractor (and subcontractors) shall have the right to determine the total number of labourers required at any one time, which may vary throughout the contract.

The Contractor shall have the right to replace labour that is not performing adequately and the replacement of any labourer shall be done in conjunction with the CLO.

Local labour employed on the contract shall be paid in accordance with the local labour rate and all statutory conditions of employment shall be met.

A3.18 Courtesy

At all points of contact with the public, the Contractor and his staff are requested to handle discussions and disputes with deliberate courtesy and understanding. To assist the Contractor in his dealings with the public, use should be made by him of the Community Liaison Officer and the Engineer's Representative on site. On occasions where the Contractor liaises directly with the public, the Community Liaison Officer and the Engineer's Representative should be informed of the outcome to be able to maintain a coherent picture of developments in the area.

A3.19 Accommodation of Traffic on public roads occupied by the Contractor (Read with SANS 1921 – 1: 2004 clause 4.13 and SANS 1921 – 2: 2004)

General

The Contractor will be responsible for the safe and easy passage of public traffic past and on sections of roads of which he has occupation or where work has to be done near traffic.

Accommodation of traffic, where applicable shall comply with SANS 1921-2: 2004: Construction and Management Requirements for Works Contracts, Part 2: Accommodation of Traffic on Public Roads occupied by the Contractor. The Contractor shall obtain this specification from Standards South Africa if accommodation of traffic will be involved on any part of the construction works.

All costs and charges related to Accommodation of Traffic shall be covered under the item for "Dealing with Traffic" included under the Preliminary and General Section in the Bill of Quantities

Basic Requirements

The travelling public shall have the right of way on public roads, and the Contractor shall make use of approved methods to control the movement of his equipment and vehicles so as not to constitute a hazard on the road.

The Contractor shall ensure that all road signs, barricades, delineators, flagmen and speed controls are effective, and that courtesy is extended to the public at all times.

Failure to maintain road signs, warning signs or flicker lights, etc, in a good condition shall constitute ample reason for the Engineer to suspend the work until the road signs, etc, have been repaired to his satisfaction.

The Contractor may not commence construction activities affecting existing roads before adequate provision has been made to accommodate traffic in accordance with the requirements of this document and the South African Road Traffic Signs Manual.

The Contractor shall design, construct and maintain all temporary access and haul roads to the various working areas. The Contractor shall construct and maintain all temporary drainage works necessary for temporary deviations.

The Contractor shall provide and grant access to persons whose properties fall within or adjoin the area in which he is working.

Traffic Safety Officer

Where warranted by traffic conditions on or near the site, the Contractor shall nominate a suitable member of his staff as traffic safety officer to be responsible for the arrangement and maintenance of all the measures for the accommodation of traffic for the duration of the project.

Duties of the traffic safety officer shall be as set out in SANS 1921 Part 2 and shall also be in compliance with the Occupational Health and Safety Act No 85 of 1993 and the latest version of the Construction Regulations.

A3.20 Sanctions

In the event that the Contractor fails to satisfy the requirements of this specification, the Employer may apply sanctions which include the rejection of claims for payment as being incomplete or the withholding of completion certificates (interim or final).

A3.21 Certificates of Payment

The statement to be submitted by the Contractor in terms of the General Conditions of Contract shall be prepared in accordance with the standard payment certificates prescribed by the Employer and shall consist of at least **two** sets of A4-sized paper copies and one electronic copy.

The work shall be measured according to the format of the BoQ and measurements should be taken together with the Engineer's Representative and are subject to agreement as to the status of work completed.

The Contractor's tendered rates for the relevant items in the Bill of Quantities shall include full compensation for all possible additional costs which may arise from this, and no claims for extra payment due to inconvenience as a result of the modus operandi will be considered.

All costs resulting from the preparation and submission of the statements shall be borne by the Contractor.

A4 EXTENSION OF TIME ARISING FROM ABNORMAL RAINFALL AND WEATHER

If during the time for completion of the Works or any extension thereof, abnormal rainfall or weather conditions occur, the Contractor may submit a claim for an extension of time in accordance with Clause 5.12 of the General Conditions of Contract. The method whereby an extension of time due to abnormal rainfall shall be determined is as follows :-

(1) Abnormal rainfall and weather for each calendar month shall be the total working days in the month under consideration during which the Contractor is unable to proceed with his operations as specified under (2) below, less the number of days representing normal rainfall for the month under consideration as shown on the following table. When drawing up the programme of work, the Contractor shall make provision for the expected delays shown in the table.

(2) The claim for extension of time shall be the sum of all the positive net monthly number of abnormal rainfall days (as calculated in the previous paragraph) over the Contract Period. Negative monthly totals shall be disregarded. A day or part of a day shall be considered as lost when the Engineer agrees that no work was done or was capable of being done on any item shown on the critical path of the current construction programme.

Items which are not shown on the critical path and have been affected by rainfall will not be considered for extension of time.

Saturdays when no work is programmed, Sundays and the special non-working days as listed in the Contract data shall be considered as non-working days.

Calendar Month	Expected No of Working Days Lost Due to Normal Rainfall	Average Monthly Rainfall (mm)	Calendar Month	Expected No of Working Days Lost Due to Normal Rainfall	Average Monthly Rainfall (mm)
January	4.1	124	July	0.4	16
February	3.7	114	August	0.7	24
March	3.9	108	September	1.5	49
April	1.8	50	October	2.7	76
May	0.6	28	November	3.4	101
June	0.4	14	December	4.1	119

The average monthly rainfall figures quoted above are for the period 1947 to 2000 from the Lilydale rainfall station No 0209750 A; they are included for use as a base of information, and shall not be used in consideration for any extension of time claims. * The number of working days lost for December and January do not allow for the builders' holidays.

A5 REPORTING BY CONTRACTOR

A5.1 Employment Generation

The Contractor shall be required to submit updated reports together with each Monthly Payment Certificate. Copies of employment contracts for all workers engaged during that month are also to be included.

Payment to the Contractor is conditional upon this information being accurately and timeously submitted.

The following schedules will be provided to the contractor to complete and maintain: -

- The requirements as listed in Form E of Part C1.2

A5.2 Daily Records

The Contractor is to maintain a Site Diary which is to be signed off daily by the Employer's Agent's Representative, for the purpose of keeping daily records in respect of work performed on the site, equipment and labour usage and all significant events. The Employer's Agent's Representative will keep one on his records, the Contractor will keep one copy and a third copy (hard copy) will remain in the site diary file, which will be kept on site for the duration of the Contract.

A5.3 Progress Reports

The Contractor shall provide a progress report which is to be tabled at each Progress/Site Meeting and will include as a minimum the information required under clause PSA 5.12

A5.4 Permits

The Employer requires no special permits for the Contractor's personnel other than those required by the statutory authorities. This includes, but is not necessarily limited to, Work and Residence permits for non-South African nationals, Blasting Certificate for the use of explosives and permits from the Department of Energy and Mineral Affairs in respect of mining and exploitation of natural resources including sand and aggregates.

A5.5 Proof of Compliance with the Law

The Contractor is referred to the Returnable Schedules in Section T.2. The Contractor shall be required to maintain evidence of the continued validity of all aspects to which he has witnessed compliance at the time of submission of his tender, as well as any permits required by nature of his operation. The Contractor will be deemed to have granted the Employer the right of inspection of such documentation in the possession of the Contractor at any time as well as to make his own independent investigations where necessary.

A6 APPLICABLE STANDARDISED AND PARTICULAR SPECIFICATIONS

A6.1 Standardised Specifications

The latest edition as at date of tender of the Standardised Specifications for Civil Engineering Construction as published by the South African Bureau of Standards shall apply (**SABS 1200)**

A Copy of the above SABS specifications is not bound into this document but may be purchased by Tenderers at their own cost from:-

SA Bureau of Standards

Private Bag X191
PRETORIA, 0001

A6.2 Variations and Additions to the Standardised Specifications

Variations and additions to the SABS 1200 Standardised Specifications are prefixed PS and take precedence over the SABS Standardised Specification. Variations and additions are given in Section C3.4.2 - Part B of this document.

A6.3 Particular Specifications

In addition, the Particular Specifications that listed under Section C3.4.3 – Part C shall apply to the contract.

Where a Particular Specification conflicts with either, the Variations and Additions to Standardised Specifications or, the SABS Standardised Specifications, the Particular Specifications shall take precedence.

For all Building Works, the latest edition (1999) of the "Model Preambles for Trades" as recommended and published by the Association of South African Quantity Surveyors shall apply. This Standardised Specification is not bound into this Document but may be purchased by Tenderers from the Master Builders Association, Natal Building Centre, 40 Essex Terrace, Westville (031 - 266 70706).

In the event of any discrepancy between the "Model Preambles for Trades" and the SABS 1200 Standardised Specifications, Variations and Additions to Standardised Specifications or Particular Specifications, the Particular Specifications, Variations and Additions to Standardised Specifications and SABS 1200 Standardised Specifications, as appropriate, shall take precedence.

A6.4 Applicable National and International Standards

Wherever possible, or where not specified otherwise, items and materials for construction of the Works shall comply with the relevant South African Bureau of Standards Specifications and with the British Standards where these are applicable in the absence of local standards. The Contractor, when using materials conforming to a Standard Specification shall, if called upon, furnish the Engineer with certificates of tests showing that the materials do so conform.

C3.4.2 PART B – VARIATIONS TO THE STANDARDISED SPECIFICATIONS

TABLE OF CONTENTS

NOTE

In certain clauses, the SABS 1200 standard specifications allow a choice to be specified in the project specifications between alternative materials and / or methods of construction and /or for additional requirements to be specified to suit a particular contract. Details of such alternative or additional requirements applicable to this contract are contained in this section. It may also contain additional specifications required for this particular Contract.

The number of each clause and each payment item in this part of the project specifications consists of the prefix PS followed by a number corresponding to the number of the relevant clause or payment item in the standard specifications.

The number of any new clause/s or payment item/s not in the original SABS 1200 specification but which is included here, follows-on from the last clause or item number used in the relevant section of the standard specifications.

PSA GENERAL (SABS 1200 A)

PSA 1 SCOPE

Replace the first paragraph of sub-clause 1.1 with the following :-

"This specification covers requirements, principles and responsibilities of a general nature which are normally applicable to all civil engineering contracts as well as the requirements for the Contractor's establishment on Site"

PSA 2 INTERPRETATIONS

PSA 2.3 Definitions

(a) General

Add the following definitions :-

"'General Conditions' : The General Conditions of Contract specified for use with this Contract and the Special Conditions of Contract as applicable.

'Specified' : As specified in the Standardised Specifications, the Drawings or the Project Specifications.".

(c) Measurement and Payment

Replace the definitions for fixed charge, time-related charge and value-related charge with the following :-

"Fixed Charge : A charge that is not subject to adjustment on account of variation in the value of the Contract Sum or a change in the Due Completion Date.

'Time-related Charge' : A charge, the amount of which is varied in accordance with any changes in the Due Completion Date of the work as adjusted in accordance with the provisions of the Contract.

'Value-related Charge' : A charge, the amount of which is varied pro-rata the final value of the measured work executed and valued in accordance with the provisions of the Contract."

PSA 3 MATERIALS

PSA 3.1 Quality

Add to the Sub-Clause:

"No used or recycled material may be used in the Works unless expressly authorized by the Employer's Agent.

Materials specified as being to the approval of a Standards Bureau shall bear the official mark of the appropriate standard.

Samples of concrete aggregates and pipe bedding material are to be delivered to an approved laboratory.

The Contractor shall submit in good time, before any construction commences, to the Employer's Agent on site, samples of all materials intended to be incorporated into the works. The samples shall be accompanied by results of tests undertaken by an approved independent laboratory on the samples in question on behalf of the Contractor and at his cost, before consideration by the Employer's Agent

The Employer's Agent, during construction, will take independent samples from stockpiles of proposed construction materials on site and from the completed works. Approval will not be granted for samples delivered by the Contractor directly to the Employer's Agent's office. The Contractor shall be responsible for the cost of all failures on test samples and control testing.

All pipes, fittings and materials used in the Works, must bear the official standardisation mark of Standards South Africa where applicable. The mark on a pipe shall be visible from above after the pipe is laid.

Rubber articles, including pipe insertion or joint rings shall be stored in a suitable shed and kept away from sunlight, oil or grease.

Large items not normally stored in a building shall be neatly stacked or laid out on suitable cleared areas on the Site. Grass or vegetation shall not be allowed to grow long in the storage areas and the material shall be kept free of dust and mud and shall be protected from stormwater. Pipes shall be handled and stacked in accordance with the manufacturer's recommendations, special care being taken to avoid stacking to excessive heights and placing over hard objects. PVC pipes shall be protected from direct sunlight by suitable covers.

Every precaution shall be taken to keep cement dry and prevent access of moisture to it from the time it leaves the place of manufacture until it is required for use on the Site. Cement is to be used on a first in/first out basis. Bags of cement which show any degree of hydration and setting shall be removed from the site of the Works and replaced at the Contractor's own expense. Any cement older than six weeks is to be removed from site.

Materials shall be handled with proper care at all times. Under no circumstances may materials be dropped from vehicles. Large pipes or large plant shall be lifted or lowered only by means of suitable hoisting equipment.

Where propriety materials are specified it is to indicate the quality or type of materials or articles required, and where the terms "or other approved" or "or approved equivalent" are used in connection with proprietary materials or articles, the Contractor is to supply with their tender the name of the manufacturer and supporting documentation that show that the materials or articles comply with the relevant specifications. It is understood that the approval shall be at the sole discretion of the Employer and the Employer's Agent.

Irrespective of any approval granted by the Employer's Agent or the Employer, the Contractor shall be deemed responsible for quality of all materials used for construction and their specified performance."

Add new Sub-Clause:

"PSA 3.3 : Ordering of Materials

The quantities set out in the Schedule of Quantities have been carefully determined from calculations based on data available at the time and should therefore be considered to be only approximate quantities. The liability shall rest entirely and solely with the Contractor to determine before ordering, the required types and quantities of the various materials required for completion of the Works in accordance with the Specifications and the Drawings issued to the Contractor for construction purposes.

Any reliance placed by the Contractor on the estimated quantities stated in the Schedule of Quantities issued for tendering purposes, or measurements made by the Contractor from the drawing issued for tendering purposes, shall be entirely at the Contractor's risk, and the Employer accepts no liability whatever in respect of materials ordered by the Contractor on the basis of Tender Documents."

PSA 4 PLANT

PSA 4.2 Contractor's Office and Stores (Refer SANS 1921-1 Clause 4.14)

Add to the Sub-Clause:

"Neither housing nor shelters are available for the Contractor's employees, and the Contractor shall make his own arrangements to house his employees and transport them to site.

The Employer will place an area of ground at the disposal of the Contractor at the pipe yard site to enable him to erect his site offices, workshops and stores. The temporary facilities and ablution facilities shall comply with the requirements of the Local Authority.

On completion of the Works or as soon as the Contractor's facilities are no longer required the Contractor shall remove such facilities and clear away all surface indications of their presence. The site is to be rehabilitated as described elsewhere."

PSA 5 CONSTRUCTION

PSA 5.1.1 Setting out the Works

Add before the first sentence:

"The Contractor will be required to set out the various sections of the Works in the order that he proposes to undertake the work as per his program, at least two weeks prior to commencing work on these sections, to enable the Engineer to check the design proposals in the field and thereafter to make any minor changes which he may deem necessary. Any additional survey work or setting out required as a result of these changes shall be undertaken on a daywork basis."

Add the following to this clause:

"The Contractor shall be fully responsible for the setting out of the works, and where labour intensive work is specified, for the setting out of the daily construction tasks.

The Contractor, within two (2) weeks after the site has been handed over to him, is to ascertain the correctness of all pegs and bench marks. Any discrepancy shall immediately be reported in writing to the Employer's Agent. Any costs or subsequent costs arising from discrepancies which had not been reported to the Employer's Agent, within the aforementioned period, shall be the sole responsibility of the Contractor.

Tender drawings shall not be used for construction purposes."

PSA 5.1.2 Preservation and Replacement of Pegs Subject to Land Survey Act (Refer SANS 1921 - 1 Clause 4.15)

Add to the Sub-Clause:

"Before the commencement of construction work in the vicinity of boundaries, the Contractor, under the direction of the Employer's Agent, shall search for plot pegs where boundaries have not been established by the erection of walls or fences and the Contractor shall compile a list of such pegs that are apparently in their correct positions. At the completion of the contract, the Contractor shall expose the pegs that were listed at the commencement of the construction and the Employer's Agent will arrange for any such pegs that are missing to be replaced at the Contractor's expense.

All plot boundary pegs shall be marked with fencing droppers which shall be painted.

As the construction of the Works may necessitate the removal and re-location of certain survey beacons the Employer will make the necessary application to the Surveyor-General and, notwithstanding the provisions of Sub-Clause 5.1.2 will meet the costs of the re-survey by a Land Surveyor of these servitude beacons in their new position.

The Employer will accordingly indemnify the Contractor against all costs implied in Sub-Clause 5.1.2 in respect of those beacons which may have to be removed by the Contractor.

The Employer's Agent will arrange for any pegs that are missing to be replaced at the Contractor's expense.

All survey reference marks shall be clearly marked and protected by the erection of three fencing standards."

PSA 5.2 Watching, Barricading, Lighting and Traffic Crossings

Add the following to this clause:

"The Contractor shall employ competent watchmen to guard the Works both by day and night.

From the time any portion of the Works commences, until the Completion of the Works and the issue of the Certificate of Completion of the Works, the Contractor shall be responsible for protecting the property of the Employer and all persons having business on the Site from anything dangerous or likely to cause damage or injury. The Contractor shall take all practical precautions to avoid nuisance or inconvenience to the owners or occupiers of properties near to the Site and to the public generally whilst carrying out the Works and shall at all times keep the Site clean and in a safe and satisfactory condition.

Temporary traffic signs shall be erected when work is being done within and adjacent to roadways. The number and layout of the traffic signs shall comply with the Site Manual entitled "Safety at Roadworks in Urban Areas", as published by the Department of Transport

The Contractor shall control all access to the site, for authorised persons only, and shall ensure that the approved conditions of the Health and Safety Management Plan are adhered to."

PSA 5.4 Protection of Overhead and Underground Services

Add the following to this clause:

"Before construction of the Works, or any phase of the Works, the Contractor shall contact all relevant parties and authority officials to establish the existence of existing services on site. The Contractor shall be responsible for obtaining all necessary wayleaves. No claims shall be lodged by the Contractor for delays in obtaining such wayleaves or permits."

PSA 5.7 Safety

Add the following to this clause:

"Compliance with
1) OHS Act and Regulations and
2) Environmental Management Plan (EMP or EMPr)

Lump sums are provided in the Bill of Quantities to cover the contractor's cost for compliance with the requirements of the Construction Environmental Management Plan and the Occupational Health and Safety Act, 1993, the Construction Regulations, 2014 and the Health and Safety Specification respectively.

In addition, Sums are included under Time Related Items in the Preliminary and General Section of the Schedule of Quantities. The lump sums shall include full compensation for the provision of the necessary site official, the training, PPE, plans, audits, assessments, administration, etc. and all other costs required for compliance. Fines issued for non-compliance will be deducted from these Sums, but are not limited to the value of the Sums stated. "

Add the following clauses:

"PSA 5.10 Record Drawing Information

As the Works are progressing, the Contractor shall mark on a special set of drawings, all as-built details and submit them to the Employer's Agent's Representative for approval. No extra payment shall be made for preparation of these as-built plans.

All valves, chambers and the like shall be coordinated together with their invert and cover/ground levels on the as-built drawings.

The Certificate of Completion shall only be issued once all the as-built information has been received and verified by the Employer's Agent.

PSA 5.11 Clearance of Site on Completion

The Contractor shall obtain, from each property owner directly affected by the Works, a certificate to the effect that the property owner is satisfied with the standard of reinstatement of any fences, boundary walls or structures, compensation paid for loss or damage to stock, crops or property, material spoiled on their properties or any other condition affecting their properties as a result of the operations of the Contractor. The Contractor shall further obtain a Clearance Certificate from each authority whose services have been affected during the construction of the Works.

All such certificates must be lodged with the Employer's Agent before the Certificate of Completion will be issued.

PSA 5.12 Project Reporting

The following forms are required to be completed and submitted monthly with the payment certificate to the Employer's Agent :

- Expanded Public Works (EPWP) forms
- Municipal Infrastructure Grant (MIG) forms

Templates will be provided to the Contractor.

The following data is to be submitted monthly, at the site meeting, to the Employer's Agent :

- Updated program
- Construction equipment schedule
- Rainfall records
- Labour Resources
- Subcontractors with particular information on local emerging subcontractors as required under Section C3.3
- Progress of each element of the works
- Progress against programme
- Cashflow against programmed cashflow
- Delays and effect on the programme
- Site Instructions
- Health and Safety
- Environmental
- Aids Awareness Programme
- Accredited Skills Training
- Community Issues
- Outstanding Information and,
- Anything else as required by the Employer, Engineer or Contractor.

The tendered Fixed and Time Related Preliminary and General Charges in the Schedule of Quantities shall be deemed to include for all costs in this regard.

PSA 5.13 Daily Photography

For the purposes of recording daily progress over the whole Site, the Contractor shall, from commencement of Works to final finishing, provide, maintain and operate all necessary elevated fixed position cameras (min four (2No) positions to be approved by the Employers Agent) or drone aerial photography equipment to capture photography of the site at noon every working day. If from a drone, the position will be selected pre-programed fixed xyz coordinates and camera orientation above the site (one position pointing vertically downwards to record the overall site and four other positions to capture angled shots of the site from the North, South, East and West), high-resolution still photographs (Minimum 3264x2448 pixels) and make these available to the Employer and Engineer on monthly basis.

The tendered Fixed and Time Related Preliminary and General Charges in the Schedule of Quantities shall be deemed to include for all costs in this regard."

PSA 6 TOLERANCES

PSA 6.2 Degree of Accuracy

Add the following to this clause:

"Degree of Accuracy II shall apply."

PSA 7 TESTING

PSA 7.1 Testing Principles

Add the following to this clause:

"When giving notice, the Contractor shall provide the Employer's Agent with the results of the check testing indicating that the work is to specification. The Employer's Agent shall be given 48 hours' notice of when testing or inspections are required.

The Employer's Agent may from time to time carry out his own check tests on the work performed by the Contractor. Should such check tests show that the Contractor's control testing be such that the quality of the Contractor's work can be called into question, then the Employer's Agent may order further check tests to be carried out on work already completed. All costs associated with such check tests shall be for the Contractor's account, as also the costs of any other check test whose results to not comply with the specification.

Failure by the Contractor to notify the Employer's Agent or to provide the required information or, where specified, to perform the required test, will be grounds to exempt the Employer from payment for the associated work and for all subsequent work which would be affected by the failure of the Work to be tested.

The Employer's Agent will be under no obligation to the Contractor to perform the tests. If the Employer's Agent elects not to perform a particular test after notification by the Contractor, the Contractor will be issued with a written instruction to proceed with the relevant works without the acceptance test being performed.

Nothing contained in this clause will relieve the Contractor of any responsibilities under the specification or in any way limit the tests, which the Employer's Agent may call for or perform in terms of the specification.

Where the Employer's Agent is called to witness certain control tests, such as the pressure testing of a pipeline, and the results of such tests do not comply with the specifications, then the Employer reserves the right to recover costs for the Employer's Agent's presence at the unsuccessful test from the Contractor."

PSA 7.2 Approved Laboratories

Add the following to this clause:

"Acceptance testing shall be done by a laboratory selected by the Employer's Agent. The Employer's Agent requires twenty-four hours' notice from the Contractor in order to perform the relevant acceptance test.

All acceptance testing by the Employer's Agent shall be paid for by the Contractor. The costs of such tests which meet the specification requirements will be reimbursed to the Contractor in the monthly payment certificate. This payment shall consist of a billed amount plus the tendered mark-up. A Provisional Sum has been provided in the Schedule of Quantities to allow for the cost of such testing.

The Contractor shall make due allowance for testing procedures in the construction program."

PSA 8 MEASUREMENT AND PAYMENT

PSA 8.1 Measurement

PSA 8.1.2 Preliminary and General Items or Section

PSA 8.1.2.2 Tendered Sums

Replace the contents of this sub-clause with the following :-

"The Contractor's tendered sums under items PSA 8.3 and PSA 8.4 shall collectively cover all charges for :-

- Risks, costs and obligations in terms of the General Conditions of Contract and of this Standardised Specifications, except to the extent that provision is made in these Project Specifications to cover compensation for any of these items of work.
- Complying with the Occupational Health and Safety Act (Act No. 85 of 1993) and in particular with the latest Construction Regulations and Part 5 – Section C5.1 : Health and Safety Specification, providing the required health and safety measures
- Complying with the Environmental Requirements as set out in the EMP / EMPr and all relevant legislation and project specifications.
- Complying with the requirements of the EPWP, when applicable, and provision of monthly labour data sheets as required
- Complying with the requirements to engage, manage, train & assist local SMME's as specified
- Complying with the requirements of the Aids awareness program as specified.
- Head-office and site overheads and supervision.
- Profit and financing costs
- Expenses of a general nature not specifically related to any item or items of permanent or temporary work
- Providing facilities on Site for the Contractor's personnel, including offices, storage facilities, workshops, ablutions, for providing services such as water, electricity, sewerage, sewerage and rubbish disposal, for access roads and all other facilities required, as well as for the maintenance and removal on completion of the Works of these facilities and the cleaning up of the camp site on completion of the Works.
- Dealing with water
- Providing facilities for the Engineer and his staff as specified in SABS 1200 AB and in these Project Specifications.
- Two name boards as specified. To be erected in positions to be indicated by the Engineer.
- The maintenance of his whole organization as established for this Contract.
- The maintenance of all insurances, indemnities and guarantees required in terms of the Conditions of Contract or Tender where applicable.
- Compliance with all general conditions and requirements which are not specifically measured elsewhere for payment in these Contract Documents.
- The fixed charge items will include all costs associated with dealing with mandatory sub-contracts. "

PSA 8.2 Payment

PSA 8.2.1 Fixed-Charge and Value-Related Items

Payment for the sum tendered under item PSA 8.3.1 will be made in Four separate instalments as follows :-

a) The first installments which is 20% of the sum, will become due upon site handover.
b) The Second instalment which is 40% of the sum, will be paid when the Contractor has met all his obligations to date under this Specification, the General Conditions of Contract and the Special Conditions of Contract.
c) The Third instalment, which is 35% of the sum, will be made when the amount certified for payment, including retention monies but excluding the second instalment referred to herein, exceeds 15% of the

tender sum.

d) The Fourth instalment, which is 5% of the sum, will be made when the removal of the Engineers and Contractors site establishment have been completed on completion of the works.

No adjustment will apply to item 8.3.1 in respect of variations in the value of work done or the time for completion finally authorised.

Payment for the sum tendered under PSA 8.3.3 will be made in monthly instalments in relation to the value of the work done (excluding the value of any price adjustments in terms of Clause 6.8 of the General Conditions of Contract).

Should the value of the measured work finally completed be more or less than the tender sum (excluding the value of any price adjustments in terms of Clause 6.8 of the General Conditions of Contract), then the sum tendered under Item PSA 8.3.3 will be adjusted pro-rata up or down and this adjustment shall be applied to the final instalment.

PSA 8.2.2 Time-Related Items

Replace the contents of this sub-clause with the following:

"Subject to the provisions of Item 8.2.3 and Item 8.2.4, payment under item PSA 8.4.1 (time-related item) will be made monthly, pro rata for parts of a month, from the Commencement Date, until the Due Completion Date, provided always that the total of the monthly amounts so paid for the item is not more than in proportion to the progress of the work as a whole.

Should the Engineer grant an extension of time for completion of the Works, the Contractor will be entitled to an increase in the sum tendered for the time-related item, which increase shall be in the same proportion to the original tendered sum for the time-related item as the extension of time is to the original time for achieving Practical Completion.

Payment for such increased amounts will be taken to be in full compensation for all additional time-related preliminary and general costs that result from the circumstances pertaining to the extension of time granted."

PSA 8.3 Scheduled Fixed-Charge and Value-Related Items

Replace the item with the following:-

"PSA 8.3.1 : Fixed Preliminary and General Charges ……..... Unit : Sum

PSA 8.3.2: Fixed and General Health and Safety Obligations ……..... Unit : Sum

PSA 8.3.3 : Value-Related Preliminary and General Charges ……..... Unit : Sum

PSA 8.3.4: Value-Related Health and Safety Obligations ……..... Unit : Sum

The sums tendered shall include full compensation for all fixed and value-related preliminary and general charges as described in sub-clause PSA 8.1.2.2. Payment will be made as described in sub-clause PSA 8.2.1."

PSA 8.4 Scheduled Time-Related Items

Replace the items with the following:-

"PSA 8.4.1 : Time-Related Preliminary and General Charges

a) General Obligations ……..... Unit : Sum
b) Compliance with OHS Act and Regulations (Including the Construction Regulations ……..... Unit : Sum
c) Compliance with Environmental Requirements ……..... Unit : Sum
d) Compliance with EPWP Requirements, where applicable ……..... Unit : Sum

e) Provision of Monthly Labour Data Sheets and other reporting required by Employer
…….. Unit : Sum

f) Engagement, management, training & assisting local SMME's …….. Unit : Sum

g) Allowance for HIV and Aids Awareness Program …….. Unit : Sum

The sum tendered for item PSA 8.4.1 (a) shall include full compensation for all time-related preliminary and general charges as described in sub-clause PSA 8.1.2.2, excluding requirements listed in Items PSA 8.4.1 b), c), d), e), f) and g).

The sum tendered for item PSA 8.4.1 (b) shall include full compensation for any and all costs related to complying with the requirements of the Occupational Health and Safety Act and in particular with the latest Construction Regulations. As well as the Project specific health and safety specification. Health and Safety Officer/s, medical examinations, accommodation, transport, communication implements, consultations, meetings and any other thing necessary for the completion of the aspect, at all times, for the full duration of the Contract. The Contractor shall provide the Employer's Agent with a complete breakdown of this tendered sum. This sum will be paid to the Contractor, in equal monthly amounts, subject to proper and accepted compliance.

The Sum tendered for Item PSA 8.4.1 (c) shall include full compensation to the Contractor for compliance with all the environmental requirements at set out in the EMP / EMPr, relevant legislation and project specifications. This sum will be paid to the Contractor, in equal monthly amounts, subject to proper and accepted compliance.

The sum tendered for item PSA 8.4.1 (d) shall include full compensation for any and all costs related to complying with the requirements of the Expanded Public Works Program (EPWP) when specified.

The sum tendered for item PSA 8.4.1 (e) shall include full compensation for any and all costs related to providing the monthly data sheets.

The sum tendered for item PSA 8.4.1 (f) shall include full compensation for any and all costs related to identifying, selecting, inviting tenders/quotations, negotiations, award, managing, training, assisting, supervising and paying of local SMMES

The sum tendered for item PSA 8.4.1 (g) shall include full compensation for any and all costs related to HIV and Aids Awareness Training as specified.

Payment will be made as described in sub-clause PSA 8.2.2."

The Contractor will not be paid Time-Related Preliminary and General Charges for any Special Non-Working Days, which shall be deemed to have been allowed for in his rates.

PSA 8.4.2.2 Facilities for the Contractor

Add the following to this clause:

Facilities for the Contractor shall include all the costs of providing water for construction other than the water required for water tightness testing of water retaining structures. Water for such tests will be measured separately.

The costs for providing security against theft and vandalism will be included in the rates tendered for Contractor facilities. No separate payment will be made for the provision of security.

Add the following new items:

PSA 8.7 Additional Items

PSA 8.7.1 Vehicles for the Engineer's Representative

a) Fixed monthly charge for provision of vehicle/s …….. Unit : Month

b) Kilometer rate for monthly travel …….. Unit : km

Where specified or measured in the Schedule of Quantities, vehicles will be provided for the sole use of the Engineer's site staff. The vehicle requirements are as specified in PSAB and each vehicle and vehicle type will be scheduled separately.

The rate tendered for item 8.7.1 (a) shall cover any and all costs for the provision of the vehicle and ensuring that it is kept fully insured and shall include for any financing costs, depreciation, licensing fees, and any other expenses and fees of a general and fixed nature that may be required. The unit of measurement shall be the Month and will be paid monthly for the full duration of the vehicle's use by the Engineer's staff. Part months shall be measured pro-rata.

The rate tendered for item 8.7.1 (b) shall cover all costs related to driving the vehicle/s and shall include for all costs related to fuel, maintenance and repairs, consumables, fully comprehensive insurance and any other expenses that may occur. The unit of measurement shall be kilometers (km) and will be measured monthly according to the odometer reading/s.

PSA 8.5 Sums Stated Provisionally by Employer's Agent

Replace the penultimate sentence of Sub-clause 8.5 to read:
"The percentage rate for (b) (2) above shall cover the Contractor's overheads, charges and profit on the work covered by the sums provisionally stated for (b)(1) above. Payment will be made on the basis of the sums actually paid for such work, exclusive of VAT."

PSA 8.5.1 Community Liaison Officer …….. Unit : Prov Sum

A provisional sum is included to allow for the salary of a person working full time as the Community Liaison Officer (CLO). The Contractor shall ensure that the salary and other expenses due are paid timeously in accordance with the payment dates of his own staff.

A separate item for overheads, charges and profit on the above item is applicable.

PSA 8.6 Prime Cost Items

Replace the penultimate sentence of Sub-clause 8.6 to read:

"The percentage rate for (b) shall cover the Contractor's overheads, charges for taking delivery and profit on the supply of materials or goods covered by the sums stated in (a) above. Payment will be made on the basis of the sums actually paid for such materials or goods, exclusive of VAT."

PSA 8.7 Daywork

Add the following to this clause:

The rates submitted by the Tenderer in the relevant schedule of the Contract shall be applicable.

Provisional items for Daywork are scheduled as follows:

a) Labour at hourly rates for skilled, semi-skilled and unskilled labourers.
b) Purchase cost of Material with a percentage allowance on the net cost for delivery to Site and all Contractors charges.
c) The Contractor's own construction equipment as a Provisional Sum. Where not listed in the BoQ, rates shall be agreed with the Engineer before such work is put in hand.

Tendered unit rates or unit rates that are agreed in terms of Sub-clause 6.5.1.3 of the General Conditions of Contract for the Contractor's own construction equipment used for Daywork shall cover the full cost of the use of such construction equipment and shall, in addition, cover the cost of operators, consumable stores, fuel and maintenance.

The Contractor will be paid the actual net cost of construction equipment hired by him for Daywork and in addition will be paid a percentage allowance on the net cost of such hire, which allowance will cover the Contractor's own overhead costs and profit.

PSA 8.8 Temporary Works

Add the following to this clause:

PSA 8.8.1 Construct and Maintain Access Roads ……..… Unit : Sum

Any extension to existing access roads or construction of new access roads as may be required by the Contractor to access the site of the Works as well as regular maintenance thereof to ensure that the roads are kept in a serviceable condition, to the satisfaction of the Engineer, for the full duration of the contract shall be the responsibility of the Contractor.

Payment of the sum tendered will be made in monthly instalments over the full duration of the contract and shall cover any and all access roads that may be required as a result of the Contractor's method of working.

PSA 8.8.2 Dealing with Traffic ……..… Unit : Sum

This item shall include supply, erection and maintenance of all temporary road signs, delineators and for flagmen that may be required, in terms of the South African Road Traffic Signs Manual, for any and all interfaces with public roads. Where permitted, construction of road crossings shall be carried out using the method of half widths and the road shall be re-opened to its full width for two-way traffic overnight. Under no circumstances will the half-widths closure be permitted to remain after normal working hours.

All road signs and delineators shall be new.

Payment of the sum tendered will be made in monthly instalments over the full duration of the contract and shall cover any and all interfaces with the travelling public that may occur as a result of the Contractor's method of working.

PSA 8.8.4 Existing Services

The tendered rate shall further cover the cost of backfilling the excavation with selected material compacted to 90% Mod. AASHTO density, keeping the excavation safe, and taking care that the services are not damaged in any way. The rate shall include for all negotiations with the authorities, notification to all affected parties and any other requirement to protect and complete the work.

PSA 8.8.6 Special Water Control in Terms of Project Specification

In addition to SABS 1200 A clause 8.3.3.2 h) and clause 8.4.2.2 h) (fixed and time-related items for dealing with water), a separate fixed Lump Sum item will be measured for payment for all temporary works required to create and maintain dry working conditions for the construction of all permanent works constructed within the Umkhomazi River flood zone, all as described in C.3.4.5.4 (Temporary River Diversion Works for Construction of Abstraction Structure).

The tendered rate shall cover all costs associated with the design, supply of all necessary materials, provision of access, construction, maintenance and, when no longer needed, the demolition and disposal of temporary works structures and materials and final making good of all disturbed areas.

The tendered amount will be certified for payment in stages; generally relating to the value of work done as agreed at the approval stage of the Contractor's design and Construction Method Statement. The final 5% will not be certified for payment until such time as the Employer's Agent is satisfied that all temporary works have been completely removed and all waste material suitably disposed of and all areas impacted by such temporary works have been made good.

Add the following clauses:

PSA 8.9 Survey Control and Setting out of Works ……..… Unit : Sum

Before commencement of work, the Contractor is to liaise with the Employer's Agent to establish the status of all survey pegs. If any pegs are missing, he shall immediately inform the Employer's Agent in writing.

On completion of the Contract the pegs that have been unavoidably disturbed will be replaced by the Employer. Pegs which have, in the opinion of the Employer's Agent, been disturbed due to the negligence of the Contractor will be replaced by a registered Land Surveyor at the Contractor's cost.

PSA 8.12 Miscellaneous Items ……..… Unit : as scheduled

An item which refers to this clause will be measured in the unit scheduled.

The sum or rate for such item shall cover the cost of all materials, labour and construction equipment required to execute and complete the work, as specified, or described in the Schedule of Quantities or shown on the drawings.

PSAB EMPLOYER'S AGENT'S OFFICE (SABS 1200 AB)

PSAB 3 MATERIALS

PSAB 3.1 Nameboards

Add the following:-

Employer's nameboards shall be erected within one month of the commencement of construction and shall be placed where ordered by the Employer's Agent. Any damage to these boards shall be repaired within 14 days of a written instruction received from the Employer's Agent. For details of the board refer to the Standard Drawings contained in this document.

All nameboards shall be removed 14 days prior to the date of the Final Approval Certificate.

PSAB 3.2 Office Building

Delete the first sentence and substitute the following:

The Contractor shall supply and furnish three (1 No) air-conditioned "Kwikjack" or similar (9 m x 3.4 m) office and conference facility for conducting meetings.

Add to the Sub-clause:

In addition to the furnishings listed under sub-items (a) to (i), the following shall be provided and properly maintained:

(j) electrical installation to include at least two lights and two 15A plug points plus adequately sized air conditioning units (for heating and cooling) for each office or meeting space.
(k) one refrigerator of at least 100 litre capacity
(l) one kettle of at least 2 litre capacity
(m) one tea set comprising six cups and saucers, six teaspoons, one teapot, one sugar bowl and one milk jug
(n) covered parking for four vehicles.
(o) un-covered parking space for two vehicles.
(p) two "Barhold" or similar wall mounted racks each with 6 clamps suitable for hanging A0 sized drawings
(q) one large meeting table
(r) ten additional chairs

The Contractor shall supply one (1) lockable toilet for the exclusive use of the Employer's Agent's staff.

In addition, the offices for the Employers Agent shall be supplied with approved burglar proofing, the cost of which shall be taken as included in the relevant tendered rates.

The tendered Fixed and Time Related Preliminary and General Charges in the Schedule of Quantities shall be deemed to include for all costs in this regard.

PSAB 4 CONSTRUCTION EQUIPMENT

PSAB 4.1 Telephone

Delete the Sub-Clause and substitute the following:

The Contractor will be required to supply the Engineer's Site Staff with:

- One cellular phones with pre-paid air-time or contract air time and data to the value of R 1 000-00 per month as soon as the Contract commences. The phones are to be Huawei P30 lite or similar approved.

The tendered Fixed and Time Related Preliminary and General Charges in the Schedule of Quantities shall be deemed to include for all costs in this regard. The Contractor shall keep the cellular phone continuously insured

against any loss, damage, or breakage and he shall indemnify the Employers Agent and the Employer against any claims in this regard.

Add the following new clauses:

PSAB 4.2 Covered Parking Bay

The Contractor shall also supply and maintain covered parking's for the exclusive use of the Employer and Employers Agent as stated in Clause 3.2 above. The parking shall be constructed with gum pole uprights with IBR or corrugated iron roofing supported on timber with 80% shade cloth cladding to the sides. The surface bed of the parking shall be free draining and constructed with a 100 mm layer of 19 mm stone.

The tendered Fixed and Time Related Preliminary and General Charges in the Schedule of Quantities shall be deemed to include for all costs in this regard.

PSAB 4.3 Uncovered Parking Bay

The Contractor shall also supply and maintain uncovered covered parking's for the exclusive use of the Employer and Employers Agent as stated in Clause 3.2 above. The surface bed of the parking shall be free draining and constructed with a 100 mm layer of 19 mm stone.

The tendered Fixed and Time Related Preliminary and General Charges in the Schedule of Quantities shall be deemed to include for all costs in this regard.

PSAB 4.2 Engineer's Survey Equipment

The Contractor shall provide the following survey equipment on the Site from the commencement to the completion of the Works :

- One automatic reading Engineer's level plus tripod
- One levelling staff (5 m long, 1 cm graduations)
- One staff angle bubble
- One metal change-point for levelling
- One separate plumb-bob
- One spirit level (one metre long)
- One hammer (2 kg) with steel or wooden pegs as necessary
- Two 50 m steel tapes
- Three 5,0 m retractable steel tapes

The survey equipment shall be for the sole use of the Employers Agent and his staff. The Contractor shall keep the equipment continuously insured against any loss, damage, or breakage and he shall indemnify the Employers Agent and the Employer against any claims in this regard. Upon completion of the Works the survey equipment as listed above shall revert to the Contractor.

The Contractor shall maintain the equipment in good working order and keep it clean until the completion of the Works.

The tendered Fixed and Time Related Preliminary and General Charges in the Schedule of Quantities shall be deemed to include for all costs in this regard.

PSAB 4.3 Computer and Office Equipment

The Contractor shall provide, for the sole use of the Employers agent and their staff for the duration of the contract, the following computers and appurtenant hardware with minimum specification as follows:

- Four (1 No) laptop computers for the use of the Employers agent and their staff
    - i5 8705G 3.1GHz- 4.1GHz
    - 16GB Ram
    - 512GB SSD
    - 2GB graphic card

  - 15.6 inch laptop
  - Wireless mouse and keyboard

- Appurtenant software pre-loaded on computer and hardware (1 off)
  - Windows 10 Pro 64 bit
  - Office 365 Business (includes Excel, Word, Outlook, PowerPoint)
  - Microsoft Project 365
  - Eset Nod32 antivirus
  - Kofax power PDF
  - Laptop carry bag
  - Security cable

- Appurtenant Office hardware and facilities
  - A3/A4 multi-functional laser printer/fax/scan/copier (Mono)
  - 1TB External portable HDD 2.5 inch (Western digital or Seagate)
  - Minimum 12 megapixel digital camera
  - Wireless network facilities at the site office with internet access, internet speeds to be minimum of 3.6Mbps upload and download (Including any relay stations etc.)

The Contractor shall keep this equipment continuously and comprehensively insured and shall indemnify the Employer and the Employers Agent against any claims and deductibles in this regard. The Contractor shall maintain this equipment in good working order and maintain all annual subscriptions on pre-loaded software until the completion of the Works, whereupon ownership of said hardware and software shall revert to the Contractor.

The Contractor shall ensure that adequate supplies of consumables (paper and ink cartridges) to a maximum amount of R 2 000.00/month are always available on site. If the usage by the Engineer and his staff exceeds R 2 000.00/month, any additional costs will be reimbursed under the item for Dayworks Materials.

The tendered Fixed and Time Related Preliminary and General Charges in the Schedule of Quantities shall be deemed to include for all costs in this regard, except for expenses in excess of the R 2 000.00/month for consumables, which will be reimbursed as set out above.

PSAB 4.4 Vehicles for the Engineer's Representative

The Contractor shall provide for the exclusive use of the Employers Agent and their staff One (1. No) vehicles as required by the Engineer. The vehicle/s shall, unless specified otherwise, be a minimum:

- Three quarter ton two wheel drive LDV or suitable SUV
- Not older than 5 years from date of 1st registration
- Not more than 60 000km on the odometer on hand-over
- Current roadworthy certificate (not less than 1 month old at time of handover)

The tendered rates shall include for all fully comprehensive insurances, financing costs, depreciation, licensing, fuel, lubricants, maintenance and repairs and any other expenses and fees of a general nature that may occur. The contractor will provide a fuel card with each vehicle supplied which can be used for fuel and other consumable purchases by the driver of the vehicle.

The Contractor shall keep this equipment continuously and comprehensively insured and shall indemnify the Employer and the Engineer against any claims and deductibles in this regard. The Contractor shall maintain the vehicle/s in good working order until the completion of the Works, whereupon ownership of said vehicle/s shall revert to the Contractor. Further the contractor will be required to wash the vehicle at least 2x per month. The Contractor shall also be responsible for providing a temporary alternative equivalent vehicle should the provided vehicle be not available for use for a period longer than 48h. Although the site staff members to whom the vehicles are allocated are not allowed to use it for personal travel, said members may need to use the vehicles for attending to other work-related needs approved by the Engineer. The vehicles will revert to the Contractor upon issue of the Certificate of Completion or date as mutually agreed

Separate items are included in the Schedule of Quantities to cover this item as follows:

(a) A monthly fixed rate to cover the cost of providing the vehicle and ensuring that it is always fully serviceable and roadworthy.
(b) A cost to cover travel by the Engineer's staff. This item will be measured in kilometres (km) and will be

measured monthly according to the odometer reading/s and shall cover all fuel, maintenance, repairs and consumables."

PSAB 5 CONSTRUCTION

PSAB 5.2 Engineer's Office (Refer SANS 1921-1 Clause 4.14)

Add to the Sub-Clause:

The toilet facilities provided for the sole use of the Engineer or his representative(s), the Employer's inspectors, CLO and PSC shall be maintained in a hygienic and sanitary condition and shall be removed on completion of the Works. The facilities provided shall conform to the local health authority's requirements as applicable and the Contractor shall pay all sanitary fees and charges.

The tendered Fixed and Time Related Preliminary and General Charges in the Schedule of Quantities shall be deemed to include for all costs in this regard.

PSAB 5.5 Survey Assistants

Delete the first sentence and substitute the following:

The Contractor shall make available to the Engineer two suitably educated labourers for use on and about the site on survey and other work directed by the Engineer at all reasonable times.

The tendered Fixed and Time Related Preliminary and General Charges in the Schedule of Quantities shall be deemed to include for all costs in this regard.

Add the following new clauses:

PSAB 5.7 Site Instruction Books

The Engineer shall supply a site instruction book for specific use on the Site. All instructions given by the Engineer's Representative must be confirmed and countersigned by the Engineer. The instruction shall be countersigned by the Contractor before implementation.

The Contractor shall supply a triplicate book for site correspondence and inspection requests to the Engineer's Representative. Reasonable notice shall be allowed prior to inspections. All inspections requests and approval/disapproval thereof shall be recorded by the Site staff in writing. All requests must be signed and dated by the Engineer's Representative before implementation.

The Contractor in conjunction with the Engineer must ensure that a suitable site quality record system is put in place to record that each section, or work item, complies with the relative works specification.
The tendered Fixed and Time Related Preliminary and General Charges in the Schedule of Quantities shall be deemed to include for all costs in this regard.

PSAB 8 MEASUREMENT AND PAYMENT

All measurement and payment for Engineer's office to be effected under PSA 8.3 and PSA 8.4.

PSC SITE CLEARANCE (SABS 1200 C)

PSC 3 MATERIALS

PSC 3.1 Disposal of Material

Replace the words from "Material obtained from clearing and Grubbing….." to "… prior written approval for the Engineer" with the following:

"The Contractor shall make his own arrangements for the disposal of material obtained from clearing and grubbing and from the demolition of structures, which material shall be removed from the site.

The disposal site shall meet with the approval of the Local Authority within whose area it falls, and the spoiling shall comply with all the statutory and municipal regulations. No burning of material will be allowed on site.

No overhaul will be paid for any spoil materials and the Contractor shall allow for all haulage in his tendered rates. All costs relating to this activity shall be deemed to be included in the rates tendered for site clearance."

B2.1

PSC 5 CONSTRUCTION

PSC 5.2.3.2 Individual Trees

Add the following:

A penalty of R 2 000.00 per tree shall apply. Prior to removing any trees, the Contractor shall, together with the Engineer, mark the trees to be preserved.

PSC 5.3 Clearing

B2.2 Add the following:

"Where any Portion of the Works traverses existing fences these shall be carefully uplifted, if required, and reinstated during the course of activities in that specific area. Where an uplifted fence interferes with the security of what it controls a temporary fence shall be installed and operated to the satisfaction of the Engineer or his Representative. Prior to removal or dismantling of any fence, the contractor will be required to photograph the fence for future reference."

PSC 8 MEASUREMENT AND PAYMENT

PSC 8.1 Basic Principles

Add the following :

"No separate payment will be made for topsoil removal or replacement along trench routes. The Contractor is to excavate trenches in such a manner that the top 150 mm of material is kept separate from other excavated material, for replacement on completion of backfill operations. All costs related to excavating this vegetation and topsoil, separate stockpiling, dust nuisance control and reinstatement of the topsoil upon completion of the backfilling operations, shall be deemed to be included in rates tendered for trench excavation and backfilling."

B2.3

PSD EARTHWORKS (SABS 1200 D)

PSD 2 INTERPRETATIONS

PSD 2.3 Definitions

Amend the sentence headed "Restricted excavation" to read:

"Restricted excavation – All excavations for individual structures starting from the specified bulk excavation platform levels or, where no bulk excavation platform has been specified, from 150mm below natural ground level (ie excluding a nominal 150mm topsoil layer to be removed beforehand)."

Replace the definition "Borrow" with the following :-

"Borrow Material : Material, other than materials obtained from excavations required for the Works, obtained from sources such as borrow pits or the authorised widening of excavations. 'Borrow' shall have a corresponding meaning."

Replace the definition "Stockpile" with the following :-

"Stockpile (Verb) : The process of selecting and, as may be necessary, loading, transporting and off-loading material in a designated area for later use and a specific purpose."

Add the following definitions :-

"Fill : An embankment or terrace constructed from material obtained from excavations or borrow. In roads it includes the earthworks up to the underside of the Selected Sub-Grade level.

Fill (Material) : Material used for the construction of an embankment or terrace.

Roadbed : The natural in-situ material on which the fill, or in the absence of fill, any pavement layers, are to be constructed."

PSD 3 MATERIALS

PSD 3.1.2 Classes of excavation

Delete the contents of this clause and replace with the following:

"For this contract, the classes of excavation will be subdivided as follows:

(a) Soft excavation

Soft excavation shall be excavation in all materials and boulders which in the opinion of the Engineer can be efficiently excavated and loaded by a 30t excavator fitted with 'rock bucket' (excavator bucket typically fitted with not more than 3 tines designed to loosen weak rock material).

(b) Hard Excavation / Hard Rock

Hard excavation shall be excavation in materials and boulders, which in the opinion of the Engineer, can only be removed efficiently with mechanical equipment larger than a 30t excavator, or with jackhammers, drilling & blasting, expanding grout etc.

PSD 3.3 Selection

PSD 3.3.1 General

Where the selected material is to be stockpiled for later use, the material shall be stockpiled separately in its respective group so that it can either be recovered later or selected by others.

Add the following sub clause :-

PSD 3.3.3 Selection in Borrow Pits and Excavations

The approval of a borrow area for a certain purpose does not necessarily mean that all material within that area is suitable for the specified purpose. What it does mean, is that the borrow area contains some suitable material. The onus is on the Contractor to ensure that only material that is indeed suitable is removed and used for the specified purpose.

Where the Contractor is required to select material from excavations for a specific purpose, the above provisions relating to borrow areas shall apply *mutatis mutandis* to excavations.

The Contractor shall not waste or contaminate material that has been selected for a specific purpose".

PSD 5 CONSTRUCTION

PSD 5.1.1.1 Barricading and Lighting (Refer SANS 1921-1 Clause 4.18.2 and 4.18.3)

Delete the Sub-Clause and substitute:

Without limiting any obligation which the Contractor may have in terms of any Act, Ordinance or other legislation, the Contractor shall ensure that all excavations which are accessible to the public or which are adjacent to a public road or thoroughfare, or by which the safety of persons may be endangered are protected as set out in Clause 13 of the General Safety Regulations of the Occupational Health and Safety Act, 1993 and that watchmen are employed to ensure that barricades, barriers and lights are effective at all times.

PSD 5.1.1.2 Safeguarding of excavations

Replace Clause 5.1.1.2 (b) with the following:

The Contractor must note that the excavations for most of the structures are deep. The Contractor is responsible for ensuring that all temporary excavation faces are stable and safe at all times and shall either:

- Provide a shoring system, designed by the Contractor and signed by a suitably qualified Professional Engineer, or

- Reduce the slope of excavations to the safe angle as determined by a suitably qualified Professional geotechnical engineer employed by the Contractor.

In addition, the Contractor shall provide stormwater diversion berms or ditches upstream of excavations for structures and, where reasonably possible, make all excavations free-draining. Where making excavations free-draining is not reasonably possible, the Contractor shall not allow water from any source to accumulate beyond 300mm deep anywhere in any excavations (excluding sludge and scour ponds once complete).

PSD 5.1.1.3 Blasting

Add the following new Sub-Clauses:

PSD 5.1.1.3a) Explosives (Refer SANS 1921-1 Clause 4.7)

Notwithstanding Sub Clause 5.1.1.3 the Engineer shall be notified at least 48 hours beforehand of the Contractor's intention to use explosives on site

It shall be the Contractor's responsibility to make himself aware of the restrictions to blasting imposed by electric transmission or telephonic lines and other similar services. Where the presence and location of electric transmission or telephonic lines etc., are known or are shown on the Engineer's drawing at tender stage the Contractor shall make allowance in his rates and programs for restrictions and delays which may result from restrictions imposed by the authorities.

PSD 5.1.1.3b) Use of Explosives (Refer SANS 1921-1 Clause 4.7)

Generally, the Contractor will be permitted to use explosives for breaking up rock and hard material during excavations, for demolishing existing structures and for such other purposes where it may normally be required, subject to the following conditions:

(a) The Engineer or Inspector of Explosives shall have the power to prohibit the use of explosives in cases where, in his opinion, the risk of injury or damage to persons, property or adjoining structures is too high. Such action by the Engineer shall not entitle the Contractor to any additional payment for having to resort to other less economical methods of construction unless otherwise provided in the Contract Data or Bill of Quantities.

(b) Should blasting be necessary, the Contractor shall take every precaution to protect the Works and persons, animals and property in the vicinity of the site. The Contractor will be held responsible for any injury or damage caused by any blasting operations and shall make good such damage at his own expense.

(c) The requirements of the Explosives Regulations Act (Act 26 of 1956) and the requirements of the Inspector of Explosives shall be complied with. In addition, where applicable, the requirements of Chapter 9 of the Regulations published in terms of the Mines and Works Act (Act 27 of 1956) and the requirements of the Government Mining Engineer shall be complied with.

(d) A copy of each blasting permit issued to workmen, and of each permit issued to the Contractor to cover the purchase, storage and transport of explosives, shall be handed to the Engineer. The Contractor shall grant the Engineer access to all records maintained for the Inspector of Explosives or the Government Mining Engineer, as the case may be.

(e) Before any blasting is undertaken, the Contractor, together with the Engineer and the ISD Consultant and CLO shall examine and measure up any buildings, houses or structures in the vicinity of the proposed blasting and establish and record together with the owners thereof the extent of cracking or damage that may exist before commencement of blasting operations. The Contractor shall produce a photographic record of neighbouring structures before blasting commences. The Contractor shall establish which structures may be affected and the Engineer shall have the right to add structures as he sees fit however, this will not relieve the Contractor of any responsibility with regard to making good blast damage, whether the structure was recorded or not. It shall be the responsibility of the Contractor to make good at his own expense any further damage to such houses, buildings or structures which is a result of the blasting.

(f) Where there is reasonable danger of damage to power and telephone lines or any other property, the Contractor shall suitably adapt his methods of blasting and the size of the charges and use adequate protective measures such as cover blasting in order to limit the risk of damage as far as possible.

(g) When blasting to specified profiles, the Contractor shall so arrange the holes and charges such that the resulting exposed surfaces are as sound as the nature of the material permits. The Contractor shall make good at his own expense any additional excavation necessitated by the shattering of rock in excess of any over break allowance specified in the Specification Data or in any other specification or given on a drawing.

PSD 5.1.1.3c) Limitations for Blasting

a) Approval of methods and keeping of records

No blasting work may be carried out prior to the Engineer's approval being given in writing

Prior to starting any drilling for the first section of blasting, the Contractor shall submit for approval to the Engineer, details of the proposed overall methods of blasting that will be used on site, including spacing, depth and pattern of holes, charging levels (kg/m^3), spacing and positioning of relays, method of blast initiation, precautions to prevent 'fly rock', maximum charge per relay, traffic arrangements during blasting, and any other details he may consider relevant. These details shall be submitted in writing and supported with sketches at least 7 days before the commencement of drilling and blasting.

The Engineer will evaluate these details in relation to the given limitations and prior to giving his approval, will indicated to the Contractor any changes that may possibly be needed to comply with the limitations.

For all subsequent blasts, the Contractor shall, at least 24 hours beforehand, notify the Engineer of the intention to blast and at the same time shall note if any changes will be made relative to the approved method.

The Engineer reserves the right to order the Contractor to modify his method of drilling and blasting, or to employ reduced blasting, without thereby invalidating the Contract. The Contractor shall have no claim for extra payment, over and above his tendered rates, due to his being ordered to use such a different method of drilling or blasting or reduced charges, regardless of any prior approval by the Engineer of any previous method.

After every blast, the Contractor shall, within 24 hours, submit to the Engineer details of the actual total mass of explosives used, the approximate volume of material loosened and the maximum simultaneous mass of explosives detonated (maximum charge per relay).

Notwithstanding any approval given by the Engineer, the Contractor shall at all times be responsible for the safety of the Works, persons, animals and property in the vicinity of the Site during blasting operations.

b) Vibrations

Blasting vibrations are caused by the transmission of the shock wave from the explosion charge through the material being blasted. This shock wave could cause damage to structures in the vicinity of the blasting if the vibrations are not limited to acceptable levels. Damage to structures is closely associated with peak particle velocity of the ground vibrations in the vicinity of the structure. Advisable maximum levels for peak particle velocity are given in Table 2.

Table 2 - Maximum Particle Velocities (Vibration)

Maximum peak particle velocity (mm/s)	Effect on people and buildings
0,5	Threshold of human perception unlikely to cause damage of any type
5	Limit for blasting adjacent to historical monuments
25	Limit for blasting near private dwellings in order to reduce disturbance to residents to a minimum
50	Limit for blasting adjacent to residential structures on good foundations
84	Limit for property owned by concern doing the blasting (ie. minor plaster cracks acceptable)
120	Recommended maximum level for blasting adjacent to sturdy reinforced concrete structures

The peak particle velocity V is related to the distance D from the blast and the maximum mass of explosive E instantaneously detonated (maximum charge per relay) by the general equation:

$$V = \left(\frac{k}{D}\right)^{m} xE^{n}$$

where k, m and n are constants for a particular set of circumstances. V is in mm/s, D is in metres and E is in kilograms. Experimentation has shown that n = 0,5 but k and m have to be determined for each site by means of vibration measurements. However blasting can be safely conducted without vibration measurements or expert advice if the following relationship is used:

$$V = \left(\frac{1150}{D}\right) xE^{0.5}$$

Which gives the maximum charge levels for V = 50 mm/s listed in Table 3.

Table 3 - Maximum Charge Levels

Minimum distance from nearest blast hole structure (m)	Maximum charge mass per relay (kg)
10	0,19
20	0,76
30	1,7
40	3,0

50	4,7
60	6,8
70	9,3
80	12,1
90	15,3
100	18,9

Only detonating relays of at least 20 milliseconds delay interval shall be used.

The above relationship can be used to calculate charge mass for other velocity limits. However, if higher charge levels have to be used for practical reasons, expert advice and possibly vibration measurements will be required.

Notwithstanding the above blasting limits, the Contractor shall at all times be responsible for the safety of the Works, person, animals and property in the vicinity of the Site during blasting operations.

PSD 5.1.1.3d) Negligence

The Contractor shall be liable for all damages to services caused as a result of the Contractor's negligence.

PSD 5.1.4.1 Dust nuisance

Add the following to this Clause:

The Contractor shall be responsible for actively implementing effective dust control measures such that dust levels do not hamper workers' health and productivity.

The Contractor shall plan his execution of the Works accordingly and shall use sufficient water (with or without approved additives) or other methods to keep the level of dust to a reasonable minimum. Water for this purpose may be abstracted from the nearby dam. This shall be done in consultation with the Engineer and to the Engineer's approval. The cost of all such mitigation measures shall be deemed to be included in the scheduled rates for excavation or Preliminary & General items.

PSD 5.1.6 Road Traffic Control

In the 4th line of Sub-Clause 5.1.6 amend "South African road traffic signs manual1)" to read:
"Southern African Development Community: Road Traffic Signs Manual1) and Chapter 13: [Road works Signing] of the South African Road Traffic Signs Manual1) ", and amend the footnote to read:

"1) Published by the Department of Transport, Pretoria."

Where traffic signals are required, they shall be provided and operated in accordance with the applicable requirements of the South African Road Traffic Signs Manual.

Where work is to be carried out while half of the roadway is closed to traffic, flagmen shall be provided and temporary road signs shall be erected, maintained and operated."

Methods and Procedures

PSD 5.2.2 Excavation

PSD 5.2.2.2 Borrow Pits

Add the following:

"A commercial source shall, for the purposes of this Specification, mean a source of material provided by the Contractor, not the Employer.

Where it is specified that material shall be obtained from commercial sources, the Contractor shall be responsible and include in his price for fill from commercial sources, for finding a source of suitable material, for making all arrangements for procuring the material with the owner of the source, for the payment of any royalties, charges or damages and for transporting the material to the site regardless of the distance involved.

No payment will be made for the removal of overburden or stockpiling at the commercial source and no extra over payment for excavating in intermediate, hard or boulder material shall apply.

Commercial sources shall not be used for any materials without the written approval of the Engineer."

PSD 5.2.2.3 Disposal

Add the following:

"The Contractor shall make his own arrangements for the disposal of excess or unsuitable materials. The disposal / spoil site shall meet with the approval of the Local Authority within whose area it falls, and the spoiling shall comply with the statutory and municipal regulations. The cost of all loading, hauling, dumping, spreading, compacting and any other costs or charges will be deemed to be included in the rates tendered for spoiling of material."

PSD 5.2.4 Finishing

PSD 5.2.4.3 Grass or other Vegetation

Replace existing clause with the following:

Where grassing is scheduled grassing be done after top soiling and shall be carried out at the earliest convenient stage of the construction and shall be arranged to suit the seasonal weather conditions. Fertiliser shall be supplied by the Contractor. Grassing shall be done using one of the following methods:

(a) Planting Grass cuttings - The areas to be Grassed by means of Grass cutting shall, unless already moist, be thoroughly watered before cuttings are planted to ensure that the soil will be uniformly moist to a depth of at least 150 mm when the planting is done. This method shall only be used on flat areas, such as sidewalks and platforms. An approved variety of Grass cuttings shall be evenly planted by hand or mechanically at a rate of at least 600 kg of cuttings per hectare and shall be covered with 30 mm of approved soil. Fresh cuttings only shall be used but not any Grass cuttings that have been allowed to dry out. Immediately after having been planted, the Grass cuttings shall be given a copious watering, and, when sufficiently dry, shall be rolled with a light agricultural roller.

(b) Sodding - Areas to be Grassed by sodding shall be given a layer of topsoil of at least 50 mm in thickness unless, where suitable soil is present, the Engineer orders the topsoil to be omitted. The areas to be sodded shall be thoroughly watered beforehand so that it will be moist to a depth of at least 150 mm during sodding. The surface shall be roughened slightly to ensure a good penetration of roots into the soil. Sods shall be protected against drying out and kept moist from the time of harvesting until they are finally placed. The handling of the sods shall not result in the sods losing their prescribed soil thickness. The first row of sods shall, where possible, be laid in a straight line, and if on a slope, laying the sods shall start at the bottom of the slope. The sods shall be butted tightly against each other, and care shall be taken not to stretch or overlap the sods. Where a good fit cannot be obtained, any intervening spaces shall be filled with topsoil. The next row shall be similarly placed tightly against the bottom row with staggered joints, and so on until the entire area has been covered with sods. Sods shall be laid in such a way that unnecessary trampling over areas previously laid is prevented. To this end, a diagonal method of laying sods is preferred, moving up the slope and behind previously laid sods. On steep slopes and batters the sods shall be held in position by a sufficient number of wooden stakes approximately 300 mm long by 20 mm in thickness and these stakes shall be knocked in to a depth of 100 mm into the subsoil. Sods laid adjacent to concrete side drains and concrete kerbs shall be laid in such a manner that the sodding will be 20 mm higher than the concrete. When stripsodding is required, the sods shall be laid in such a manner that the sods are proud of the surrounding Ground level. During stripsodding the areas in between shall be planted as specified in item B5.2.4.3(b) above. Stripsodding shall at all times be staked as specified above. As sodding is completed each section shall be lightly rolled or firmly pressed to ensure a proper bond with the underlying material, and thoroughly watered afterwards.

(c) Seeding - The soil to which the seeds are to be applied should be in a firm condition, but not so firm or compacted so as to inhibit infiltration. Loose soils may require light rolling. If the surface is compacted to the point where infiltration is inhibited, the top 100-150mm should be harrowed or tilled before rolling. The intent is to accommodate seeding to a proper depth and to provide sufficient infiltration of precipitation for soil storage of moisture and to decrease runoff and erosion. On slopes, harrowing along contours should be done to slow runoff and promote infiltration. Depth of harrowing or tilling should be determined by depth of topsoil applied and should be set to minimize intermixing of this topsoil layer and the underlying subsoil or spoil material. Seeds must be placed at the appropriate depth in the soil to optimize germination. In general, seeds should be placed 6-12mm into the soil. There are several acceptable methods to accomplish efficient seeding on disturbed sites.

1) Drill Seeding: Drill seeding is normally considered to be the most efficient and effective seeding procedure. Seed should be drilled to a depth of 6-12mm. Drill seeding is very effective and economic on large relatively flat areas (up to 3:1 slope). Drilling depths should be determined by recommended depths for the species selected for the project mix.

2) Hand/Mechanical Broadcast Seeding: Hand or mechanical broadcast seeding can be very effective, with proper technique, and is more practical and economic for small or hard to reach areas. The seedbed is tilled or harrowed prior to seeding. After broadcasting the seed, the seedbed should be lightly harrowed or chain dragged to fully incorporate the seed with the soil. Seeding rates shall be double the recommended drill-seeding rate.

3) Hydro-seeding: Hydro-seeding is an efficient means of applying seed to steep areas (>3:1). This method has the disadvantage of a less effective means of achieving proper soil to seed contact. The operation should be done as a separate operation from hydro-mulching, although it is accept able to add a small amount of mulch in the seed slurry to bind to the soil and allow visible evidence of covered areas. Seeding rates should be double the recommended drill-seeding rate.

For grassing (seeding) of large areas a mix of species will be used (minimum 5-6), rather than just one, for the following reasons:

- To ensure that at least some of the species take and are successful, as there is always a proportion of germination failure;
- To mirror natural succession processes (whereby a variety of pioneer grasses colonise disturbed soil and are later replaced naturally by grass species representing a more stable environment);
- To provide diversity in the rehabilitation process rather than a monoculture (with implied ecological ‘stability’ in variety);
- To provide a blend of different physical grass types for maximum soil stability (i.e. annual, perennial, tufted, rhizomatous, etc. – analogous to using a bolts, nails, screws etc. than just nails);
- To minimize colonisation by aliens and other undesirable plants.

The contractor is also to ensure that the mix of seeds or type of grass used is compatible with the local environmental habitats. For this reason, the following guideline types of grass seed should be use in their respective habitats:

1. KZN Coastal areas (warm, moist coastal) (Minimum mix should include: Digitaria eriantha, Sporobolus africanus, Eragrostis ciliaris, Chloris virgata, Dactyloctenium austral)

Digitaria eriantha (many cultivars available)
Setaria spacelata var. sericea
Sporobolus africanus
Eragrostis ciliaris
Ehrharta erecta var. erecta & var. natalensis
Eragrostis racemosa
Loudetia simplex
Eragrotis gummiflua
Panicum schinzii
Eragrostis cilianensis
Eragrostis heteromera
Panicum maximum
Pogonarthria squarrosa
Digitaria velutina

Eleusine coracana
Bothriochloa insculpta
Digitaria ternata
Cynodon dactylon
Chloris virgata
Chloris pycnothrix
Dactyloctenium australe
Urochloa panicoides
Urochloa mossambicensis

2. KZN Midlands & Escarpment (moist, higher country) (Minimum mix should include: Digitaria eriantha, Eragrostis curvula/chloromelas, Setaria pallide-fusca, Melinis repens, Sporobolus africanus)

Themeda triandra
Hyparrhenia cymbaria
Digitaria eriantha
Eragrostis curvula/chloromelas
Tragus koelerioides
Setaria spacelata var. sericea
Setaria pallide-fusca
Sporobolus africanus
Aristida junciformis subsp. junciformis
Eragrostis racemosa
Cynodon dactylon
Melinis repens
Eragrostis pseudosclerantha
Eragrostis plana
Chloris virgata

3. KZN Bushveld & Dry coastal (e.g. drier inland river valleys & the Zululand coastal plain, + rain-shadow areas nearer coast) (Minimum mix should include: Tragus berteronianus, Cenchrus ciliaris, Setaria spacelata var. torta, Eragrostis cilianensis, Dactyloctenium giganteum, Eleusine coracana)

Andropogon gayanus
Tragus koelerioides
Tragus berteronianus
Cenchrus ciliaris
Setaria spacelata var. torta
Sporobolus africanus
Ehrharta calycina
Loudetia simplex
Cynodon dactylon
Eragrotis gummiflua
Eragrostis cilianensis
Brachiaria deflexa
Sporobolus nitens
Setaria sagittifolia
Pogonarthria squarrosa
Dinebra retroflexa
Eleusine coracana
Bothriochloa insculpta
Bothriochloa radicans
Cynodon dactylon
Dactyloctenium giganteum
Urochloa mossambicensis

4. Wet sites (wetlands, river banks, pans etc.) (Minimum mix should include: Hemarthria altissima,Cynodon dactylon, Paspalum scrobiculatum, Imperata cylindrica, Panicum coloratum but this mix can be varied to include species better suited to lower altitudes when needed, and to heavy clay when needed).

Hemarthria altissima (all altitudes)

Pennisetum thunbergii (higher altitudes)
Pennisetum sphacelatum (higher altitudes)
Setaria spacelata var. sericea (higher altitudes)
Setaria incrassata (all altitudes)
Imperata cylindrica (all altitudes)
Sporobolus africanus (all altitudes)
Eragrostis capensis (all altitudes)
Panicum maximum (all altitudes except very high and cold)
Sporobolus fimbriatus (all altitudes)
Panicum schinzii (all altitudes)
Eragrostis inamoena (warmer, lower-lying areas)
Eragrostis heteromera (warmer, lower-lying areas)
Sorghum bicolor (warmer, lower-lying areas)
Panicum coloratum (cultivars such as Bambatsi, Bushman Mine, Pollock and Burnett – espec good for heavy clay soils; all altitudes)
Panicum repens (sandy soils; lower warm altitudes)
Bothriochloa bladhii (lower altitudes; suitable for clay)
Agrostis lachnantha (all altitudes)
Leersia hexandra (all altitudes)
Miscanthus capensis (all altitudes)
Eriochloa meyeriana (coastal and wet Bushveld)
Diplachne fusca (all altitudes)
Arundinella nepalensis (all altitudes)
Echinochloa colona (all altitudes)
Echinochloa pyramidalis (lower altitudes)
Ischaemum fasciculatum (all altitudes, but espec lower)
Digitaria eriantha (all altitudes)
Andropogon appendiculatus (all altitudes)
Cynodon dactylon (all altitudes)
Chloris virgata (all altitudes)
Paspalum scrobiculatum (all altitudes)
Urochloa panicoides (all altitudes)

5. Forested areas (for where forest has been broken into by construction. Note that the ideal is to plant grass + some naturally occurring shrubs/tree/pioneer herbaceous plants to 'heal' the breach so that the forest does not dry out inside and disintegrate further, or aliens establish themselves in the forest. Ideally forests should be treated on a case-by-case basis with specific rehab. specs based on the local conditions and the local natural forest species composition – generalisations will be largely ineffective. Forests grass species are few and often don't form very thick or extensive cover).

Setaria megaphylla
Ehrharta erecta var. erecta & var. natalensis
Miscanthus capensis
Urochloa mossambicensis
Oplismenus hirtellus

d) Maintenance of Grassed areas - Maintenance shall include weekly watering, weeding as and when required, weekly mowing, refertilisation where necessary, reGrassing of areas that, in the opinion of the Engineer, are unsatisfactory, and any other work that is necessary to achieve full, healthy and weed-free Grass cover to banks and plateaux before the end of the defects liability period.

Mowing shall be undertaken with an approved power mower. All established Grass cover shall be cut to a height of 25 mm above Ground level. Mowing shall be undertaken initially with the mower set to cut 50 mm above Ground level, the height of cut being reduced to 25 mm when adequate cover has been achieved."

PSD 5.2.5 Transport of Earthworks

PSD 5.2.5.1 Freehaul

Delete the contents of sub-clause 5.2.5.1(b) and replace with "All movement of materials from commercial sources, borrow pits selected by the contractor, cut, fill and spoil materials will be regarded as freehaul."

PSD 5.2.5.2 Overhaul

Delete the contents of sub-clause 5.2.5.2 and replace with "No overhaul shall apply."

PSD 7 TESTING

PSD 7.2 Taking and testing of samples

Replace the contents of the sub-clause with the following:

The Contractor shall carry out sufficient process control checks on the compaction of all fill and backfill layers in the presence of the Engineer's Representative to be able to demonstrate that the specified compaction is being achieved. The frequency of testing shall be such that tests shall be carried out for every lift of backfill material starting from 300 mm. The costs of testing shall be deemed to be included in the rates for backfilling of the platform.

PSD 8 MEASUREMENT AND PAYMENT

PSD 8.1 BASIC PRINCIPALS

Add the following Sub-clauses:

PSD 8.1.4 Restricted excavation: Provision for working space and access ramps

The tendered rates for provision of working space (see Sub-Clause 8.3.5) shall be deemed to include excavation and subsequent backfilling of any access ramps required and all measures required to render the sides of the excavation stable and the supply, installation, maintenance and removal of safety barricades.

PSD 8.1.5 Recording of original ground profiles

The tendered rate for excavation shall cover the cost of recording the original ground profiles, rock and/or foundation levels, as applicable prior to commencement of any excavation, including stripping of topsoil. This is required to allow the Engineer to check the Contractor's survey and adjust his design levels if necessary.

PSD 8.3 SCHEDULED ITEMS

PSD 8.3.14 Planting of Grass Cuttings by Hand ……. Unit : m²

The tendered rate shall include for all work, labour, materials, water etc to procure, transport and install as per the specification Grass cuttings, the work shall be measured by the area to be grassed.

PSD 8.3.15 Planting of Grass Cuttings by Machine ……. Unit : m²

The tendered rate shall include for all work, labour, materials, water etc to procure, transport and install as per the specification Grass cuttings, the work shall be measured by the area to be grassed.

PSD 8.3.16 Planting of Grass by Sodding ……. Unit : m²

The tendered rate shall include for all work, labour, materials, water etc to procure, transport and install as per the specification Grass sods, the work shall be measured by the area to be grassed. (Top soiling measured elsewhere)

PSD 8.3.17 Planting of Grass by Strip Sodding ……. Unit : m²

The tendered rate shall include for all work, labour, materials, water etc to procure, transport and install as per the specification Grass sods in strips, the work shall be measured by the area of grass strips installed.

PSD 8.3.18 Planting of Grass by …… Seeding ……. Unit : m²

The tendered rate shall include for all work, labour, materials, water etc to procure, transport and install as per the specification Grass seeding, the work shall be measured by the area of grass strips installed. The payment item will specify the type seeding to be used (Drill, hand or mechanical broadcast or hydro seeding.)

PSD 8.3.19 Maintenance of Grassed Areas …….…. Unit : Months

The tendered rate shall include for all work, labour, materials, water etc to maintain all areas grassed during the contract period, for a period of time after the issue of the Contract Completion Certificate. Including the costs of any regressing etc ordered by the Employers agent to achieve the required coverage.

PSDA 8.3.20 Survey and Protection of Surrounding Structures before Blasting
……..… Unit : included

The rate provided for Hard Rock excavation shall cover the cost to examine and measure up any buildings, houses or structures in the vicinity of any blasting and establish and record together with the owners thereof the extent of cracking or damage that may exist before commencement of blasting operations. The rate shall include the costs of reduced working width, and the costs of any special working methods required to protect the structure throughout the course of the nearby construction work. This shall include, where required, but is not necessarily limited to, the use of shoring or lateral trench support and the placing of barriers to demarcate restricted working area in the vicinity of the structure.
The photographic record of neighbouring structures etc shall be provided to the employers agent before blasting commences.

PSDB EARTHWORKS (PIPE TRENCHES) (SABS 1200DB)

PSDB 3 MATERIALS

PSDB 3.1 Classes of Excavation

Delete the contents of this clause and replace with the following:

"For this contract, the classes of excavation will be subdivided as follows:

(a) Labour Intensive Excavation

(i) Soft Excavation

Soft excavation shall be that excavation in material, which in the opinion of the Engineer, can be efficiently excavated and loaded by means of hand-held tools excluding pneumatic or hydraulic breaking tools. Soft excavation shall include all boulders with a volume of less than 0.125 m^3 and a maximum dimension of 500 mm, which can still be removed by hand methods.

(ii) Hard Excavation/Hard Rock

Hard excavation shall be excavation in material, which in the opinion of the Engineer, can only be removed efficiently with mechanical equipment such as jackhammers, drilling & blasting etc. Hard excavation shall also include boulders with a volume > 0.125 m^3 and the maximum dimension > 500 mm, which cannot be broken down and removed by hand methods.

(b) Machine Based Excavation

In cases where heavy excavation equipment is permitted, the classes of excavation will be subdivided as follows:

(c) Soft excavation

Soft excavation shall be excavation in all materials and boulders which in the opinion of the Engineer can be efficiently excavated and loaded by a 30t excavator fitted with 'rock bucket' (excavator bucket typically fitted with not more than 3 tines designed to loosen weak rock material).

(a) Hard Excavation / Hard Rock

Hard excavation shall be excavation in materials and boulders, which in the opinion of the Engineer, can only be removed efficiently with mechanical equipment larger than a 30t excavator, or with jackhammers, drilling & blasting, expanding grout etc.

PSDB 3.7 Selection

Replace the words "if he so wishes" in the first line of the second paragraph with the words "at his own cost".

PSDB 3.5(a) Backfill Material

In the third line delete "150 mm" and substitute "100 mm".

PSDB 3.5(b) Backfill Material

In the second line delete "PI not exceeding 12" and substitute "PI not exceeding 6".

PSDB 3.5(c) Cement Stabilised Backfill

Add the following new Sub-Clause:
Where scheduled, or directed by the Engineer, backfill shall be stabilised with 8% cement by mass. The backfill material shall have a plasticity index not exceeding 10 and all material must pass through a sieve of aperture size not exceeding that specified in SABS 1200 LB, Sub-Clause 3.2, as amended.

The dry materials shall first be mixed in a concrete mixer thereafter sufficient water is to be added to produce the stiffest consistency available for placing and compacting with vibrators.

PSDB 5 CONSTRUCTION

PSDB 5.4 Excavation

Add to the Subclause :

“Where a pipe is to be laid in a vertically-sided trench with temporary side support, it is necessary to ensure that the compacted bedding and backfill is hard up against the soil forming the trench side by withdrawing the temporary supports stage by stage as the backfill rises up the trench.

Where it is permitted for the pipe trench to cross surfaced roads (Generally paved road crossings will be effected by means of pipe or sleeve jacking), the Contractor shall neatly cut two parallel grooves into and through the "black top" before excavating between the grooves. The grooves are to be set back at least 200 mm from the edge of the excavation face to prevent raveling of the cut edge. The cost of this operation, where not scheduled separately, will be held to be covered in the general rates for excavation.

Add the following subclause:

PSDB 5.4.1 Determination of Method of Excavation:

Trenches for pipelines shall be excavated by either mechanical means or by hand, determined as follows:

Trial holes of minimum dimensions 1,0 x 1,0 m shall be excavated by hand along all pipeline routes at 50 m intervals ahead of the Contractor's program for trench excavation. The trial holes shall be to the depth required for the pipeline under consideration to a maximum depth of 1.5 m.

If material that cannot, in the opinion of the Engineer, be excavated by hand methods but can be machine excavated is encountered before the bottom of the trial hole, then excavation may be deemed to be carried out by mechanical means, the length of such excavation determined on the basis of other trial hole findings.

If hard rock material that can only be removed by blasting or using jackhammers is encountered before the bottom of the trial hole, then excavation may be deemed to be carried out by hand up to the level of the hard rock where after the excavation shall be completed by means of using blasting or jackhammers as appropriate. The length of such excavation determined on the basis of other trial hole findings.

If soft material only is encountered at such trial holes, then excavation may be deemed to be carried out by hand up to a maximum depth of 1,5m, the length of such excavation determined on the basis of other trial hole findings. Classification of excavated material shall be as per Clause PSDB 3.1.

PSDB 5.5 Trench Bottom

Add to the subclause :

Where pipes are laid in waterlogged conditions and/or where so instructed by the Engineer a 150mm thick layer of imported single sized stone (19mm size unless otherwise instructed by the Engineer) with a geofabric filter surround (“bidim” Grade A4 or similar approved) shall be constructed under the bedding layer specified for the pipes.”

Add the following subclause:

PSDB 5.5.1 Jointing Holes

Jointing holes shall be cut of sufficient length and depth to allow for the proper making, welding or bolting of pipe joints and to ensure that joint collars or sleeves do not rest on the trench bottoms. After the pipework has been inspected, tested and approved by the Engineer, the jointing holes shall be refilled with selected soft material free from stone and then rammed to provide a continuous uniform support for the pipework. No specific payment will be made for forming and refilling holes, the cost of which is deemed to be included in the tendered rates.”

PSDB 5.6 Backfilling

PSDB 5.6.1 General

Add the following:

"Notwithstanding the requirements of subclauses 5.6.1 and 5.6.6, no pipe joint or pipe filling shall be covered by either the bedding, blanket fill or the main fill prior to the successful completion of the visual inspection, and the pressure testing of the relevant section of the pipeline."

PSDB 5.6.4 Disposal of Intermediate and Hard Rock Material

Add the Following:

"The Contractor shall make his own arrangements for the disposal of excess intermediate and/or hard rock material. The disposal / spoil site shall meet with the approval of the Local Authority within whose area it falls, and the spoiling shall comply with the statutory and municipal regulations. The cost of all loading, hauling, dumping, spreading, compacting and any other costs or charges will be deemed to be included in the rates tendered for excavation."

PSDB 5.7 Compaction

PSDB 5.7.2 Areas subject to Traffic Loads

Add the following:

"All backfill to pipes under roads and in road reserves or future road reserves shall comply with the requirements of subclause 3.5(b) and shall be compacted in accordance with subclause 5.7.2."

PSDB 5.9 Re-Instatement of Surfaces

Add the following new subclauses:

"PSDB 5.9.7 Cultivated and Arable land

Where pipelines traverse cultivated and arable privately-owned or community land, the entire disturbed construction corridor (and any temporary construction access roads across such areas) shall be restored to their full cultivation potential; namely:

- The full original depths of the topsoil ('A' horizon) (applicable to full construction corridor) and subsoil ('B' horizon) (applicable where removed at site levelling and trench excavation stage) are replaced / reconstructed and lightly compacted to effectively match the natural undisturbed state of compaction. Where the 'B' horizon has not been excavated but has been subject to compaction by the construction activities, such compacted layers shall be scarified to the Employer's Agent's approval before replacing the topsoil over it.

PSDB 5.9.8 Cross Drainage Berms

Cross drainage berms are required along all steeply inclined pipeline routes at intervals to be determined by the Engineer, to minimize possible flood damage."

PSDB 8 MEASUREMENT AND PAYMENT

PSDB 8.3 Scheduled Items

PSDB 8.3.1 Site Clearance and Topsoil Removal

No separate payment shall be made for topsoil removal or replacement upon completion along pipeline routes. See clause PSC 8.1.

PSDB 8.3.2 Excavation

Add the following sub-item to Sub-Clause 8.3.2 a):

"(d) Excavate to expose and remove existing pipeline:
1) Excavate to within 300mm of pipe crown…… …….Unit : m³
2) Excavate by hand last 300mm of cover and expose and remove pipe…… …Unit : m
3) Prepare trench invert ready to receive new pipe…… ….Unit : m
4) Excavate in all materials to deepen existing trench……..Unit : m

Measurement for (d) 1) shall be by volume excavated. Rate to cover all items as per 8.3.2 (a), but shall also include all additional costs associated with taking care not to damage the pipe being excavated.

Measurement for (d) 2) shall be by length of pipe exposed and successfully removed. Pipes unnecessarily damaged in the recovery process (in the opinion of the Engineer) shall not be measured for payment. Rate to cover all costs associated with carefully removing the pipe, cleaning-off all soil and delivering the pipes to the Employer's yard and stacking same in secure, sound manner; including supply of wooden support batterns. Damaged or otherwise unsound pipes are to be disposed of at an approved dump site.

Measurement for (d) 3) shall be by length of trench. Rate to cover cost of preparation of trench invert after removal of old pipe, ready to lay new pipe.

Measurement for (d) 4) shall be by length of trench excavation in all materials were necessary to deepen the trench to required depth after removal of old pipe (separate scheduled items in 1m depth increments measured from ground level). Rates to cover all items as per 8.3.2 (a); including cost of preparation of trench invert after removal of old pipe, ready to lay new pipe. Extra-over items for volumes of hard rock excavated shall be scheduled."

Add the following 'extra-over' sub-items to Sub-Clause 8.3.2.(b):

(3)	Hand excavation and backfill where ordered by the Engineer	…..… Unit : m³
(4)	Backfill stabilised with 8 % cement where directed by the Engineer	…..… Unit : m³
(5)	Working in confined area (area identified)	…..… Unit : Sum
(6)	Dealing with local residents	…..… Unit : Sum
(7)	Working next to (identified) structures	…..… Unit : Sum

The tendered rates for (4) above shall include full compensation for selecting, mixing, backfilling and compacting of the stabilised material to 90% of modified AASHTO density.

The rate tendered for Extra Over item (5) shall cover all additional costs associated with having to deal with local working-space factors hampering pipe trench excavation; including pipe laying, bedding and backfill.

The rate tendered for Extra Over item (6) shall cover all additional costs associated with liaison and dealing with local resdients in the specified area over the full period of construction.

The rate tendered for Extra Over item (7) shall cover all additional costs associated with having to deal with and providing temporary support to identified structures (such as street light poles) where trenching and pipe laying operations are endangering the stability of same.

PSDB 8.3.3.4 Overhaul

No measurement for payment of overhaul will be made. All distances are Freehaul.
Add the following new item:

PSDB 8.3.8 Cultivated and Arable land ……..… Unit : Ha

Where extra measures are required to restore cultivated and arable land to its original cultivation potential (as described in PSDB 5.9.7), an extra-over item for the full width of the construction servitude will be measured for payment. The tendered rate shall cover all additional costs associated with taking extra care to remove, stockpile and maintain and conserve the topsoil ('A' horizon) and subsoil ('B' horizon) material and reinstate said layers to the Employer's Agent's satisfaction.

Failure to satisfactorily restore 100% of all such layers as specified in PSDB5.9.7 (including, in the opinion of the Employer's Agent, unnecessary loss / mixing / contamination of the respective layers with other, unsuitable, material), will preclude the Contractor from achieving Practical Completion until such time as the Contractor has, at his own cost, made good the deficiency (including satisfactorily disposing of any contaminated material and importing approved similar topsoil and subsoil to replace unnecessarily lost material where necessary).

PSDB 8.3.9 Cross Drainage Berms ……. Unit : Sum

The tendered rate shall include all material, labour, and plant for the construction of cross drainage berms. A cross drainage berm shall be 300 mm high, 800 mm wide. The berms shall be constructed of selected excavated material compacted to 90 % MOD AASHTO or to the approval by the engineer, with no stones or rocks exceeding 100 mm diameter in the largest dimension. Cross drainage berms shall be placed at all steeply inclined pipeline sections at intervals to be determined by the Engineer."

PSDK GABIONS AND PITCHING (SABS 1200 DK)

PSDK 3 MATERIALS

PSDK 3.1.2 Gabion Cages

Add to the Sub-Clause:

The wire used for the fabrication of wire mesh cages and for lacing and bracing operations shall be zinc-coated mild steel wire with PVC coating. The lacing wire will be of the same or larger diameter of that used to manufacture the cage frames.

PSDK 3.1.2 Gabions

Replace Clause 3.1.2 with the following:

Gabion boxes shall consist of double twisted, hexagonal wire mesh of nominal 80 mm mesh, with 4.4 mm o/d frame wire and 2.7 mm o/d mesh wire. Complete with partitions at 1 m centres. All wire to be mild steel to SANS 1580 – 2010, zinc coated by hot-dip galvanizing to SANS 675 – 2009.

Mattresses shall consist of double twisted, hexagonal wire mesh of nominal 80 mm mesh, with 4.4 mm o/d frame and 2.7 mm o/d mesh wire. Complete with partitions at 1 m centres. All wire to be mild steel to SANS 1580 – 2010, zinc coated by hot dip galvanizing to SANS 675 – 2011.

PSDK 3.1.3 Geotextile

Add to the Sub-Clause:

Geotextile filter fabric:

Where the Engineer has authorised the use of geotextile filter fabric, this shall be measured by area as: width x nett length, where the width shall be the full or half-width supplied by the manufacturer which conforms closest to the specified of plus 2 x base width plus 200mm. The tendered rate shall include the cost of supply, placing and losses as a result of overlaps and over excavated trench widths.

Geotextile to conform to the following minimum specifications:

Material:	Nonwoven, needle punched, Continuous Filament, Polyester Geotextile (minimum)
Tensile Strength:	14 kN/m (minimum)
UV Stability:	70% strength retained after 1000 hours
Permeability @ 50mm head:	3.6 m/sx10^{-3}

The material shall be placed as directed and shall not be exposed to direct sunlight for prolonged periods.

PSDK 3.2 Pitching

PSDK 3.2.1 Stone

Amend the Sub-Clause as follows:

In Table 2, Column 2, for extra heavy, replace 300 with 500.

PSDK 3.2.3 Wire netting

Add to the Sub-Clause:

Wire netting for gabion and mattress cages shall be hexagonal steel wire mesh strengthened by selvedges of heavier wire and by mesh diaphragms that divide the cases into 1 m compartments.

Nominal 80 mm mesh shall be used for gabion cages with 2.7 (Refer to PSDK 3.1.2) mm diameter galvanised steel wires.

Nominal 80 mm mesh shall be used for mattress cages with 2.7 (refer to PSDK 3.1.2) mm diameter galvanised steel wires.

Selvedge wire shall be galvanised and the diameter shall be a minimum of 4mm.

PSDK 5 CONSTRUCTION

Add new Sub-Clause:

PSDK 5.1.3 Diaphragms

Each diaphragm shall be connected in the same manner to the sides and top panels in addition to the bottom panel.

PSDK 5.2.3 Assembly

Add to the Sub-Clause:

All gabion and mattress cages shall be connected to adjacent gabion and/or mattress cages by lacing the adjacent selvedges together with 2.0 mm dia. galvanised steel wire. The lacing shall be in accordance with Sub-Clause 5.1.2.

PSDK 5.2.4 Rockfilling

Add to the Sub-Clause:

Particular care shall be taken in the filling gabions and mattresses so as to ensure that the voids in the rockfill are reduced to the minimum that can be reasonably achieved. In order to minimise the voids in the rockfilling, the filling shall proceed in layers not exceeding 300 mm deep and each layer shall be rodded and barred so as to compact the rockfill before filling of the next layer commences. Where appropriate, hand packing of selected rock particles shall be carried out.

PSDK 5.2.4.2 Mattresses used in revetments and aprons

Add to the Sub-clause:

Where gabions and mattresses are placed in exposed positions the rock particles forming the exposed faces shall be specially selected so as to present a fair and even surface.

PSDK 5.3.4 Wired Pitching

Add to the Sub-Clause:

The areas in which wired or grouted wire pitching are to be used will be indicated on site by the Engineer.

PSDM EARTHWORKS (ROADS, SUBGRADE) (SABS 1200 DM)

PSDM 3 MATERIALS

PSDM 3.1 Classification for excavations purposes

Delete the clause and replace with the following:

The classification of material for excavation shall be as specified in Project Specification Clause PSD 3.1.2.

PSDM 3.2.3 Selected Layer

Add the following:

The Contractor shall obtain selected subgrade material from the existing stockpile on site.

PSDM 5 CONSTRUCTION

PSDM 5.2.3.3a) Preparation and compaction of road bed

Substitute the first paragraph with the following:

The roadbed shall be scarified to a depth of 150 mm, watered, shaped and compacted to 93 % of AASHTO density (100 % for sand), except where otherwise ordered by the Engineer.

PSDM 7 TESTING

PSDM 7.3.2 Routine inspection testing

Replace the contents of this sub-clause with the following:

No density shall be less than the specified minimum density for the relevant layer.

The cost of additional testing ordered by the Engineer, and of which the results do not comply with the specified minimum requirement for the material, shall be borne by the Contractor and will be subtracted from the monthly payment certificates.

PSDM 8 MEASUREMENT AND PAYMENT

PSDM 8.3.4 Cut to fill, borrow to fill

Add the following to the contents of this sub-clause:

If scheduled otherwise, classification and payment for excavation in soft / intermediate and hard material shall be as per PSD8 items.

PSG CONCRETE (STRUCTURAL) (SABS 1200 G)

PSG 2 INTERPRETATIONS

PSG 2.4.2 Strength concrete

Add the following to Clause 2.4.2:

With the exception of mixes weaker than 15 MPa, all concrete for the Works shall be considered to be strength concrete, with reference to the table below:

ELEMENT	28 DAY STRENGTH (MPa)	EXPOSURE CONDITION	COVER (mm)
BLINDING, MASS CONCRETE, SCREED	15	SEVERE	N/A
INTERNAL SURFACE BEDS	30	MODERATE	40
FISHWAY BENCHING MASS CONCRETE	25	SEVERE	N/A
RC FOUNDATIONS	35	SEVERE	50
(INTERNAL) RC COLUMNS	35	MODERATE	40
(INTERNAL) RC SLABS	35	MODERATE	40
(INTERNAL) RC BEAMS	35	MODERATE	40
WALLS	35	SEVERE	50
(EXPOSED) RC COLUMNS	35	SEVERE	50
(EXPOSED) RC SLABS	35	SEVERE	50
(EXPOSED) RC BEAMS	35	SEVERE	50

To ensure uniformity of colour of the formed surfaces of all concrete which will be visible on the exterior of the structures, the cements shall be supplied by a single cement factory. Tenderers are to make allowance for this in concrete rates.

PSG 3 MATERIALS

PSG 3.2 Cement

Add the following to Clause 3.2:

With the exception of non-structural concrete, all binders used in the works shall be either an approved blend of CEM II/A 52,5N and PFA, or CEM III/A 42,5N. Cement type CEM II 32,5N may be used for non-structural concrete. In all cases the cements shall comply with SANS 50197-1.

PSG 3.2.3 Storage

Add the following to Clause 3.2.3:

Cement shall be used in the order in which it is received (first in, first out basis)

Cement kept in storage for longer than 6 weeks shall be removed from site and not used in the Works.

Any cement that shows signs of hydration, such as the formation of lumps, may not be used and is to be immediately removed from site.

"Cement and PFA shall be stored in a closed structure or container and shall not be kept in storage for longer than two months without the Engineer's permission."

PSG 3.3 WATER

Replace the contents of Clause 3.3 with the following:

Only potable quality water from an approved source may be used for mixing concrete. Water from a river or stream may only be used for curing.

PSG 3.4 AGGREGATES

PSG 3.4.1 Applicable Specification

Add the following to Clause 3.4.1:

The maximum aggregate size shall be 26mm. The nominal stone size specified in the concrete grade shall mean stone conforming to SABS 1083 for the nearest equivalent size.

Any aggregate may be used provided the free sodium alkali content in the concrete mix does not cause an alkali-aggregate reaction.

Coarse aggregate may be obtained from the nearest available commercial sources, and shall be subject to the Engineer's approval.

Flakiness index of coarse aggregates when tested in accordance with SANS 5847 shall not exceed 35.

Soundness to be tested in accordance with ASTMC33 and C88 (SANS 5839) coarse aggregates shall not show a loss in mass of more than 18% and fine aggregates not more than 15% after 5 cycles using magnesium sulphate.

Shrinkage shall be determined in accordance with SANS 5836. The upper limits of shrinkage shall be:
Fine aggregate : 150% of the shrinkage of the reference aggregate
Coarse aggregate : 150% of the shrinkage of the reference aggregate
The reference aggregate shall be defined by the *Engineer*.
The volume of water required to mould the sample in accordance with SANS 5836 shall be reported with the above results.

Fine aggregate may be obtained from local sources subject to testing of its suitability by an approved laboratory and approval by the Engineer.

Aggregates shall be tested periodically for reactivity, and shrinkage, the costs of which shall be deemed included in the rate tendered for concrete. A trial design mix will have is to be prepared and the results submitted to the Engineer for approval before construction begins.

At least one month before commencement of concrete work the Contractor shall supply at his own cost representative samples to the Engineer of the aggregates he intends using, together with certificates from an approved laboratory indicating that the aggregates comply with the specifications. Approximately 50 kg of each sample of aggregate shall be supplied.

After approval, these samples shall be taken as standard for the agreed aggregates to be used in the Works. If at any time during the course of the Contract the Engineer considers that there has been any deviation from the approved standard the Contractor shall submit further tested samples of material to the Engineer for approval.

PSG 3.5 ADMIXTURES

Add the following Clause PSG 3.5.3:

PSG 3.5.3 Concrete using reactive aggregates

The Contractor shall provide the Engineer with sufficient data to enable him to assess the degree of alkali-aggregate reactivity of the aggregates to be used for the concrete.

Where reactive aggregates and other quarzitic aggregates are used for concrete, the Contractor shall, in order to ensure that the concrete is not subject to alkali-aggregate reaction, design his mixes and/or use cement with a sufficiently low alkali content such that the total equivalent sodium oxide content of the concrete is less than 1.8kg/m3.

(NOTE: The equivalent sodium oxide content (alkali content) is measured as (Na2O + 0.658 K2O). For cement it is expressed as a percentage by mass, for concrete is it expressed in kg/m3).

In the case of other aggregates that are less reactive, the Engineer will determine the type and degree of precautionary measures to be adopted.

For each delivery of cement or precast concrete units the Contractor shall provide acceptable written evidence that the requirements of this clause are being met.

PSG 3.6 REINFORCEMENT

Mild steel shall be in accordance with SABS 920 – Type A 250 MPa yield and high yield stress steel according to SABS 920 – Type C, Class 2, Grade 1, 450 MPa yield.

Add the following Clauses PSG 3.9 – 3.12:

PSG 3.9 MATERIALS FOR MOVEMENT JOINTS

PSG 3.9.1 General

The various jointing materials, the manufacturers of the materials and the methods of application shall be as approved by the Engineer. Materials shall be stored and protected to avoid damage, degradation, distortion or contamination.

The joint materials shall be resistant to ultraviolet light and to biological degradation.

PSG 3.11.2 Waterstops

Waterstops shall be of approved manufacture and of the pattern and the material and widths scheduled and specified and shown on the drawings. They shall comply with the tolerances specified in clause 6.1 of SABS 1200GThe waterstops shall conform to the Specifications as set out in CKS 388 for Rubber Waterstops and shall have the appropriate physical properties as set out below:

Form	Black Rubber
Hydrostatic Head	Up to 50m
Tensile strength	>20.7 MPa
Elongation at break	500%
Hardness BS degrees (IRHD)	62 to 72°

All intersections between waterstops shall be pre-fabricated in the factory in accordance with the manufacturer's instructions and to approval of the Engineer. Only straight lengths of waterstop may be field-welded using the appropriate jigs and tools.

Where required, waterstops shall have eyelets so that they may be tied securely to the adjacent reinforcement. Waterstops shall be centre bulb unless specified otherwise elsewhere.

PSG 3.9.3 Joint Formers

Closed cell expanded polyethylene joint formers shall have the following typical properties:

Nominal Density	90 - 110 kg/m3
Compression set after 24 hours recovery	14 %

Tensile Strength	Minimum 680 kPa
Elongation at Break	98 %
Max. water absorption after 24 hours by volume	0,1%

Joint formers shall be pre-cut to suit the application as per drawings with a tear-out strip for forming the specified recess for the sealant. The joint formers shall be developed for use in applications with a head of water of at least 10m. If so required the filler shall be glued into position with approved epoxy glue.

Joint formers will be used for expansion joints in the walls and roof and as indicated on the drawings.

Joint formers will also be used where the perimeter walls are cast up to the beams and shall have a thickness of 12 mm. Where this is the case, the joint formers will be cut out to a depth of 12 mm to allow a cavity for the application of an approved 12 mm x 12 mm UV resistant polyurethane sealant.

PSG 3.9.4 Bond Breakers, Primers and Sealants

The bond breaker (if specified) shall be self-adhesive PVC tape (or equal, approved material) with a width the same as the joint recess into which it is to be applied.

The primer, if required for the sealant, shall be fully compatible with the sealing compound that is to be used.

The elastomeric sealant shall be a one-component polyurethane liquid polymer base complying with the requirements of SABS 110. The polymer shall be pouring grade for horizontal or near horizontal joints and gun grade for vertical/overhead joints and joints steeper than 1 in 10 to the horizontal. Sealants shall have a movement tolerance of 25 %. Sealants shall have been tested to ensure that they are non-toxic and do not impart any odour or taste to, or otherwise taint, the water.

These sealants shall be suitable for indoor as well as outdoor applications and shall be UV resistant. The sealant shall be suitable for use at movements and connection joints in floors as well as for joints in contact with potable water.

Sealant samples shall be timeously submitted for testing upon the request of the Engineer.

Selected contraction and expansion joints will be waterproofed by an approved high performance tape/bandage placed over the joint as indicated on the drawings. This tape shall have a minimum thickness of 2 mm and dimensions as indicated on the drawings.

The tape shall be bonded to the concrete and covered with an approved epoxy-paste adhesive which is not sensitive to moisture.

This tape shall have the following typical properties:

- Suited for use in Potable water
- High water pressure resistance
- High Durability and chemical resistance
- UV- and weather resistant
- Root-Resistant
- Plasticizer free

PSG 3.10 WATERPROOFING SLURRY

An approved cementitious in-depth waterproofer shall be used on planned construction joints as indicated on the drawings. Surfaces shall be prepared and the product shall be applied as per the approved manufacturer's instructions.

The waterproofing slurry shall be suitable for use on concrete substrates and should be suitable for use in potable water structures.

The slurry shall have the following typical properties:

Appearance	Grey Powder
Workability at 20 °C	Approximately 30min
Setting time at 20 °C	1-2 hours

PSG 3.12 TORCH-ON WATERPROOFING

Waterproofing for the parapets of the roofs of both the utilities building and guard house shall be with a torch-on waterproofing system. Waterproofing shall be done according to the approved manufacturer's specifications.

PSG 3.17 POLYURETHANE COATING ON FLOORS AND WALLS

Epoxy flooring and walls shall be provided for the High Lift Pump Station Building. This flooring shall have be a heavy duty self-smoothing polyurethane screed such as Sikafloor -21N PurCem or similar approved. Covering for walls and bund walls shall be a similar approved product suitable for the application. The product shall be applied to a minimum thickness of 5 mm on designated concrete surfaces including bund walls, drainage channels, plinths and on the brick walls up to a height of at least 1500 mm as per Drawings. This screed shall have excellent resistance to chemicals and be able to resist a wide range of organic and inorganic acids, alkalis, amines, salts and solvents. The screed shall be odourless, shall have a high mechanical resistance and shall be easily maintained. The epoxy shall be colour coded for different areas of the utilities building as per the Drawings. The coating shall be jointless and shall have a bond strength in excess of the tensile strength of the concrete

PSG 4 PLANT

PSG 4.3 MIXING PLANT

PSG 4.3.1 General requirement for mixing plant

Add the following to Clause 4.3.1:

Stand-by mixers of adequate capacity and with an independent power unit shall be maintained on site for immediate use in the event of breakdown of the regular mixers failure of the power supply.

PSG 4.4 VIBRATORS

Add the following to Clause 4.4:

Stand-by vibrators of adequate capacity and with an independent power unit shall be maintained on site for immediate use in the event of breakdown of the regular vibrator failure of the power supply.

Vibrators for in-situ concrete shall be of the internal or immersion type.

PSG 4.5 FORMWORK

PSG 4.5.1 Design

Add the following to Clause 4.5.1:

Detailed drawings of the formwork shall be issued by the Contractor for its fabrication. All such design and drawings shall be available for inspection by the Engineer if so required.

The Contractor shall arrange for a Professional Engineer to design and sign the drawings for the formwork (including all supports) to be used for suspended slabs and roofs.

No formwork which is in the opinion of the Engineer major formwork shall be erected without the Engineer's prior written approval of the design and moving or handling arrangements. The Contractor's proposed design and drawings shall be submitted to the Engineer in ample time to permit examination without delay to the works, and in any event not less than three clear days before the date when the Contractor proposes to commence fabrication of

the formwork. The Engineer's approval for use shall not be deemed to relieve the Contractor of his responsibility for the adequacy of the formwork.

Where smooth or special formwork is required, only new or as-new steel shuttering shall be used. Where steel is definitely impractical, an alternative may be used but only as approved by the Engineer.

PSG 4.5.3 Ties

Add the following to Clause 4.5.3:

After removal of ties, all ferrules are to be drilled out of the concrete to provide an oversized reamed hole free of all remnants of the ferrule and blown out to remove all dust and other loose material.

The surface of the hole is to be primed by well wetting with a cement/SBR latex slurry and the hole filled by caulking with a cementitious mortar consisting of 1 part cement to 2 parts concrete sand by volume, well mixed with sufficient clean water to obtain the required consistency. This grout is to be well tamped into the hole to completely fill same and provide a dense, void-free plug. The surface is to be trowelled to finish flush with the surrounding area.

PSG 5 CONSTRUCTION

PSG 5.1 REINFORCING

PSG 5.1.2 Fixing

Add the following to Clause 5.1.2:

Fixing of reinforcing bars by welding and heating of bars will not be permitted.

Any bars which are severely rusted or with a cross-section which is, in the Engineer's opinion, reduced by rusting or other cause, shall be rejected and immediately removed from site,

Where clips, stools and other supports are not shown on the drawings and are structurally not required, the Contractor shall provide those supports he deems necessary to ensure the correct positioning of the reinforcement, to the satisfaction of the Engineer. The cost of such steel, labour, and other fixing materials shall be inclusive in the rate for the scheduled reinforcement and no additional payment shall be made.

PSG 5.2 FORMWORK

PSG 5.2.1 Classification of Finishes

Add the following to Clause 5.2.1:

Formwork panels or forms shall be free from surface markings. The form surface shall be so lined that it is free from nail, screw, rivet, weld or other marks. Special care shall be taken to avoid form oil, curing water or other stains on exposed surfaces. The forms shall not be re-used unless in perfect condition and capable, in the opinion of the Engineer, of producing exactly the same surface pattern texture and finish as the previous cast.

Rough formwork Degree of Accuracy III may be used on the outside faces where the concrete is more than 300 mm below the final ground level.

Smooth formwork Degree of Accuracy I will be used elsewhere unless specified otherwise.

All honeycombing shall be repaired by cutting back to sound concrete and patching with a suitable repair procedure to the approval of the Engineer.

PSG 5.2.2 Preparation of Formwork

Add the following to Clause 5.2.2:

All exposed external angles in concrete work shall have 20 mm x 20 mm chamfers unless otherwise specified or ordered, but the top edge of a slab that is to receive an applied finish shall not be chamfered.

Formwork shall be completely grout-tight under vibration.

PSG 5.2.5 Removal of Formwork

Add the following to Clause 5.2.5.2:

Where test cubes to determine stripping times are not made, the minimum periods, which shall elapse between the time of the placing of the concrete and the time of removal of the forms shall, unless otherwise agreed with the Engineer, be in accordance with the table hereunder, where each day covers a full 24 hour period. The following table 2 supersedes table 2 in SABS 1200 G.

Table 2: Removal of Formwork (Minimum stripping time in days (24 h))

	CEM I		**CEM II/A & CEM II/ B (MAX 29% EXTENDER)**		**CEMII/B (30-35% EXTENDER)**	
TYPE OF STRUCTURAL MEMBER OR FORMWORK	**Normal weather (Above 15° C)***	**Cold weather (Below 5° C)***	**Normal weather (Above 15° C)***	**Cold weather (Below 5° C)***	**Normal weather (Above 15° C)***	**Cold weather (Below 5° C)***
Beam sides, wall or unloaded columns	1	2	2	4	2	6
Slabs, with props left underneath	4	7	5	8	6	10
Beam soffits, props left in place	7	12	8	14	10	17
Removal of slab props	10	17	10	17	12	21
Removal of beam props	14	21	14	21	18	28

*Average daily temperature of the atmosphere adjacent to the concrete as measured by a maximum and minimum thermometer. When the average daily temperature is between 5°C and 15°C the minimum stripping times shall be interpolated from the table.

The table assumes that the member concerned is not subjected to any heavy construction loads and that the total force to be supported is not more than half the design load. Where heavier loads are to be carried, no stripping of soffits shall be permitted until the concrete has attained its full strength. Any days during which the average temperature was below 2°C shall be completely disregarded.

In the case of walls and columns the stripping times shall be determined by means of cube test results in the first instance, so as to ensure that no damage is caused to the structures by removing formwork.

Add the following to Clause 5.2.5.5:

Special attention is to be paid to the repair and sealing of shutter-ties in all water retaining concrete to ensure watertightness.

PSG 5.3 HOLES, CHASES, AND FIXING BLOCKS

Add the following Clauses:

Fixing blocks for the attachment of fixtures may be embedded in concrete provided that the strength or any other desirable feature (such as appearance) is not, in the opinion of the Engineer, impaired thereby.

PSG 5.4 PIPES AND CONDUITS

Add the following Clauses 5.4.1 to 5.4.3:

PSG 5.4.1 Fixing for equipment and pipe specials

The Contractor will be responsible for the forming of pockets and grouting in of pipe items and/or holding down bolts for equipment supplied under the contract.

Upon completion of the positioning and alignment of equipment, the Contractor shall, grout up pipe items, pockets and base plates (subject to below) necessary for the permanent installation of the equipment.

Only after the Engineer is satisfied with the alignment and the level of each item of plant shall the Contractor grout up the base plates/pipe specials with an approved non-shrink grout.

PSG 5.4.2 Pipes and conduits embedded in concrete

Except with the written approval of the Engineer, no pipes other than those shown on the drawings shall be embedded in concrete and the approval of the Engineer for the position of all services to be embedded shall be obtained before concreting commences.
The clear space between pipes of any kind embedded in reinforcement concrete and the clear space between such pipes and reinforcement shall not at any point be less than:

a) 40 mm, or
b) 5 mm plus the maximum size of coarse aggregate, whichever is the greater.

PSG 5.4.3 Casting/grouting in of pipes and specials

Where pipes are to be cast into concrete, the Contractor shall provide a box-out in the wall and grout the unit in at a later stage. When constructing such a box-outs, reinforcement shall not be cut, but shall run through the opening. Reinforcement shall be cut and/or bent out at a later stage to suit the item being cast in. After installation of the item the remaining reinforcement shall be bent back in position.

Where box-outs for pipes/specials have been provided in the walls, the Contractor shall be responsible for the grouting in of such pipes/specials regardless of whether or not these have been supplied by himself.

An approved non-shrink grout shall be used for the grouting in of pipes and specials after they have been positioned. The details and method statement is to be submitted to the Engineer for approval prior to the commencement of any grouting. The approval by the Engineer shall not relieve the Contractor from his obligation to provide a watertight joint between the concrete and grout used.

PSG 5.5 CONCRETE

PSG 5.5.1 Quality

Add the following to Clause 5.5.1:

Where 35 MPa concrete is specified for severe exposure, the minimum and maximum cementitious contents of 325 kg/m^3 and 450 kg/m^3 respectively shall be used. For concrete containing extenders the maximum cementitious content shall be 450 kg/m^3. The water to cement ratio for this class of concrete shall not exceed 0.50.

All concrete mix designs shall be approved by the Engineer in advance.

The mix design and casting procedure shall be approved by the Engineer prior to casting. All excavations and foundations must be checked and approved by the Engineer or delegated Geotechnical Engineer prior to casting.

All Water Retaining structures, manholes and valve and other chambers shall be constructed using watertight concrete. The Contractor shall abide by all conditions set out in sub-clause 5.5.11 of SABS 1200 G, and pay particular attention to this aspect of the works.

Cubes shall be taken on all pours in accordance with SABS 1200 G. Payment shall be included in the rate tendered for the supply of concrete. No payment shall be made for concrete pours on which no cube tests have been performed. A single cube test comprises the mean crushing strength of 3 cubes taken from the same batch of concrete and cubes must be taken at the frequency specified SABS 1200 G

The concrete shall be tested for water sorptivity, oxygen permeability, chloride conductivity, depth of cover and shrinkage; the details of the tests are given in the specification.

PSG 5.5.1.4 Chloride Content

Add the following to Clause 5.5.1.4:

Efflorescence will not be acceptable on any exposed concrete surface

PSG 5.5.1.5 Durability

Add the following to Clauses 5.5.1.5:

The water/cement ratio, as specified in Table 5 in SABS 1200 G, but shall not exceed 0.5 for severe exposure conditions.

The exposure conditions for the various structural elements are as indicated on the general notes drawing.

PSG 5.5.1.6 Prescribed Mix Concrete

Add the following to Clause 5.5.1.6:

Notwithstanding the requirements of Sub-clause 5.5.1.6, samples of aggregates will not be made available by the Engineer. The Contractor shall supply aggregates from commercial sources located by him, complying with the requirements of Sub-clause 3.4.1, as amended, for the production of prescribed mix concrete.

"No-fines" concrete:

A nominal aggregate size of 19 mm shall be used in the manufacture of "no-fines" concrete.

No-fines concrete shall be laid where specified and shall consist of coarse aggregate, cement and water only. No-fines concrete shall have a 28-day characteristic strength of 15MPa unless specified otherwise elsewhere. No fine aggregate shall be used. Sandwiching or layering of pours will not be permitted. The Contractor shall cast to the profile depth in one pour.

The mixing of the cement and water paste shall have the consistency of paint capable of coating each coarse aggregate particle uniformly and sufficiently to form a small fillet at all the contact points of each stone in the aggregate.

Between 24 and 48 hours after the no-fines layer has been laid it shall be covered with 1:4 cement: sand mortar layer with a nominal thickness of 2 mm. The mix shall be comparatively dry to ensure that it does not penetrate and block the cavities in the no-fines concrete. The surface shall be steel floated to form a plane surface.

The mortar skim shall be cured in the same manner as concrete for a period of not less than 2 days.

Payment shall be per cubic metre of no-fines concrete placed. The rate shall include compaction and skimming to the approval of the Engineer.

PSG 5.5.1.7 Strength Concrete

Add the following to Clause 5.5.1.7:

The concrete mix design for strength concrete must be prepared in an approved laboratory and the results of actual test mixes must be submitted for approval together with 7-day and 28-day strength test results at least 14 days prior to casting of the concrete. Special attention is drawn to the fact that the concrete mix must provide a very dense and impervious concrete.

The Contractor shall submit details of the proposed concrete aggregates and design mix to the Engineer for approval, after which he shall be required to make a trial mix and obtain cube test results to validate the proposed mix. Only after receipt of satisfactory cube test results, the Contractor shall be permitted to use the mix in the construction of water retaining structures. The cost of designing and proving the proposed concrete mix shall be deemed to be included in the tendered rates.

There shall be three grades of strength concrete used on the works designated Grades 35/19, 30/19 and 25/19, and composed of cementitious material, sand and stone as previously specified .

a) Grade 35/19 Concrete for Water Retaining Structures

For Grade 35/19 concrete Ordinary Portland Cement (OPC) and Pulverised Fly Ash (PFA) shall be blended together such that the combined cementitious material comprises 70% OPC and 30% PFA by mass.

The minimum content of combined cementitious material shall be not less than 360 kg and not more than 450 kg per cubic metre of concrete and the minimum cement/water ratio shall be 2,0.

The characteristic cube strength at 28 days shall be not less than 35 MPa.

The concrete mixes for the abovementioned grades of strength concrete are to be designed by an approved laboratory. At least six weeks before placing any concrete on the works the Contractor shall supply and deliver to the laboratory, at his own cost, samples of the aggregates he proposed to use in the concrete mixes. The Contractor shall include in his tender for all the fees and charges levied by the laboratory and all other costs incurred in designing and adjusting the strength concrete mixes.

PSG 5.5.2 Batching

Add the following to Clause 5.5.2:

Batching of all strength concrete shall be by mass. Prescribed concrete may be batched by volume. Batching shall not be done by wheelbarrow.

All concrete shall be mechanically mixed.

Stand-by mixers of adequate capacity and with an independent power unit shall be maintained on site for immediate use in the event of breakdown of the regular mixers failure of the power supply.

PSG 5.5.3.2 Ready-Mixed Concrete

Replace the contents of Clause 5.5.3.2 with the following:

Concrete produced at a central facility, other than at the site of the Works, shall not be accepted for use in the Works except with the prior and express approval of the Engineer. When such approval has been given the Engineer will then decide whether or not to accept the test results obtained by the facility concerned.

The use of concrete from a ready-mixed concrete facility shall be permitted subject to the following provisos:

- The facility shall be accredited as being compliant with the requirements of the ISO 9001-2000 standard.
- The concrete batching plant shall be inspected by the Engineer for compliance with SABS specifications and his approval must be obtained in writing before commencement of the concrete works.
- Before any ready-mixed concrete is used on the works, the Contractor shall furnish the Engineer with a copy of his letter to the supplier in which was specified:
    - i) the type of cement(s);
    - ii) the nominal maximum sizes of aggregates;
    - iii) the cement / water ratios;
    - iv) the required compressive strengths;
    - v) the required slump at the time and place of delivery; and
    - vi) the type of additive - documentary evidence proving the suitability of the additive for use in the concrete, particularly in the grade 35/19 water retaining concrete, shall be given to the Engineer for his prior approval.

The following shall be specified in the Contractor's contract/order with the ready-mixed concrete supplier and a copy of the relevant documentation shall be given to the Engineer's Representative:

- A maximum delivery period of 90 minutes from the time water is added to the concrete mix to the actual completion of the discharge of concrete on site shall be permitted. The discharge period (including placing the concrete) shall not exceed 30 minutes. (90 mins is the max.)

- The concrete slump of every truckload shall be measured on delivery to site as soon as discharge commences and it shall comply with Clause SABS 1200 G 5.5.1.2 prior to any concrete from that truck being placed. No additional water may be added to the mix after it has left the batching plant without the written approval of the Engineer's Representative.
- A detailed computer printout of the constituents of the concrete mix from the batching plant is to be handed over to and retained by the Engineer's Representative on site on arrival (i.e. truck registration, mix proportions and the time water was added to the mix). The masses of the concrete constituents of each truck shall be checked against that of those submitted with the trial mix, subject to the batching accuracy as specified in SABS 0100-2: 1992. The arrival time of each truck on site and the time that the concrete discharge is completed shall also be recorded by the Engineer's Representative. Dedicated truck drivers shall be used, where possible, for the delivery of the concrete to site.
- When required the Contractor shall satisfy the Engineer that acceptable alternative means of supplying concrete have been arranged and can be brought into operation in the event of disruption in the supply of concrete. In this regard, the Engineer may require that the alternative means of supply shall commence if the disruption in the supply of ready-mixed concrete has lasted for a period of 1½ hours.
- The use of ready-mixed concrete will in no way relieve the Contractor of any of his obligations for providing concrete that complies with the specifications."

PSG 5.5.5 Placing

Add the following to Clause 5.5.5:

PSG 5.5.5.1 No cast shall be started when rain is falling or, when in the Engineer's opinion, heavy or continuous rain is probable. Should rain occur after the commencement of casting, the Contractor shall provide all measures necessary to ensure satisfactory completion and protection of that section of the works being cast. No cast shall be started when weather conditions are such that sand or salt spray is blown onto steel, formwork or concrete.

Add the following Clause PSG 5.5.5.10:

PSG 5.5.5.10 Casting of Concrete in Excavation

Concrete used in pipe trenches for encasement and for the thrust / anchor blocks may be cast directly against the side of the excavation.

After vibration, the concrete shall be spaded in corners, in angles and against forms to release air bubbles which may have been trapped in these positions.

PSG 5.5.6 Compaction

Add the following to Clause 5.5.6:

All concrete shall be vibrated with approved internal vibrators of minimum 65 mm diameter and ample power to maintain a speed of at least 7000 rpm when immersed. Electrically driven vibrators shall be used when practicable. Smaller diameter vibrators may be used subject to the approval of the Engineer where areas of rebar congestion restrict the use of large diameter vibrators.

Vibrators shall be inserted only at a sufficient distance from the sloping face of an advancing layer to prevent undue slumping or flow of the face.

PSG 5.5.7 Construction Joints

Add the following to Clause 5.5.7:

PSG 5.5.7.1 General

The edge of joints, exposed to view in the finished structure, shall be so formed as to provide a straight edge true to line and level.

All joints, other than expansion, contraction and other movement joints shall be treated as follows:

As soon as practical the construction joint surface shall be prepared to receive fresh concrete. This preparation, as specified in Sub-clauses 5.5.7.3(a) to (d), shall be such as to remove all laitance or inert and strengthless material which may have formed by high pressure water jets or sand blasting and the specified chipping or sand blasting shall be such as to produce a roughened surface all over. The timing of this operation is important in order to obtain the required finish. Each joint shall be inspected by the Engineer before it is rendered inaccessible by the erection of further shuttering.

Construction joints shall be covered with a waterproofing slurry as indicated on the drawings.

When concreting is interrupted concrete surfaces shall be protected from the sun as specified in Sub-clause 5.5.8(d) or by means of hessian kept damp until concreting is resumed.

About ½ hour before placing concrete or mortar, construction joints shall be saturated with water and immediately prior to placing concrete or mortar on any part of the joint, all surplus water shall be removed by compressed air jets or other approved method.
Unless construction joints between designated joints shown on the drawings are authorized by the Engineer in writing, concrete in the floor and wall shall be cast continuously between the designated joints shown on the drawings.

All costs connected with the forming of construction joints shall be deemed to be included in the relevant concrete rates.

Particular attention should be paid to construction joints where works has been standing for a considerable period of time. In addition to the above requirements the joints shall be cleaned of any other deleterious material (e.g. fungal growths, mould, plant growth etc.) which may affect the performance of the joint.

Add the following Clauses PSG 5.5.7.4 – 5.5.7.12:

PSG 5.5.7.4 Formed Joints (Generally Vertical or Near Vertical)

Formed joints will be considered to be designated joints as defined in Sub-clause 2.4.3. (The forming of a straight edge to a construction joint as specified in PSG 5.5.7.1, as amended, does not constitute a formed joint).

Each joint shall be formed as shown on the drawings, complete with rebates, formwork, waterstops, sealants, approved joint filler, dowel bars and their PVC tubes, etc. as indicated.

PSG 5.5.7.5 Non-Designated Joints

Any non-designated joints shall be identical to designated joints, as shown on the drawings, which would be used in similar positions and shall perform the same function.

PSG 5.5.7.6 Joints between Footings or Floors and Walls or Columns

Construction joints between foundations, footings or floors and walls, columns or piers connected to them, shall not be made flush with the supporting surface, but shall be made at a distance above the footing or floor shown as on the drawings or approved by the Engineer. The "kicker" shall be cast as an integral part of the foundation, footing or floor.

PSG 5.5.7.7 Construction Joints

- Construction Joints In Walls Or Footings

Construction joints may only be placed where shown on the drawings or to the approval of the Engineer.

The entire contact surface along the joint in the concrete already cast shall be chipped or water jetted to expose the coarse aggregate to 5 mm beyond the surrounding matrix. Care shall be taken to ensure that the concrete structure is not damaged and that all loose material is removed. The surface must be thoroughly cleaned and wetted before casting against the joint.

- All construction joints in the reservoir walls and footing shall be cast with water stops. Water stops shall be rubber, as per detail drawings.

Payment shall be per linear meter. The rate shall include the cost of all material and labour for the construction of the joint as indicated on the drawings, including formwork, testing and making good. Rates shall also include the cost of the supply and placing of any waterstops, dowels or other insets.

PSG 5.5.7.8 Application of Primers and Adhesives

The concrete to which the primer or adhesive is to be applied shall be dry and shall be cleaned of all dust, grit, grease, surface laitance and foreign matter by compressed air and/or water, solvents, or other suitable approved means. The Contractor shall provide on Site an approved moisture meter to measure the degree of dryness of the joint. This meter shall be made available to the Engineer for testing. The joint shall be approved for the application of the primer and adhesive if the moisture content of the concrete is less than or equal to 5%. It may be necessary to dry the concrete surfaces locally to reduce the moisture content to 5% or less.

All application and drying times shall be included in the Tender Programme.

PSG 5.5.7.9 Contraction and Expansion Joints

Expansion and contraction joints shall be constructed as detailed on drawings using rubber water stops. These joints shall be formed true to line in smooth formwork. Water stops extruded from recycled material shall not be permitted. Prior to bandaging, concrete surfaces shall be prepared by means of high pressure water jetting, scabbling, sandblasting, etc. upon approval by the Engineer.

A waterproofing bandage shall be used for joints as indicated on the drawings and as described in section PSG 3.11.4. The bandage shall be applied and installed as per the instructions of the approved manufacturer.

All surfaces shall be thoroughly cleaned of all accretions of concrete or other foreign matter by scraping or other approved means.

Particular care shall be taken to compact the concrete around waterstops, edges, etc. using adequate approved tools and experienced, reliable workmen.

Rebates for seals shall be formed to required dimensions and lines, or cut true to line and size after floating the surface and before the final set of the cement has taken place. All rebates, etc., shall be adequately protected against damage until the completion of the work; accidental damage which in the opinion of the Engineer will impair the performance or appearance of the joint shall be made good by reconstructing the work as directed by the Engineer. Rebates for seals shall be grit blasted or wire brushed on all faces to remove surface laitance and thoroughly cleaned with soft brushes and/or compressed air jets, and, if necessary, dried by blow-lamp or other approved means before priming.

Payment shall be per linear meter. The rate shall include the costs for all materials and labour for the construction of each joint as shown on the drawings including the cost of formwork, testing and making good and shall include the cost of supplying and placing any waterstops, dowels or other insets.

PSG 5.5.7.10 Installation of Waterstops in Joints

Where waterstops are required, they shall be installed in the longest practicable lengths , and securely held to shape, lines, etc. in proper formwork.

Waterstops shall be held in the formwork so as to prevent air pockets forming underneath them. Special precautions shall be taken, to the approval of the Engineer, to ensure that all flexible waterstops are in perfect contact with well compacted void-free concrete.

PSG 5.5.7.11 Installation of Joint Filler in Expansion Joints

Filler in the joints shall be neatly butted so as to exclude mortar from the joint. Edges of filler strip against waterstops, concrete, formwork, projections, etc., shall also be closely fitted to exclude mortar, so that there is no resistance (other than the compression of the filler) to the expansion movement for which the joint is designed.

Joint filler shall be fixed to the first cast of concrete with an approved adhesive and as directed by the Engineer.

PSG 5.5.7.12 Application of Joint Seals

Rebates shall be cleaned as required by PSG 5.5.7.6 Application of primers and adhesives and shall be inspected and approved by the Engineer's Representative before filling.

Joint sealants and primers shall be applied strictly in accordance with the approved manufacturer's instructions. Flow and non-slumping grades shall be used for horizontal and vertical joints respectively unless indicated otherwise. Immediately after the compound is applied the joint shall be protected against damage until completion of the Contract.

Batch numbers of sealants shall be recorded. Only skilled workmen, experienced in this type of work shall be employed to apply the sealant.

Immediately after the compound is cold the joint shall be protected against damage until completion of the contract.

PSG 5.5.8 Curing and Protection

Add the following to Clause 5.5.8:

Curing shall be done using a curing compound to the Engineer's approval and frequency or, in addition to water curing, well-secured plastic sheeting, shall be used. Water curing alone shall not be permitted. Where the Contractor fails to cure for a minimum of 7 days, no payment shall be made for the relevant pour of concrete. All curing times shall be included in the Tender Programme. Any membrane curing compounds used shall be certified as non-toxic, shall be inert in reaction to chlorine and shall not deteriorate in less than three weeks regardless of the degree of exposure to the elements.

PSG 5.5.8.1 Horizontal Surfaces

Horizontal surfaces shall be wet cured only. The Contractor shall provide a method statement describing his proposed method of curing. This method statement is to be approved by the Engineer prior to construction.

PSG 5.5.8.2 Curing for Normal Concrete Surfaces

In order to achieve durable, impermeable concrete, all exposed surfaces (including joint surfaces) of strength concrete shall be properly and carefully cured. Curing shall take place from the time that the concrete has taken its initial set. (the length of time when formwork is in place may be deducted from the curing period).

The use of membrane curing compounds will be allowed on vertical faces or steeply inclined faces (i.e. steeper than 15° to the horizontal) of cast in situ members of the structures. Approval will be subject to the Contractor producing sufficient, satisfactory cube crushing strength test results where the crushing strength of cubes which have been cured with the proposed curing membrane and left exposed to the elements are compared with those of an equal number of water cured cubes. The crushing strength of cubes cured with the proposed membrane shall be at least 85% of the crushing strength of the water cured cubes.

Before any membrane curing compound is used, each batch shall be tested on a trial surface to ensure that it forms a satisfactory membrane, and any compound which is unsatisfactory in the opinion of the Engineer, shall be rejected. Curing membranes will be disallowed if permanent discolouration of the concrete takes place. Surfaces where curing membranes are used shall be treated in such a manner that the final concrete texture and colour blends in with the rest of the concrete work. Furthermore, the Engineer shall, at his discretion, require the Contractor immediately to adopt an effective alternative means of curing any area of the structure to which a membrane has been applied which, in the opinion of the Engineer, is unsatisfactory. The curing compound used shall be to the approval of the Engineer. Wax based curing compounds will not be permitted.

The curing compound shall be applied immediately as formwork is progressively stripped or, in the case of unformed surfaces, when the concrete has taken its initial set. It shall preferably be applied by spraying and the rate of application shall be strictly in accordance with the manufacturer's recommendations. A method of monitoring the area to which curing compound has been applied and the application rate shall be as approved by the Engineer and rigidly applied by the Contractor.

Surfaces of joint rebates, where elastomeric sealant is to be applied, shall be protected from contamination by curing compound by the use of masking tape.

Curing times shall be included in the Tender Programme.

The Contractor shall immediately adopt an effective alternative means of curing any area of the structure where, in the opinion of the Engineer, curing is unsatisfactory.

Particular attention should be taken to proper curing of the vertical surfaces of the reservoir retaining walls in order to limit drying shrinkage cracking. A suitable curing regime shall be submitted to the Engineer for approval prior to the commencement of any concrete works.

PSG 5.5.10 Concrete Surfaces

Replace the contents of Clause 5.5.10 with the following:

PSG 5.5.10.1 Screeded Finish

After placing and compacting the concrete on a top (unformed) surface shall be struck off with a template to the designated grades and tamped with a tamping board to compact the surface thoroughly and to bring mortar to the surface, leaving the surface slightly ridged but generally at the required elevation. No mortar shall be added, and noticeable surface irregularities caused by the displacement of coarse aggregate shall be made good by re-screeding after the interfering aggregate has been removed or tamped.

PSG 5.5.10.2 Wood-Floated Finish

Where wood-floating is ordered or scheduled, the surface shall first be given a finish as specified in Sub-clause PSG 5.5.10.1, as amended, Screeded finish and, after the concrete has hardened sufficiently, it shall be wood-floated, either by hand or machine, only sufficiently to produce a uniform surface free from screeding marks.

PSG 5.5.10.3 Steel-Floated Finish

Where steel-floating is specified or scheduled, the surface shall be treated as specified in Sub-clause PSG 5.10.1, as amended, Screeded finish except that, when the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the screeded surface shall be steel-trowelled under firm pressure to produce a dense, smooth, uniform surface free from trowel marks.

Add the following Clauses PSG 5.5.10.4 – 5.5.10.6:

PSG 5.5.10.4 Brushed Finish

Where brushed finish is specified or scheduled, the surface shall be treated as specified in Sub-clause PSG 5.10.1, as amended, Screeded finish except that, when the moisture film has disappeared and the concrete has hardened sufficiently to prevent laitance from being worked to the surface, the screeded surface shall be finished/brushed by dragging a broom across the surface of the concrete in order to obtain a non-slip surface.

PSG 5.5.10.5 Power-Floated Finish

Where a power-floated finish is specified, the surface shall be trowelled smoothly with a well-balanced power trowel. Care shall be taken to ensure the surface is trowelled when it is at the optimum trowelling consistency.

PSG 5.5.10.6 Rough Finish

In certain special cases where a rough finish is desired or specified on the drawings, the surface shall be screed-tamped to an approximately even dense surface, and shortly after final set of cement the surface shall be wire broomed and washed down to remove any laitance, leaving a clean rough surface with coarse aggregate partially exposed, but not disturbed.

PSG 5.5.10.6 Granolithic Screeds

PSG 5.5.10.6.1 General

Before placing any granolithic screeds the base concrete shall be chipped to expose the aggregate over 100% of the area to be screeded and soaked with water for at least 24 hours.

The base concrete shall be thoroughly cleaned by scrubbing and all standing water removed after soaking. A 1:2 cement/sand grout shall then be brushed into the prepared surface followed by the granolithic screed before the grout sets. The granolithic screed shall be of the driest feasible consistency with a slump not exceeding 50 mm and shall be formed true to profile and shape as required and shown on drawings. Before placing granolithic screed

against an adjacent band of granolithic screed the edge of the latter shall be prepared by chipping back to firm material, wire brushing and brushing with grout as for the base concrete.

Granolithic screed shall be compacted to remove all air and shall be screeded and finished with a steel trowel to Degree of Accuracy 1.

The trowelling shall be carried out in the following stages:

a) First - as soon as the granolithic screed has been compacted and screeded.
b) Second - after 2 hours to close the surface and remove laitance.
c) Third - after a further 4 hours.

The time intervals are estimated as appropriate to normal temperature conditions and shall be varied by the Contractor to ensure a smooth dense finish.

Granolithic screed shall be cured as specified in Sub-clause 5.5.8(b), as amended, but shall additionally be protected from direct sunlight and drying winds as it is being placed.

PSG 5.5.14 Defects

Add the following to Clause 5.5.14:

All defects shall be repaired as soon as possible after the formwork has been removed and the Engineer has inspected the concrete. A statement of the method to be used for each repair shall be submitted to the Engineer for his approval before any work is carried out. The Engineer may prohibit the further placing of concrete in the particular area concerned until he is satisfied that the repair has been satisfactorily executed.

Honeycombed or otherwise defective concrete shall be cut out, together with part of the sound concrete, as directed by the Engineer; anchor reinforcement drilled into holes into sound concrete shall be provided if and as ordered by the Engineer. The cavities shall then be filled in flush with the concrete of the same mix but in general a smaller maximum aggregate size to be specified by the Engineer, placed against special formwork; the joint being treated as a construction joint. For minor honeycombing and defects, the Engineer may order a shallower cut-out, the edges of which shall be square to the face, or preferably undercut to a depth of at least 25 mm. Such cut-outs shall be filled with mortar of composition and colour similar to the concrete mortar, and applied by a tradesman or suitably skilled personnel.

Exposed corners, etc., which are patched shall be bonded to sound concrete by approved epoxy resin or similar bonding agents applied in accordance with the manufacturer's instructions. An approved experienced specialist sub-contractor shall be employed for critical work, such as the above, if directed by the Engineer.

Special care shall be taken to ensure that any repair exactly matches the formed surface in colour and texture.

No patching or filling of surface defects other than air holes shall be permitted. If the exposed surface has defects which are in the opinion of the Engineer detrimental to the desired architectural effect, that cast of concrete shall be removed and reconstructed at the Contractor's cost; any adjacent casts damaged in this process shall also be reconstructed.

Add the following Clauses PSG 5.5.16 – 5.5.18:

PSG 5.5.16 Casting Pipes and Specials in Concrete

Where the pipe or specials is to be cast into a valve or other chamber or manhole, the Contractor may elect to provide a box-out in the wall and cast the unit in at a later stage. When constructing such box-outs reinforcement shall not be cut but shall run through the opening. Reinforcement shall be cut and/or bent out at a later stage to suit the item being cast in. After installation of the item the remaining reinforcement shall be bent back in position.

Before commencing the positioning in holes of any pipes/specials the Contractor shall:

a) remove all formwork and boxing remaining in the holes;
b) make any alternations required to the position and shape of the holes and cut reinforcement to suit the item, as directed by the Engineer; and

c) thoroughly scabble and water jet the sides of the holes so as to obtain a satisfactory bond surface for the new concrete and treat the surface as specified in Sub-clause 5.5.7.3, as amended.

Immediately prior to the placing of mortar and concrete around the pipes, the surface of the existing concrete shall be saturated with water. All surplus water shall be removed and the surface covered with a layer, approximately 12 mm thick, of mortar made of the same mix as the concrete in which the pipes/specials are to be placed.

The concrete ingredients shall be mixed and placed as dry as possible to obtain a dense, waterproof concrete. The concrete shall be carefully worked around the puddle flange, if any, and the pipe barrel or body of the special, and shall be vibrated in layers so as to obviate a falling away from pipe/special surfaces of the concrete already placed. The whole shall, when set, form a dense, homogeneous, and waterproof mass.

PSG 5.5.17 Precast Paving Slabs

The area to be paved shall be compacted to 93% of MAMDD, trimmed and then treated with an approved weed killer, with care being taken to avoid contaminating surrounding areas. The paving slabs shall be laid on a sand bed approximately 25 mm thick, which shall be graded to the required levels and slopes as approved by the Engineer. The joints between the slabs shall be 2 mm to 6 mm wide and shall be grouted with cement mortar. Gaps in the pattern of slabs shall be filled with grade 15 MPa/19 mm concrete and given a wood floated finish.

PSG 5.5.18.1 Fixings for Items Supplied Under this Contract

Holding down bolts or other fixings required for the installation of items supplied under this Contract shall be provided by the Contractor. These fixings shall be cast in or grouted into pockets or installed by other means as approved by the Engineer.

Where anchor bolts are used which are installed into holes drilled into concrete or masonry these shall be of a type approved by the Engineer. All such bolts used shall be manufactured from stainless steel or a metal with a resistance to corrosion equal to that of grade 304 stainless steel. Precautions to be taken when stainless steel fixings are used on galvanised steel members.

Anchor bolts shall have mean ultimate tensile resistance and mean ultimate shear resistance at least equal to those specified below:

Specified Anchor Size	Mean Ultimate Tensile Resistance (kN)	Mean Ultimate Shear Resistance (kN)
M10	36.8	18.90
M12	53.3	28.4
M16	72.4	53.6
M20	149.2	92.4

PSG 5.5.18.2 Supervision

The Contractor shall be responsible for ensuring that the erection of the concrete work is carried out under the supervision of a person with adequate knowledge of the mixing, transporting, placing and curing of concrete.

PSG 5.5.18.3 Programme and Plant

Prior to carrying out any concrete work, the Contractor shall obtain the approval of the Engineer in respect of:

a) Structural programme,
b) Concrete plant details,
c) Materials to be used in concrete,
d) Details of concrete
e) Construction joints

PSG 5.5.19 Foundation Preparation

(a) General

Prior to placing any concrete, (including any RCC, filler concrete, bedding mix, or other conventional concrete placed adjacent to and at the same time as the concrete) all surfaces shall be cleaned and free of loose, un-keyed, and deteriorated rock, all mud and silt accumulations, vegetation, loose fragmented rock pieces, laitance, puddles or ponds of free surface water, mortar coatings and other detrimental materials. High pressure water jetting, followed by mild high-volume, low-pressure washing shall be used on all concrete surfaces for the removal of laitance, mortar coatings or other difficult-to-remove surface contaminants.

(b) High-Volume Low Pressure Washing

It is anticipated that removal of loose materials in the foundation and on receiving surfaces can be achieved using high-volume low-pressure water washing. Low-pressure water jets shall have 25mm nozzles available and a capacity of at least 750 litres per minute in the case of truck mounted devices.

PSG 5.7 POLYURETHANE COATING ON FLOORS AND WALLS

Polyurethane coating on floors and walls of the High Lift Pump Station building shall be installed as per the Manufacturer's specifications and by a skilled supplier or Contractor as approved by the Engineer. Designated walls shall be covered with the coating

PSG 7 TESTS

PSG 7.1.1 Facilities

Add the following to Clause 7.1.1:

Water-Bath

A temperature-controlled water-bath with a sufficient capacity to cure the amount of cubes required shall be provided on site. The water-bath shall be located under cover.

PSG 7.1.2 Frequency of Sampling

Add the following to Clause 7.1.2:

One sample shall consist of three concrete test cubes.

For each sample taken the position in the structure shall be recorded where the batch represented by that sample is placed as also the date sampled.

PSG 7.2 Testing

Add the following Clauses PSG 7.2.5

PSG 7.2.5 Testing Watertight Concrete

The Balancing Tank shall be tested for water tightness in accordance with BS 8007: 1987 Section 9 unless specified otherwise elsewhere. Testing of the Watertight Structure The floors and walls of all water retaining structures shall be considered to be watertight concrete structures It is envisaged that due to the size of the Balancing Tank and the volume of water involved, the water tightness testing will take place during the first filling of the Tank. The entire inside surface of the Balancing Tank including walls and floors shall be thoroughly hosed down with water and brushed until properly cleaned off all dirt and other foreign matter. The structure shall then be tested as follows:

- The structure shall be filled with clean water up to full supply level. the water level should be maintained by the addition of further water for a stabilising period (21 days) while absorption and autogenous healing take place.
- After the stabilization period , refill (top up) and record the water level at 24 hour intervals for a test period of 7 days. During this 7 day test period the total permissible drop in level, after allowing for evaporation, should not exceed 10 mm.
- Notwithstanding the satisfactory completion of the test, any evidence of seepage of the liquid to the outside faces of the liquid-retaining walls shall be assessed by the Engineer against the requirements of the

specification. Any necessary remedial treatment of the concrete, cracks, or joints shall be carried out by the Contractor from the liquid face where practicable.

- If a lining is used for this purpose, it shall be sufficiently flexible and not be in any way detrimental to the water quality.
- In the event of any leakage or dampness being evident at any stage of the filling or testing or in the event of the Engineer considering the final degree of water-tightness to be unsatisfactory, the Contractor when ordered by the Engineer shall discontinue such filling or testing and shall, at his own expense, immediately take approved steps to rectify the leakage and to make the work thoroughly sound to the complete satisfaction of the Engineer. All such rectification work shall be continued assiduously until a satisfactory test is obtained, which shall prove to the Engineer that water tightness has been obtained. Water shall be supplied free of charge for the first filling only.
- If required by the Engineer, the structure shall be retested before the expiry of the Defects Liability Period. The Works will not be certified complete until the structure has been proved by testing to be watertight to the satisfaction of the Engineer.
- The cost of the above tests will be deemed to be included if the rates for the relative concrete to be provided by the contractor. Payment shall be a lump sum. The rate shall cover the costs of all materials, labour and water used.
- The time required for testing and all remedial work shall be part of the contract time.

PSG 7.2.5 Durability Testing:

Concrete shall comply with the durability parameters defined below:

a) Water Sorptivity:

Sorptivity is sensitive to surface effects and may be used to assess the effectiveness of initial curing.

b) Oxygen Permeability:

Permeability is sensitive to changes in the coarse pore fraction and is thus a means of assessing the degree of compaction of concrete. It may be used to quantify the microstructure of the concrete and is sensitive to macro-defects such as voids and cracks. Permeability shall be tested in a manner approved by the Engineer.

c) Chloride Conductivity:

Chloride conductivity provides a method of characterisation of concrete in the marine environment and may be used to assess the chloride resistance of concrete.

Unlike oxygen permeability and water sorptivity, chloride conductivity is not really a measure of construction quality, but it shall be used for materials selection and design of mixes in aggressive chloride conditions. It will therefore only be used as a check on mix designs during the initial stages of construction.

d) Concrete Cover:

Concrete cover is a dimensional indicator of cover concrete depth. Cover concrete is the outer concrete layer which protects the internal reinforcing steel, and its depth varies according to the requirements of the different environmental exposure classes.

Test for cover shall be conducted using an approved calibrated electromagnetic cover meter.

This test shall be conducted when instructed by the Engineer to confirm that the specified depth of concrete cover has been achieved. The cover meter tests shall cover at least 1 m2 for every 10 m2 exposed. The average cover of the 1 m2 subjected to the test shall be used to determine the payment, unless the Contractor chooses to carry out additional tests as detailed under clause PSG 7.3.8. The cover meter must be calibrated for each project by drilling and measuring actual cover in at least 3 locations to validate the readings.

Minimum cover to reinforcing for the utility building and guard house shall be as indicated on the drawings.

e) General:

Durability predictions will be based on the following tests that shall be arranged by the contractor. The durability testing shall be carried out by a laboratory approved by the Engineer.

f) Shrinkage

The dry shrinkage tests shall be conducted in accordance with SABS 1085. The drying shrinkage shall not exceed 0.04%.

PSG 7.3 Acceptance Criteria for Strength Concrete

Add the following Clauses PSG 7.3.6 – 7.3.10:

PSG 7.3.6 Durability Index Tests

Testing for durability shall be carried out using test panels which are constructed with the same concrete mix, formwork type, and compaction and curing methods as the actual concrete drums. The test panel shall be 150 mm thick, and of at least 0.5 m sides. Samples for testing shall be obtained from the face of the test panel that mimics the cast face of a drum, after a period of 28 days curing. The test panels required for durability testing shall be constructed:

a) At the start of production
b) Initially for the first 50m3 batch of concrete.
c) Thereafter 2 sets for every discreet element namely floors, sloped floors and walls.

The durability tests are to be carried out by an accredited laboratory approved by the supplier in terms his Quality Management System and shall be:

a) Oxygen permeability index test (OPI)
b) Water sorptivity index test (including porosity)
c) Chloride conductivity index test

The test procedures for these tests are obtained from the University of Cape Town Durability Index Test Manual.

Two sets of four cores each (70 mm dia) are required from a test panel: four cores for the oxygen permeability and water sorptivity tests; four cores for the chloride conductivity test.

The required target values for the tests are summarized in the table below. (These are the average values for the four core specimens used for the testing on each occasion). These values are required to be met simultaneously for both sets of cores, i.e. the cores must pass the requirements for both OPI and chloride conductivity.

PSG 7.3.6.1 Durability Test Parameters

DURABILITY INDEX TEST	TARGET VALUE
Oxygen permeability index	≥ 10 (log scale)
Chloride conductivity index	≤ 0.6 m.sec/cm
Water Sorptivity	≤ 8 mm / hr0.5

In the case that the results do not comply with the above values in the above table, another set of cores shall be drilled from the test panel. Where the second set of cores fails to comply with target values, a drum from that batch of concrete shall be sampled by way of drilling four cores for each of the oxygen permeability test and the chloride conductivity test. If these sets of cores fail either of the target values for OPI or chloride conductivity, all drums from that batch of concrete shall be discarded. The contractor shall keep records of all tests results relating to the samples tested.

The contractor shall ensure that site testing is carried out by a trained person. The contractor shall ensure that all off-site laboratory testing is performed in an approved laboratory approved in terms of their Quality Management System.

PSG 7.3.7 Criteria for the Compliance with the Requirements

No extra payment shall be made for cube strength testing. The cost of cube strength testing shall be included in the rates tendered for concrete.

Water used for testing shall be free of charge except for failed tests when water will be charged at standard municipal rates.

In the event that the actual achieved average cube strengths of an element are less than 85% of the target mean strength, the Engineer may instruct the taking of cores for additional strength testing. The cost of taking the cores and repairing the holes in the structures shall be for the Contractor's account.

The Engineer will conduct routine tests for the durability parameters on cores taken from the completed elements during the construction, the costs for which shall be to the Employer's account unless the parameters are not met.

The test results shall be accepted or rejected based on the criteria as set out in PSG 7.3.6.1 based on the following categories:

a) Full Acceptance:
Concrete shall be accepted unconditionally and full payment shall be made.

b) Conditional Acceptance:
Concrete may be accepted at the Engineer's discretion with a warning that construction methods be examined to improve the durability criteria. A reduced payment shall be applied to all the relevant pay items under SABS 1200 G for the non-conforming element or concrete pour. Alternatively, the Contractor may elect to carry out remedial work to improve the durability of the concrete to the criterion of "Full Acceptance" to the satisfaction of the Engineer, and receive full payment. All proposed remedial measures shall be subject to the approval of the Engineer. The cost of all such remedial work shall be for the Contractor's account.

c) Rejection:
The concrete shall be removed and replaced with fresh concrete at the expense of the Contractor, as directed by the Engineer.

Should the test result(s) indicate conditional acceptance or rejection of the item tested, the Contractor shall have the option of carrying out additional tests on that item, at his own expense, to confirm or disapprove the original test result(s). Not more than two such additional tests shall be carried out.

PSG 7.3.8 Procedure in the Event of Non-Compliance with the Requirements

Structural concrete elements or concrete pours shall be represented by test cubes and extracted cores, which shall be tested for strengths and the appropriate durability parameters.

If the durability parameters have been proved acceptable, the costs for such testing shall be borne by the Employer. However, where non-compliance to the specified parameters has been identified, the assessed element shall be rejected and at the Engineer's sole discretion any of the following measures may be considered at the Contractor's expense:

a) Coating with an approved product specifically designed to improve the non-conforming parameter depending on the severity of the test results.
b) Acceptance at reduced payment.
c) Demolition and rebuilding.

PSG 7.3.9 Tests Ordered By the Engineer

One concrete cube strength test shall comprise the results of tests carried out on three standard test cubes made from concrete sampled from one batch of concrete in accordance with these specifications.

Percentage payment for concrete cover shall be based on the average result of the total number of cover meter tests performed on a particular concrete element.

The overall percentage payment applied to a concrete member shall be based on the average of the percentage payments applicable to each durability parameter, together with the percentage payment based on the strength requirements described in the project specifications.

The reduced payments shall apply to the relevant payment items scheduled in the Schedule of Quantities.

PSG 7.3.10 Grouting

The Contractor shall, where so ordered, carry out a site test for each grouting procedure. The tests shall be carried out on a dummy bedplate similar in configuration to that which is to be grouted, but not exceeding 1 m2 in area unless otherwise ordered. When the dummy bedplate is dismantled, the underside shall show a minimum grout contact area of 80% with reasonably even distribution of the grout over the surface grouted except that, in the case of expanding grout, the minimum grout contact area shall be 95%. The test shall show evidence of good workmanship and materials and the results shall be to the satisfaction of the Engineer.

The Contractor shall, when so ordered, make standard test cubes from various grout mixtures and also subject them to compression tests to determine whether the specified strength has been achieved. Test procedures shall comply with the relevant requirements of Sub-clauses 7.2.1 to 7.2.3.

PSG 8 MEASUREMENT AND PAYMENT

PSG 8.1.1 Formwork

Add the following Payment Item PSG 8.1.1.7 – 8.1.1.9:

PSG 8.1.1.7 Edges of blinding layer

No separate payment will be made for formwork to the edge of the blinding layer. The rates tendered for concrete to the blinding layer shall cover the cost of such formwork.

PSG 8.1.1.8 Chamfers and fillets

No additional payment will be made for chamfers and fillets up to 40 mm wide. Larger fillets and chamfers will be measured by length in accordance with Sub-clause 8.2.5.

PSG 8.1.1.9 Kickers

Formwork for kickers will be measured as plane (or circular) vertical (not as narrow widths) and no separate payment items will scheduled for kickers.

PSG 8.1.2 Reinforcement

Add the following to Payment Item 8.1.2.2 and 8.1.2.3:

Notwithstanding the method of measuring and paying for reinforcement specified in Sub-clauses 8.1.2.2 and 8.1.2.3, reinforcement will be measured and paid for as scheduled.

PSG 8.1.3 Concrete

Add the following to Payment Item 8.1.3.3:

The rates for concrete shall also cover:

a) the use of dolomitic aggregate where prescribed,
b) the cost of the preparation of design mixes by an approved laboratory and submission for approval by the Engineer,
c) screeded finish of unformed surface as specified in PSG 5.5.10.1, as amended, Screeded finish, and

d) Inclusion of admixtures where specified.

PSG 8.2 SCHEDULED FORMWORK ITEMS

Add the following to Payment Item 8.2:

Rates for formwork shall include any additional items required for the fastening of formwork such as embedded fastening systems.

PSG 8.4 SCHEDULED CONCRETE ITEMS

PSG 8.4.4 Unformed surface finishes Unit: m2

Add the following to Payment Item 8.4.4:

The rates for unformed surface finishes shall cover the cost of providing the respective surface finish as specified in PSG 5.5.10, as amended, Concrete Surfaces.

- Screeded Finish Unit: m²

Add the following Payment Item PSG 8.4.7 :

PSG 8.4.7 Cast in of Pipes through Walls and Floors of Structures Unit: No

Unless scheduled separately, casting in of pipes through walls and floors of structures shall be deemed to be included in the rates for pipes and structures. For scheduled items, different items will be stated for ranges of diameters of pipes to be cast through walls and floors of structures, and thickness of the walls and floors (or type of structure) as applicable.

The tendered rate shall include full compensation for cutting and splicing reinforcing where required, for opening and closing of formwork where required, securing of pipes against uplift and for all additional costs required to install pipes in the exact positions as shown on the drawings. At box-outs for pipes below ground level and for water retaining structures the rate shall include chipping and wire brushing the concrete surfaces to expose the coarse aggregate and coating the surfaces with an approved wet to dry epoxy to specification before casting in of the pipe.

PSG 8.5 JOINTS

Add the following to Payment Item 8.5:

Only designated joints as shown on the drawings will be measured for payment according to the length of each type of joint constructed. The rate shall cover the cost of all materials, labour and plant required to construct each type of joint specified on the drawings, including the cost of all shuttering, treatment of the joint as specified in Sub-clause 5.5.7.3, as amended, the provision of chamfers as specified where concrete is exposed, as well as testing and repairing where necessary. The rate shall also include any waterbars, dowels or other inserts as indicated on the drawings.

Non-designated joints will not be measured for payment.

Add the following Payment Item PSG 8.5.1 to this payment clause:

PSG 8.5.1 Formed joints Unit: m

Formed joints will be measured by the length of the joint.

The rates shall cover the cost of all operations and materials specified in Sub-clause 5.5.7, as amended, and Sub-clause PSG 5.5.7.2, as amended, Formed joints (generally vertical or near vertical), and detailed on the drawings such as joint filler, dowel bars and tubes, joint sealant, bitumen coats, etc., including waterstops or water bars as detailed. The rates shall also include the treatment of the surfaces before applying sealants, fillers, slurries or any other coatings.

Formed joints shall be classified in the bill as on the drawings.

Construction joints which shall be covered with a waterproofing slurry as indicated on the drawings, shall include the rates of the waterproofing slurry and the application thereof.

Add the following Payment Items PSG 8.9 – 8.16

PSG 8.9 NO-FINES CONCRETE Unit: m3

No-fines concrete will be measured by volume. The volume measured shall be based on the neat dimensions as shown on the drawings. The Contractor shall make provision in his rates for additional volume which may be required as a result of any overbreak during excavation.

The rate shall cover the cost of supplying materials, constructing and placing in position the no-fines concrete, and shall include for the steel floated 2 mm mortar skim.

PSG 8.10 ITEMS CAST IN CONCRETE Unit: No.

Items cast in concrete will be measured by number separately for each type of item.

Notwithstanding Sub-clause 8.2.6, the rate shall cover the cost of fixing in position and casting in the item as construction proceeds, irrespective of whether the Contractor chooses to fix the item in the formwork and cast it in directly or to box out a hole and grout the item in subsequently. At box-outs for pipes below ground level and for water retaining structures the rate shall include chipping and wire brushing the concrete surfaces to expose the coarse aggregate and coating the surfaces with an approved wet to dry epoxy to specification before casting in of the pipe.

The item will be measured and paid separately.

PSG 8.11 GRANOLITHIC SCREEDS Unit: m2

Special floor finish will be measured by area. The rate shall cover the cost of the supply and application of the specified material, complete as specified by the manufacturer and to the approval of the Engineer. Repairs to unsatisfactory work will not be paid for.

Measurement of granolithic screeds will be by the surface area covered.

The unit rate or lump sum shall cover the cost of all materials, labour and equipment required to provide the screed as specified in Sub-clause PSG 5.5.10.6, as amended, Granolithic screeds. The rate shall include the steel float finish.

PSG 8.12 WATERTIGHTNESS TEST Unit: Sum

The watertightness test will be paid by a lump sum separately for each structure.

The sum shall cover the cost of all labour, equipment and materials to carry out the tests, as specified in PSG 7.2.5 to rectify faults and to achieve a test result to the satisfaction of the Engineer.
The sum shall include for all water required over and above that required for one filling of the relevant structure based on the assumption that water will be available in time as part of this Contract.

PSG 8.12 DURABILITY TESTS Unit: Sum

The durability test will be paid by a lump sum separately for the reservoir structure.

The sum shall cover the cost of all labour, equipment and materials to carry out the tests, as specified in PSG 7.2.6, to rectify faults and to achieve a test result to the satisfaction of the Engineer. Durability tests will include tests for Sorptivity, Oxygen Permeability, Chloride conductivity, Concrete Cover and Shrinkage as specified in PSG 7.2.6.

PSG 8.13 BITUMEN EMULSION Unit: m^2

Bitumen Emulsion will be used as a bond breaker between surfaces and joints. The rate for the emulsion shall be per square meter and shall include the rate for the cleaning of surfaces, materials and labour required for application.

PSG 8.21 TORCH-ON WATERPROOFING Unit: m^2

Rates for torch-on waterproofing required at the roofs of the guard house and utilities building will be per square meter. Rates shall include the cost of all material, plant and labour required for this installation.

PSG 8.16 POLYURETHANE COATING ON FLOORS Unit: m²

Polyurethane coatings shall be measured per square meter. Rates for polyurethane coatings shall include supply, delivery and installation as well as all materials and colour pigments used as per drawings and specifications. The rates shall cover all components required for the application of the 5 mm screed as per the Supplier's specifications.

PSG 8.17 PREPARATION OF RECEIVING FOUNDATION SURFACES Unit: m²

The unit of measurement shall be the square metre of surface prepared. The rate shall include for all materials, equipment and labour required to prepare surfaces in accordance with Clause 5.5.19

PSH STRUCTURAL STEELWORK (SABS 1200H)

PSH 3 MATERIALS

PSH 3.1 Structural Steel

Add to the Sub-Clause:

Except where scheduled to the contrary or shown on the drawings, the grade of steel to be used in the manufacture of the following shall be that grade normally supplied by reputable manufacturers approved by the Engineer:

All structural steelwork which shall include ladders, safety cages and platforms, shall be manufactured in conformity with SABS 1431 to the following grades:

- Hot-rolled Sections: S355JR
- Hot-formed Hollow Sections: S355JR

Except where shown to the contrary on the drawings or in the schedule of quantities.
All steelwork not specified as Stainless Steel to be sand blasted to SA 2.5 and hot-dip galvanised to SABS 763.

All stainless steel shall be grade 304L, except where shown to the contrary on the drawings or in the schedule of quantities.

Grade 3Cr12 steel shall be used where scheduled or shown on the drawings and shall be fully pickled and passivated prior to installation.

PSH 3.3 Steels Used For Cold-Formed Sections

Add the following to Clause 3.3:

Cold formed sections are to be provided in accordance with BS 2994: 1967.

PSH 3.5 Welding Consumables

Add the following to Clause 3.5:

All welds to be designed to transmit full member strengths and to be 6 mm fillet welded unless specified.

PSH 3.6 Bolts, Nuts And Washers

All bolted connections to be designed in accordance with SABS 0162-1:2005.

PSH 5 CONSTRUCTION

Add the following to Clause 5:

All structural steel works to be carried out in accordance with SABS 2001 – CS1:2005 unless specified otherwise elsewhere.

PSH 5.1.2 Contractor to Provide Shop Details

Add to the Sub-Clause:
The Contractor shall prepare his own shop details based on the dimensions and details given on the drawings and will be required to submit his shop details to the Engineer at least 3 weeks prior to fabrication. Written consent must be obtained from the Engineer, prior to commencing fabrication. The Contractor is still responsible for ensuring that the shop details are dimensionally correct.

PSH 5.2 Fabrication

Add the following to Clause 5.2:

Fabrication of steelwork shall be sequenced so as to limit welding distortion and the possibility of locked-in stresses.

PSH 5.2.6 Handrails

Add to the Sub-Clause:

Handrailing shall be of tubular construction in GMS or Grade 304L stainless steel of an approved proprietary make as scheduled.

Hand and knee rails shall be not less than 32 mm O.D. (wall thickness not less than 1,6 mm) and the height of the handrails (centre) shall be 1 000 mm above walk-way level, with knee rails located approximately midway between.

Stanchions shall be not less than 44 mm O.D. (wall thickness not less than 1,6mm) and shall have ball type or spun and flared connectors to suit horizontal or angled handrailing as required. The base plates shall not be less than 8mm thick.

In general all bends in the hand and knee railing shall be 140 mm radius. Handrails shall be either side or top mounted and shall be fastened with stainless steel nuts, bolts and washers.

Spacing between stanchions shall be determined by site conditions but in no case shall it exceed 1 800 mm c/c. At bends, stanchions shall be provided on either side at a distance of 300 mm from mid-bend.

Finished handrailing shall be true to line and level and connections shall be securely fixed by means of 2 No. stainless steel pins, finished flush on each side of the joints (to the approval of the Engineer).

All ends shall have closures joining the hand and knee railing.

The rate quoted per metre is to include for the supply and installation of the handrail, knee rail, portion of a stanchion, footing, Chemical type holding down bolts and nuts (expanding anchors will not be acceptable) and is to be inclusive of all cutting, mitring, welding, grinding and waste.

PSH 5.2.7 Ladders

Add to the Sub-Clause:
Stairs and ladders are to be provided in accordance with the details shown on the drawings.

PSH 5.2.8 Open Grid Floors

Add to the Sub-Clause:
Open grid steel flooring is to be cut and framed to the required panel shapes and sizes all in accordance with the details shown on the drawings.

PSH 5.2.10 Protective Treatment

Add to the Sub-Clause:
All mild steel shall be hot-dip galvanised except where shown to the contrary on the drawings or in the schedule of quantities. Hot-dip galvanising shall conform to SABS 121;2000 for heavy duty coatings or equivalent. Screwed and socketed tubing shall be galvanised in compliance with BS 1387. Galvanised malleable cast iron fittings shall comply with SABS 509.

PSH 5.2.11 Pipe Clamps and Brackets and/or Supports (New Sub-Clause)

Clamps and brackets around pipes and supports under pipes and valves are to be constructed to the details shown on the drawings and are to be provided with all necessary bolts for fixing to concrete.

Where pipes and valves are supported inside concrete chambers on fabricated steel pipe supports, a layer of 6 mm thick GP rubber sheet (Shore hardness 65) shall be attached to the top surface of the steel support by contact adhesive prior to receiving the pipe or valve to be supported. The rubber is to extend 20mm beyond the edges of the plate.

PSH 5.3.4 Welding

Add the following to Clause 5.3.4:

Details of the weld procedures, consumables to be used in the welding process as well as shop drawings shall be submitted to the Engineer for approval at least 14 days prior to fabrication.

All welding is to be carried out by suitably qualified coded welders. No welding is to take place without the approval of the Engineer.

PSH 5.3.6 Grouting

Add to the Sub-Clause:
The Contractor will be fully responsible for all grouting work under this Contract.

PSH 6 TOLERANCES

PSH 6.1.3 Accuracy of Erection

Add to the Sub-Clause:
The accuracy of erection shall be the degree of accuracy II as tabulated but amended as follows:
In items d)1) and d)2) of the table the Degree of Accuracy given as "$\pm$ 5" shall be read as "$\pm$ 3".

PSH 7 TESTING

PSH 7.1 Test Certificates

Delete the part sentence "in terms of the project specification" from the wording of the Sub-Clause and add the words "when so requested by the former" at the end of the sentence.

PSH 8 MEASUREMENT AND PAYMENT

PSH 8.3 Scheduled Items

Add the following introduction to the subsequent Sub-Clauses:

The tendered rates shall cover the cost of preparing shop details (where applicable), the supply of all materials, fabrication, process control, loading, transporting to Site, off-loading, erection (unless separately included), setting into concrete or brickwork and grouting in. They shall also include for the supply of all nuts, bolts, holding down bolts, washers, rivets, cutting to waste, all temporary bracing, templates and shuttering necessary for installing, transporting and erecting.

Where the scheduled items for steelwork include corrosion protection, then the price stated shall also include for such protection as specified in SABS 1200 HC as amended by PSHC. Similarly the materials and corrosion protection for nuts, bolts, washers etc shall match the steelwork ordered.

Where the requirements of the above introduction conflict with the requirements of Sub-Clauses 8.3.1 to 8.3.6 inclusive the requirements of the introduction shall take precedence. Holding down bolts (i.e. bolts secured in concrete, brickwork etc shall be of the Chemical type (expanding anchors will not be acceptable).

PSHB CLADDING AND SHEETING (SABS 1200 HB)

PSHB 3 MATERIALS

PSHB 3.2 Steel Sheeting

PSHB 3.2.2 Pre-painted Galvanised Steel Sheeting

Add To The Subclause:

"Where indicated on the drawings roof sheeting and/or side cladding, with the IBR pattern shall be of approved manufacture and be pre-painted to the specified colour, shall be supplied and installed. The requisite flashings, gable end closures, ridge pieces and other compatible accessories shall be supplied by the same sheeting manufacturer.
The roof sheeting and side cladding shall, unless otherwise specified or scheduled, be 0,58 mm thick Z275 galvanised steel with a 'Chromadek' finish on one side. Roof flashings, gable ends, ridge pieces and other accessories shall also be 0,58 mm thick Z275 galvanised steel with a 'Chromadek' finish on one side.
Installation shall be in accordance with the manufacturer's details and the finished product shall be entirely weatherproof."

PSHB 3.4 FC SHEETING

Delete The Subclause And Replace With:

PSHB 3.4 TRANSLUCENT SHEETING

Where indicated on the drawings glass-fibre reinforced polyester or polycarbonate translucent roof sheeting as manufactured by "Modek Fibreglass Sheeting" or similar approved shall be supplied and installed. All such sheeting material shall comply with SABS 1150 and shall be 85% translucent. Both sides of the sheeting shall have the gel coat applied."

Add New Subclause:

PSHB 3.11 Shade Cloth/Netting

The nylon cloth/netting shall be UV resistant and shall be manufactured by an approved manufacturer and shall allow 20% light to pass through.
Joints shall be heat-welded continuously along the full length with a maximum overlap of 20 mm, or machine-stitched if approved by the Engineer. Edges shall be prepared as described below.
Machine-stitching shall be by means of a UV-resistant nylon thread of not less than 200 kg breaking strain at a stitch spacing not exceeding 10 mm. All stitching shall be uniform and regular.
Where the outer edge of a single sheet or a set of multiple jointed sheets is to be fixed to a structural element, it shall be fixed along its entire length as follows:
The free edge of each sheet, before fixing to a structural element, shall be free from burs and loose threads, and shall be trimmed to an exact size permitting a wide enough strip for preparation of edge reinforcing.

Edge reinforcing shall be either factory-manufactured or heat-treated on site to fuse all loose threads in a manner which prevents irregularities and fraying when stretched. Where heat-treated on site, the reinforcing strip shall be equivalent to a factory-manufactured edge reinforcing in all respects."

PSHB 5 CONSTRUCTION

PSHB 5.5 Installation of Sheeting

PSHB 5.5.1 General

Add To The Subclause:

"The roof sheeting shall be supplied and installed in the longest lengths available in order to minimise the number of end laps. Narrow flutes shall be outermost, with single flute side laps laid facing away from the prevailing driving rain. All sheets shall be secured to the purlins set generally at 1 500 mm centers utilising the fasteners and fixing methods recommended by the manufacturer. Main fasteners shall be positioned in the crown of the second and fourth narrow

flutes, i.e. two fasteners per sheet per purlin. Sidelaps shall be secured with fasteners spaced equally between purlins and at centres not exceeding 750 mm. 15 mm of the broad flute of all roof sheets shall be turned up through 45 degrees at the apex to form a dam and turned down through 10 degrees at the eaves to form a drip.

The vertical cladding shall be fixed in long lengths, broad flutes outermost, with single flute sidelaps fixed facing away from the prevailing wind. All sheets shall be secured to the grids set generally at 1500 mm centres utilising the fasteners and fixing methods recommended by the manufacturer. Main fasteners shall be positioned in the bottom of the first and third narrow flutes, i.e. two fasteners per sheet per girder. Sidelaps shall be secured with fasteners spaced equally between girders and at centres not exceeding 750 mm. Every care must be taken during construction to ensure that sheeting is kept clean from plaster droppings and any staining of sheeting by any other means.

Any sheeting that is defective or on which then paint coating has been damaged, shall, at the discretion of the Engineer be removed and replaced by the Contractor at his own expense. If by doing so any good work is affected, this work will also have to be replaced at the Contractor's expense."

Add New Subclause:

PSHB 5.8 Shade Cloth/Netting

PSHB 5.8.1 Fixing to Eyelets

Where eyelets are welded to structural steel members or anchored in concrete with PVC-sheathed threads, to the satisfaction of the Engineer they shall consist of 20 mm closed circular rings manufactured from a 3 mm mild steel round bar and shall be spaced apart at not more than 250 mm.

The reinforced edge of each sheet shall be tied to the eyelets with a UV-resistant nylon thread of not less than 200 kg breaking strain with double knots that shall be sealed by heat treatment to prevent self-loosening due to the effects of the temperature. Heat treatment of knots shall consist of applying a heated object to the knot long enough to ensure fusion between threads without adversely affecting its strength.

PSHB 5.8.2 Fixing Around Thin Structural Members

Where fixing to a structural member with a circular profile and with a cross-sectional circumference of less than 300 mm, the edge of the sheet shall be wrapped around the member and heat treated to effect bonding along a continuous edge with the rest of the sheet. The strength of the bond as regards strength, quality and finish, shall be as specified for joints in Subclause PSHB 3.11.

PSHB 5.8.3 Fixing of Continuous Sheet over the Top of a Supporting Structural Element

Fixing of a continuous sheet over the top of a supporting structural element shall not be permitted, in order to allow for uniform movement due to temperature expansion and contraction of single sheets or sets of jointed sheets without warping. Only edges of sheets may be fixed to structural members.

Notwithstanding the requirements specified in the above paragraph, the Engineer may require that a supporting structural element be fixed to the top where excessive sagging of shade cloth/netting becomes apparent at high ambient temperatures, and then only at certain points and in a manner which shall not adversely affect the aesthetic appearance.

All shade cloth/netting shall thus be primarily spanned from outer edge to outer edge at a maximum tension which shall not exceed the maximum working tension and other working properties of the shade netting during periods of maximum contraction."

PSHC CORROSION PROTECTION OF STRUCTURAL STEELWORK (SABS 1200HC)

PSHC 5 CONSTRUCTION

Add the following Clause:

PSHC 5.1 Structural steel

All structural steel members shall be hot dip galvanized unless otherwise indicated on the drawings and BoQ.

PSHC 5.3 Dressing and Repairs During Fabrication

Add to the Sub-Clause:

Edges shall be ground to a smooth radius of at least 2 mm unless otherwise indicated

PSHC 5.4.1 Preparation for Coating-General

Add to the Sub-Clause:
The work of surface preparation prior to painting shall be carried out at the manufacturer's works.
The work of surface preparation prior to galvanising shall be carried out at the galvaniser's works.

PSHC 5.4.3.1 Abrasive Blast Cleaning

Add to (a) General:

The standard of blast cleaning required in terms of Swedish Standard SIS-05-59-00 is Sa 2 1/2.

The surface profile after blasting shall be in accordance with the paint manufacturer's requirements for the particular paint system being used.

Add to (b) Dry Abrasive Blast Cleaning

The blast cleaning media shall not be recycled.

PSHC 5.4.3.2 Cleaning by Hand or with Power Tools

Add to the Sub-Clause:
Cleaning by hand or power tools, where permitted or ordered by the Engineer, shall be to standard St 3 of SIS-05-59-00.

PSHC 5.7 Coating system for New Steelwork

Add to the Sub-Clause:

All structural steel members shall be hot dip galvanized

The coating system to be applied under this Contract shall be carried out strictly in accordance with the manufacturers instructions which written instructions shall be obtained by the Contractor and a copy handed to the Engineer's Representative prior to commencing painting operations.

The paint system to be used shall be selected by the Contractor from the following alternative systems:

PSHC 5.7.1 Painting System No. 1
For structural steelwork coastal regions - exterior work

AECI Dulux	DFT (µm)	Plascon	DFT (µm)
Zinc galv 6(2)	75	Zinc rich primer M1 233	70
Zinc galv 1	touch up	Chemcote High Build CHC 101 – light grey	70

Chlorinated Rubber – Kemrist	90 165	Chemcote enamel CHC 3000 series	30 170

PSHC 5.7.2 Painting System No.2
For structural steelwork coastal regions - interior work

AECI Dulux	**DFT (µm)**	**Plascon**	**DFT (µm)**
Zinc galv 6(2)	60	Degrease with Aquasolv GR	-
Zinc galv 1	touch up	Zinc phosphate Primer UC 182	55
Chlorinated Rubber - Kemrist	60 120	Alkyd undercoat UC 189	35
		Enamel	30 120

PSHC 5.7.3 Painting System No.3
For overcoating galvanised work

AECI Dulux	**DFT (µm)**	**Plascon**	**DFT (µm)**
Prepare surface Galvkleen	-	Prepare surface cleaner GIC	-
Corrocote 2(2)	10	Galvogrip metal primer	30
Chlorinated Rubber – Kemrist	70 80	Universal undercoat UCI	30
		Supergloss Enamel Code G	25 85

PSHC 5.8 Application of Painting Coatings

Add to the Sub-Clause:
No application of paint shall be carried out before the paint manufacturer has approved the firm of applicators and the plant to be used, except where instructed to the contrary by the Engineer.

Where applicable, the range of temperature, outside the range of +5º to 35ºC, within which paint may be applied, shall be that range which the Contractor shall obtain in writing from the manufacturer of the paint.

The embedded lengths of irremovable fasteners which penetrate deeper than 75mm from the concrete face may be left as base metal. The remaining portion shall comply with the paint system specified for the adjacent steelwork.

Surfaces which will become inaccessible for coating after fabrication or erection shall be given the full paint treatment specified plus one further top coat prior to the surfaces becoming inaccessible.

PSHC 5.9 Application of Metal Coatings

Add to the Sub-Clause:
The grade of HDG (hot dipped galvanising) required shall be carried out in accordance with SABS 121:2000, and shall be that for heavy duty coatings. This shall be applicable to all metalwork where HDG is called for either on the drawings or in the Schedule of Quantities.

PSHC 7 TESTING

PSHC 7.1d) Testing by the Contractor

Tests are not required to be carried out after the application of each intermediate coat.

PSHC 7.3.8 Dry Film Thickness

The frequency of DFT test readings required is to be in accordance with SABS Method 141.

PSL MEDIUM PRESSURE PIPELINES (SABS 1200 L)

PSL 1 SCOPE

Replace Clause 1.1 with the following:

This specification covers the supply and installation of pipelines, specials and fittings for rising mains, gravity mains, pipework for pumping installations and reservoirs as well as reticulation.

PSL 2 INTERPRETATIONS

PSL 2.4 Abbreviations

Add the following:

"HDPE	:	High Density Polyethylene
mPVC	:	Modified Polyvinyl Chloride
oPVC	:	Orientated Polyvinyl Chloride
DI	:	Ductile Iron
GRP	:	Glass Reinforced Polyester
CML	:	Cement Mortar Lining
FBMDPE	:	Fusion Bonded Medium Density Polyethylene"

PSL 3 MATERIALS

PSL 3.1 General

The materials and construction of all pipes, fittings, valves and specials shall comply with the appropriate SANS, BS or other appropriate specification, whether stated or not, and shall be approved by the Engineer. Only full-length pipes bearing the relevant standard's mark will be acceptable. Cut pipes shall only be used at pipe junctions to position valves and specials as shown on the drawings, and at connections to structures. When laying the pipes the markings shall be visible from above.

The Contractor shall be responsible for the structural and hydraulic design of all fabricated steel pipe specials (puddle pipes in hydraulic test point anchor blocks, offtake chambers, isolating valve chambers, meter chambers, non-return valve chambers etc) where these are not standard off-the-shelf items designed and guaranteed by the manufacturer for the purpose intended (see also PSL7 for quality control requirements for specials).

Add the following subclauses:

PSL 3.1.1 Materials Control

PSL 3.1.1.1 Checking Material Lists and Drawings

In the case of materials to be supplied by the Employer as "free issue", not more than 4 weeks after the contract has been awarded the Contractor shall complete his check of the available materials in the stock yards against the drawings and advise the Engineer of any shortages or omitted items.

The materials stored in the stock yard/s for "free issue" by the Employer to the Contractor shall be fully inspected by the Contractor to confirm compliance with the specification and once satisfied, the Contractor shall sign acceptance of the material where after, any damage or other problems with the materials so accepted by the Contractor shall be the responsibility of the Contractor.

If any variations in the contract are authorised, the Contractor shall ensure that any additional items to be supplied by the Contractor (or the Employer where applicable) are ordered in good time so as not to cause delay to the works.

The Contractor shall check the delivery timing of all items and ensure that it is in line with the Contract program. Any critical items that could be delivered late are to be brought to the attention of the Engineer.

The delivery status of materials is to be checked and followed up upon by the Contractor throughout the contract.

PSL 3.1.1.2 Materials Control – General

The Contractor is held responsible for the inspection and control on site of all the materials and equipment for the duration of the Contract. Once material and equipment has been accepted, any subsequent damage shall be made good to the satisfaction of the Engineer at the expense of the Contractor. Damage to internal linings and external coatings that are necessary and incidental to good welding practices and the manufacturing of pipe specials are excluded.

Any item damaged beyond repair shall, at the discretion of the Engineer, either be replaced at the Contractor's expense or the value reimbursed in full to the Employer as appropriate.

PSL 3.1.1.3 Acceptance of Pipes, Fittings and Materials

Before acceptance of any pipes, fittings or other items of equipment the Contractor is to carry out a thorough inspection to ensure that the materials have been delivered undamaged and are as ordered.

Pipes shall be checked for:

1. Identification
2. Certification
3. Soundness and Internal lining
4. Ends bevelled correctly
5. Circumference according to specification and within tolerance

Inspection of pipe fittings, valves and other equipment shall include, but is not limited to:

1. Identification
2. Certification
3. Material schedule and rating
4. Lining, where specified
5. Coating where specified
6. Circumference according to specification and tolerance
7. Damage to items – example flange faces

Defective items shall not be accepted, but marked, quarantined and immediately reported to the Engineer.

If accepted, the Contractor shall take the required steps to ensure that all delivery documentation together with signed acceptance notes is filed in the Construction Dossier.

PSL 3.1.1.4 Material Storage

The Contractor shall store all items so that no damage occurs whilst awaiting installation. Where practical, items are to be stored in lockable containers for protection from the weather and pilferage.

All piping, pipe fittings and equipment stored outside or awaiting installation are to be protected from the weather, stormwater and soil wash and stored on pre-prepared surfaces. Pipes taken over from the Employer shall receive the required attention in order to ensure safe storage in yards, protected from fires, vandalism and incidental damage that can reasonably be prevented.

PSL 3.1.1.5 Handling Pipe, Fittings and Equipment

Strict supervision shall be maintained at all times when handling pipes and equipment. Particular attention is to be given to correctly rated lifting gear, slings and lifting beams. All lifting gear is to be inspected regularly for signs of wear and tear in terms of the relevant Safety Legislation and Clauses. Equipment is to be lifted at the recommended points specified by the manufacturer. Pipe is to be lifted with a lifting beam and slings, which shall be fitted at quarter points around the pipe. Due care shall be taken when fitting and placing slings to ensure that ancillary items do not get crushed during lifting. Pipe coating is to be protected by padding or otherwise from scuffing damage during lifting.

The equipment utilized for lifting pipes is subject to approval by the Engineer, which approval shall in no way absolve the Contractor of any responsibility in this regard, and all equipment judged unsuitable according to this specification or found to be unsuitable in practice shall be removed from site and replaced at the Contractor's expense. It is prohibited to handle pipes using chains or any other device involving metal contact with the pipe coating.

The Contractor shall ensure that all lifting equipment complies with the relevant safety regulations at all times.

Wet sponge tests shall be done to detect holidays on coatings and linings (where appropriate) of the pipes.

The Contractor shall, at his own expense, test each and every surface area, internal lining (where appropriate) as well as external coating during construction as per this specification. Testing for holidays shall be done after inclusion of materials, manufactured specials and equipment, as well as pipes, into the permanent works. Any defects found shall be repaired and the costs for remedial work shall be deemed to be included in the tendered rates for the construction of the pipeline. These tests and results shall be recorded on the Quality Control Plan as approved by the Engineer.

PSL 3.4 Steel Pipes, Fittings and Specials

PSL 3.4.1 General

Add to the subclause:

"All steel pipes and fittings under this contract shall be to the dimensions and details shown on the drawings or schedule of quantities. All pipes, fittings and specials shall have their relevant item numbers painted onto the exterior surface prior to despatch from the factory.

Steel pipes supplied by the Employer shall be checked for acceptance by the Contractor in accordance with SANS 719 and including the integrity of the coatings and linings."

Further, it is a contractual requirement that all Steel pipe and fabricated steel specials shall be fabricated in accordance with an approved quality control plan (QCP). Manufacture shall not commence until such time as the QCP has been approved by the Employer's Agent. The Contractor shall, in consultation with the Engineer, prepare and submit for approval a draft QCP within 14 days of award of the contract.

The Engineer shall approve the QCP, subject to amendments if necessary, and advise the Contractor accordingly within 14 days of receipt of the draft QCP. The QCP shall address inter alia the following tests/inspection:

TYPICAL QUALITY CONTROL TESTS OR INSPECTIONS	
PARAMETER	**COMMENT**
Material certification	To comply with the relevant standards
NDE testing	To comply with the relevant standards
Verification of tolerances	eg "Go, No-Go" gauges
Surface preparation	eg cleanliness and blast profile
Coating / lining performance criteria	To comply with the relevant standards
Material identification	To comply with the relevant standards
Personnel certification (including welders and NDE)	To comply with the relevant standards
Weld preparation	To comply with the relevant standards
Compliance with dimensional tolerances	To comply with the relevant standards
Hydrostatic testing	To comply with the relevant standards
Coating/lining thickness tolerances	To comply with the relevant standards

An independent Inspectorate employed by the Engineer shall verify that the QMP is being adhered to and sign-off acceptance of each and every special delivered to site. No specials shall be incorporated into the Works until signed-off. A Method Statement for any remedial works required to achieve compliance shall be agreed with the Engineer and the costs of all such work be to the Contractor's account.

PSL 3.4.2 Pipes of NB up to 150mm

In the second and third lines delete 'medium class, shall be screwed' and substitute with 'heavy duty class, shall have plain ends, and be hot dipped galvanised.'

PSL 3.4.3 Pipes of NB over 150mm

Delete the contents of this sub clause and substitute:

PSL 3.4.3.1 Grade of Pipe

All pipes supplied shall comply with SANS 719/71, as amended by this project specification.

SANS 719 Grade B steel shall be used for pipes unless otherwise specified in the drawings or in the schedule of quantities

PSL 3.4.3.2 Welds

Pipes shall be manufactured from steel strips or plates continuously welded along the seams and the height of the inner weld reinforcement shall not exceed 1mm. In the case of pipes used with couplings, the external weld reinforcement shall be ground flush with the outer wall of the pipe over a suitable distance of the pipe. Pipes must have a continuous helical seam but for smaller than 300mm diameter, longitudinal and circumferential seams would be acceptable.

PSL 3.4.3.3 Hydraulic Testing at the Factory

Each pipe shall be hydraulically tested in accordance with SABS 719, clause 7.3 to 3500kpa."

PSL 3.4.4 Fittings and Specials

Add the following:

"All bends, fittings and specials shall be manufactured from straight pipe specified elsewhere unless otherwise stated in the Bills of Quantities

The lengths of the pipes shall be as dimensioned on the drawings but shall be verified on site prior to fabrication.

All steel bends, fittings and specials shall be fabricated to the dimensions and details shown on the drawings and/or described in the Bills of Quantities.

The sides of taper pieces shall diverge at an angle of not more than 11° to each other.

Individual bends, fittings and specials smaller than DN 200 shall be hot-dip galvanised to heavy duty grade in accordance with SABS 121:2000 after fabrication. Where a hot dipped galvanised fitting is to be welded to a coated and lined pipe, the galvanising is to be abraded off prior to welding. The external coating at the welded joint is to be primed and coated with an approved anti corrosion system.

Bends, fittings, and specials of DN 200 and larger shall have the internal lining and external coating made continuous ("made good") as specified elsewhere for welded joints on coated and lined pipes.

Bends, fittings and specials shall be manufactured and tested in accordance with the specification for straight pipe and additionally with Section 8 of BS EN 10311: 2005 and BS 10224: 2002. The nominal dimensions of each bend, fitting and special required are itemised in the Bills of Quantities and/or on the drawings and 'exact length' tolerances shall be adhered to. All plain ends on bends, fittings and specials shall have the plain ends prepared for butt welding except those plain ends that are to be jointed with adaptor joints or bell ends.

Bends shall generally be of the formed type except where otherwise stated or shown on the drawings.

The bend, fitting, and special fabricator shall supply written confirmation that all hand welding was carried out by coded welders.

The Contractor will be responsible for the design and provision of strengthening webs, crotch plates, gussets etc as may be necessary to prevent excessive deflection or deformation of fittings and specials when subjected to hydraulic pressure tests, and the tendered rates for the work will be deemed to include for the design and provision of this reinforcing wherever necessary. All calculations are to be submitted to the Employers Agent prior to fabrication. All crotch plates, wrappers, collars and gussets to be provided by the Contractor under this Contract are to be manufactured from SANS 719 Grade B steel, or of the same grade as the main pipe.

Bends shall be fabricated in accordance with the Table below.

Deflection of Angle	
Up to and including 3 °	One pipe end scarfed on site
Exceeding 3 ° and up to and including 9 °	Mitre cut (two pipe ends scarfed on site)
Exceeding 9 º but less than 15 º	2 segment bend
15 º and larger but less than 45 º	3 segment bend
45 º and larger but less than 60 º	4 segment bend
60 º and larger but less than 75 º	5 segment bend
75 º and larger but less than 90 º	6 segment bend

Long radius bends shall have a centre to face radius of at least 2.5 times the pipe diameter.

Bends greater than 90º shall be fabricated from combinations of items from the table above.

Shop drawings of bends, fittings and specials shall be submitted to the Engineer for approval prior to manufacture.

All flanged bends, fittings and specials shall be hydraulically tested at the fabricator's premises to the same pressure that they will be subjected to during the hydraulic testing of the completed pipeline. No visible signs of leakage will be permitted. Cutting and welding of flanged bends, fittings and specials will not be permitted on site. Any adjustments required due to on site conditions will have to be made at the fabricator's premises and all coating and lining repairs and tests completed prior to being returned to site."

Add the following new subclauses:

PSL 3.4.5 Stainless Steel Pipework

Pipework fittings and specials shall comply with the dimensional requirements specified for mild steel pipe work, fittings and specials. The wall thickness shall be not less than 4,0 mm for pipes of diameter up to 150 mm and not less and 5,0 mm for pipes exceeding 150 mm in diameter, or as called for on the pipe schedules.

Stainless Steel pipework, fittings and specials shall be Grade 304L and shall not be supplied coated unless otherwise specified.

Plain ends of pipes and fittings shall be covered and protected against damage whilst being transported and stored.

PSL 3.4.6 Puddle Collars and Anchoring Flanges

Puddle collars and anchoring flanges used as pipe anchorages shall be of the same dimensions as corresponding flanges but those cast into concrete walls are to be undrilled. The collar/flange shall be capable of transmitting a longitudinal force 33% greater than the internal hydraulic pressure to be applied when testing, multiplied by the area of the bore and, under that condition, the stress in the material shall not exceed its yield stress.

Where puddle collars are shown on the drawings as being 20 mm thick, those collars are not required to transmit thrust, their purpose being to assist with the waterproofing of the concrete chambers by increasing the path that ground water might have to take to enter the chambers.

Where polyethylene pipes are cast into concrete structures, they shall be specially prepared and adapted by positioning a custom-made tight-fitting natural rubber sealing sleeve around the circumference of the pipe and in the case of structured-wall pipe creating shear keys through removing small segments of the outer wall. The rubber seal shall be 10 mm thick and 200 mm wide or 80% of the width of the wall and shall be 60 to 65 shore hardness, with a vulcanised joint. It shall need to be stretched over the pipe circumference to ensure a tight fit.

PSL 3.4.7 Closure Pipes

Closure pipes, which are to be cut on site to the exact lengths, shall have the diametrical tolerances specified for the pipe ends applied over the full length of the pipe. Closure pipes shall be supplied in standard lengths.

PSL 3.4.8 Welding Tests at fitting Fabrication Shop(s)

PSL 3.4.8.1 Qualification Tests for Welding Procedures

Only appropriately coded welders may be used.

The qualification tests for welding procedures shall be carried out generally in accordance with the requirements of the American Petroleum Institute API 1104. The detailed procedure to be adopted during manufacture shall be established and the quality of the welds so produced shall be determined by carrying out one transverse tensile weld test and two guided cold bend tests on suitable coupon plates.

The tests are to be carried out before fabrication of fittings is commenced.

The coupon plates shall be prepared either from plates of the same material as the pipe and welded in a similar manner to that to be used during production, or by cutting suitable specimens from a pipe selected at random by the Engineer from the first production. The coupon plate for the tensile weld test and those for the guided cold bend tests shall be prepared in accordance with the requirements of SANS 719.

The qualification tests shall be considered satisfactory if:

a) The weld has a joint efficiency greater than 95% of the minimum specified tensile strength of the parent metal and,
b) The bend test specimens are capable of being bent around a former with a diameter equal to six times the nominal thickness of the plate to an angle of 180 degrees without developing a crack, except at the arises of the specimen, of length or width greater than 3 mm.

Failure to pass the above qualification tests shall result in the rejection of any pipes welded with the procedure used and the preparation of a new qualification of procedure test.

Any changes in the electrode case type used or change of flux used shall require a qualification test before approval of the procedure is granted.

PSL 3.4.8.2 Radiographic Examination of Shop Welds

The Contractor shall include in his prices for the supply of fittings and specials, the cost of carrying out, under the supervision of the inspector appointed by the Employer, examination of shop welds on the following basis:

a) One hundred percent radiographic examination of all welds deposited manually or semi-automatically in fittings and specials which cannot be hydraulically tested prior to the fittings and specials being installed in the pipeline.

b) Ten percent radiographic examination of all welds deposited manually or semi-automatically in specials and fittings that are to be tested hydraulically prior to the fittings and specials being installed in the pipeline.

The Engineer shall in all cases determine which welds are to be radiographed on the quantity basis specified above. All radiographs and records thereof made by the Contractor shall be made available to the Engineer to enable him to determine whether the welds are acceptable or not and no coating, lining or wrapping of pipes shall be permitted until the welds have been accepted by the Engineer. To avoid unnecessary delays, at the option of the manufacturer, radiographs may be approved by the manufacturer's inspectors subject to them being subsequently approved by the Engineer.

When a section of the weld is shown by radiography to be unacceptable, and if the limits of the deficient weld are not defined by the radiograph, additional radiography shall be carried out at the Contractor's expense until the limits of the deficiency are determined.

Repairs shall be made to defective welds at the Contractor's expense. All repair welds shall be identified with a stamp marking, indicating which welder conducted the repair. Repaired welds shall be radiographed at the Contractor's expense but after any repair welder has had ten consecutive repairs approved, the extent of the radiography of the repairs conducted by the welder may be decreased by agreement between the Engineer and the Contractor.

PSL 3.7 Other Types of Pipes

PSL 3.7.2 Polyethylene Pipes

Delete this Subclause and replace with the following:

PSL 3.7.2: Polyethylene (PE) Pipes and Fittings

All pipe and fittings are to be PE-100, compliant to SANS ISO 4427 Part 1 unless otherwise specified. Pipe must be supplied from a SABS and ISO 9001 approved manufacturer and member in good standing with SAPPMA (South African Plastic Pipe Manufacturers Association), and will meet the following:

Pipe Characteristics	*Applicable Standard*
Outer Diameter	ISO 11922-1 (Grade B)
Min Wall Thickness at any point	ISO 11922-1 (Grade U) – ISO 4065
Ovality	ISO 11922-1 (Grade N)

All HDPE Pipes shall be indelibly marked at 1 metre intervals in accordance with the applicable SANS / ISO standard:

- TRADE NAME Manufacturer/Supplier Name
- SPECIFICATION SANS ISO 4427
- PIPE OD e.g. 630
- PIPE OD TOLERANCE Grade B
- WALL THICKNESS e.g. 51.4
- NOMINAL PRESSURE e.g. PN 12.5
- MATERIAL DESIGNATION PE 100
- BATCH No. Manufacturer/Supplier Trace ability
- PROJECT NAME XXXXXXX

PSL 3.7.2.1 Unreinforced PE pipes

Unreinforced PE pipes and fittings shall comply with the relevant requirements of SANS/ISO 4427.

PSL 3.7.2.2 Steel-mesh-reinforced Polyethylene (PE) pipes

Steel-mesh-reinforced PE pipes shall comply with the requirements of SANS 370.

PSL 3.7.2.3 Materials Control – General

The Contractor is held responsible for the inspection and control on site of all the materials and equipment for the duration of the Contract. Once material and equipment has been accepted, any subsequent damage shall be made good to the satisfaction of the Engineer at the expense of the Contractor.

Any item damaged beyond repair shall, at the discretion of the Engineer, be replaced at the Contractor's expense.

PSL 3.7.2.4 Acceptance of Pipes on Delivery to Site.

The Contractor is to ensure that the manufacturer makes available a full-time field technician to supervise the offloading, stacking and protection of the pipes to ensure that all the manufacturer's specifications and requirements regarding stacking and storage are met.

Before acceptance of any pipes, the Contractor is to carry out a thorough inspection to confirm together with the field technician that the materials have been delivered undamaged and are as ordered.

Defective items shall not be accepted, but marked, q
ed and immediately reported to the Engineer.

Add the following sub-clauses:

PSL 3.7.3 mPVC Pipes

mPVC pipes shall not be permitted unless otherwise shown or agreed with the Engineer

PSL 3.7.4 oPVC Pipes

oPVC pipes shall not be permitted unless otherwise shown or agreed with the Engineer

PSL 3.7.5 Ductile Iron Pipes

Ductile Iron pipes, fittings and accessories shall be fitted with spigot and socket rubber ring joints and shall comply with the relevant requirements of BS, EN 545: 2010 and ISO 2531- 2009.

The following documents form a part of this Specification to the extent specified herein. In any case of conflict, the requirements of this Specification shall prevail. The latest issues shall apply.

BS EN545: 2010	:	Ductile Iron pipes, fittings, accessories and their joints for water pipelines – Requirements and test methods.
ISO 2351 – 2009	:	Ductile Iron pipes and fittings, fittings, accessories and their joints for water pipelines – Requirements and test methods.
ISO 4179	:	Ductile Iron pipes for pressure and non-pressure pipelines – Centrifugal cement mortar lining – general requirements.
ISO 8179-1/2	:	Ductile iron pipes – External zinc coating with finishing layer.
ISO 8180	:	Ductile iron pipes – Polyethylene sleeving.
ISO 4633	:	Rubber seals-Joining rings for water supply, drainage and sewerage pipelines-Specification for materials
EN15189	:	Ductile Iron pipes – External polyurethane coating
BS EN 14901:2006	:	Epoxy coating for Ductile Iron pipes and fittings

PSL 3.7.5.1 Ductile Iron Fittings and Accessories

All bends, fittings, couplings and other accessories for ductile iron (DI) pipe shall be fabricated from ductile iron (DI) and shall comply with the test pressures as specified.

Corrosion protection coatings (external) and linings (internal) for fitting and accessories shall be as specified for pipes save that, where appropriate, hand application of linings and coatings may be used.

Repair work shall be carried out as for pipes.

PSL 3.7.5.2 Corrosion Protection of Ductile Iron (DI) Pipes

Unless otherwise stated, ductile iron pipes shall be cleaned and then externally zinc sprayed with a finishing layer (coating) to ISO 8179-1.

Pipe ends shall be coated as follows:

1. External surface of spigot: Zinc spray coating with finishing layer
2. Flanges and sockets (face and internal surface): Bituminous paint or synthetic resin paint to supplement the zinc spray coating. All paints shall be approved for use on potable water applications by an approved body (USA Environmental Protection Agency (EPA) or similar).

External Zinc Coating and Finishing Layer

The external coating of centrifugally spun ductile iron pipes shall comprise a layer of metallic zinc, covered by a finishing layer of bituminous or synthetic resin paint compatible with zinc. Both layers (zinc and finishing layer) shall be works-applied using suitable spray equipment.

The metallic zinc coating shall cover the external surface of the pipe and provide a dense and continuous uniform layer. It shall be free of bare patches, areas of lack of adhesion or other defects and shall be visually uniform. The mean mass of zinc shall not be less than 200 g/m^2. Zinc purity shall be at least 99.99%.

The finishing layer (bituminous or synthetic resin paint) shall be physically and visually uniform over the entire metallic zinc layer and shall be free from defects such as bare patches, areas of lack of adhesion, air bubbles, pinholes, runs and sags. The mean thickness of the finishing layer shall not be less than 70 µm and the local absolute minimum thickness shall be 50 µm.

Shop and Field Repairs

Damage to coatings where the area of total removal of zinc has a width exceeding 5 mm or other areas designated by the Engineer shall be repaired in the following manner:

Where applicable, remove the finishing layer by mechanical or other means, to 50mm beyond the zinc area to be repaired, to achieve a sound, clean zinc substrate surround.

Repair the damaged area by means of metallic zinc spray or by means of a zinc rich paint containing at least 90% zinc by mass as appropriate. The mean mass of the cured applied zinc paint dry film shall not be less than 200 g/m^2. The zinc paint repair shall terminate 10 to 15 mm from the finishing layer of the repair site. The zinc repair site shall appear visually uniform and shall be free of defect.

Once the zinc repair has cured completely, the entire area shall be painted with bituminous or synthetic resin paint, overlapping at least 20mm onto the sound undisturbed finishing layer and allowed to cure. The finishing layer shall be defect free and appear to be visually uniform and shall be allowed to cure completely before being handled or buried.

Polyethylene Sleeving

Where specified for Ductile Iron pipes as an additional external corrosion protection barrier to the zinc coating and finishing layer, polyethylene sleeving shall comply with ISO 8180 – 1995. The nominal thickness of the sleeving shall not be less than 200 µm and the density shall be between 910 and 930 kg/m^3.

Internal Cement Mortar Lining

The cement mortar lining of ductile iron pipes shall constitute a dense, homogeneous layer covering the entire internal surface of the pipe barrel. It shall be works applied by centrifugal spinning process or by centrifugal spray head or a combination of these methods. Troweling to achieve a smooth internal bore shall be permitted.

The cement mortar mix shall comprise cement (or high alumina cement) to ENV 197-1, suitably graded sand (with no organic impurities, fine clay particles or other deleterious matter that may adversely affect the mortar quality) and potable water. Chloride-free admixtures shall be permitted with the approval of the Engineer. The ratio of sand to cement shall not exceed 3.5 by mass. The water / cement ratio shall be determined for the particular lining process and this ratio shall be maintained to achieve the relevant specifications.

The freshly applied lining shall be cured by approved means to provide sufficient hydration of the cement and, after curing, the cement mortar shall have a minimum 28-day compressive strength of 50 MPa.

The surface of the cement mortar lining shall be uniform and smooth and shall have a nominal lining thickness and minimum lining thickness as indicated below. Trowel marks may be evident but there shall be no recesses, intrusions or local defects which reduce the thickness to below the minimum thickness specified below. Upon installation, the pipes shall have a minimum Hazen Williams smoothness coefficient of 120 (C >= 120).

Fine crazing or hairline cracking associated with cured cement-rich mortars will be acceptable provided that there is no evidence of mortar disbondment from the substrate. The maximum permissible shrinkage crack width and radial displacement is given below.

CEMENT MORTAR LINING THICKNESS AND PERMISSIBLE CRACK WIDTH			
Diameter Nominal (DN)	***Lining Thickness***		***Maximum crack width and radial displacement***
	Nominal [1]	***Tolerance [2]***	
40 to 300	*4.0*	*-1.5*	*0.4*
350 to 600	*5.0*	*-2.0*	*0.5*
700 to 1200	*6.0*	*-2.5*	*0.6*
1400 to 2000	*9.0*	*-3.0*	*0.8*
NOTE: *1. Pipe ends may have a chamfer not exceeding 20 mm in length* *2. Negative tolerance specified only*			

Shop and Field Repairs

Where cement mortar lining repair is deemed to be necessary, it shall be repaired in the following manner:

Defective mortar shall be carefully removed to ensure that adjacent sound mortar is fully bonded to the ductile iron pipe substrate.

The adjacent sound mortar shall not be feathered but shall be cut-back at approximately an 80° angle to achieve a “dove-tail” joint.

All mortar shall be removed from the repair area to achieve a clean ductile iron pipe substrate and the repair area shall be washed with copious quantities of potable water.

The repair shall be effected using either a rich cement mortar or a compatible polymer mortar (EPIDERMIX 338 or similar approved) which shall be worked in by hand; care being taken to avoid the inclusion of air bubbles. Latex additives, designated (by EPA or similar body) as being suitable for use on potable water installations may be used.

Large Repair Areas.

The repair shall be smoothly and neatly trowelled to match the adjacent pipe profile.

PSL 3.7.6 Glass Reinforced Polyester Pipes (GRP)

Glass Reinforced Polyester pipes and fittings shall conform to ASTM D3262 and ASTM 3754 and AWWA C 950.

The applicable SABS specification for these pipes is:

SABS 1748 – 2004 Part 1 Glass - Fibre – Reinforced Thermosetting Plastics (GRP) pipes Part 1 Pipes for Water Supply, Sewerage or Drainage.

The manufacturer shall have an ISO 9001: 2008 Quality Management System.

Installation

Installation shall be in accordance with SABS 1200 LB and LD for Flexible Pipes. Pipes shall be either plain ended with Double Bell couplings or Bell and Spigot. A typical pipe will be described as PN 16 DN 700 SN 5000 GRP pipe

ESR - Glass shall be used for sewer applications and E- Glass shall be used for water applications."

PSL 3.8 Jointing Materials

PSL 3.8.2 Flexible Couplings

Delete the subclause and replace with the following:

"Where ordered, steel flexible couplings are to be of the "Viking Johnson"/"Klamflex"/"Aqualok" or similar approved type without central registers, each comprising one centre collar, two special flanges, two rubber rings and hot dipped galvanised mild steel bolts.

Steel couplings shall be assembled strictly in accordance with the manufacturer's instructions and all bolts shall be torqued to the value recommended by the manufacturer. On completion of hydraulic pressure testing of the installation, the entire joint shall be protected as described in Clause PSL 3.9.3.8.

The tendered prices for laying and jointing are to include for the supply of all necessary materials, plant and labour to complete the joint and necessary corrosion protection as specified.

Flexible couplings shall conform generally to BS 10311: 2005 for slip-on type couplings and shall be of approved manufacture. They shall be capable of being tightened and released without damaging or improperly distorting the rubber seating rings and shall be designed to prevent the rubber rings being blown out under pressure or sucked in under vacuum.

Each coupling is to be capable of withstanding the test pressure applicable to the pipes with which they are to be used without exceeding a stress in the steel of 67% of the yield point.

Mild steel couplings shall be protected by an approved epoxy coating system such as an approved solvent-free epoxy (SFE) system such as "Nordbak 1" or similar approved system and applied within 4 hours of abrasive blast cleaning the metal surfaces of the coupling in accordance with ISO 8501-1 Grade Sa 2½. Nuts, bolts and washers shall be hot dipped galvanised. The plain end of the pipe shall be properly prepared, and in the case of steel pipes before corrosion protection, so as to accept the flexible coupling.

Adaptor couplings and anchoring adaptor joints shall comply with the above specification for flexible couplings and be of a similar design, but one end shall be flanged to enable connection of plain ended pipes to flanged joints. The adaptor joints are to be complete with bolts and nuts for connecting the flanged joint to the anchoring flange situated generally 300 mm to 400 mm from the plain end of pipe. All bolts, nuts and washers are to be hot dipped galvanised. In order to anchor the plain ended pipe to the flanged joint all of the bolts for the flanged joint are to pass though the anchoring flange and are to be fitted with nuts and washers at the flanged joint and on either side of the anchoring flange."

Dismantling joint shall comply with the above specification for flexible couplings and be of a similar design, but both ends shall be flanged to enable connection of two flanged joints. The adaptor joints are to be complete with bolts and nuts for connecting to each flange. All bolts, nuts and washers are to be hot dipped galvanized.

PSL 3.8.3 Flanges and Accessories

Add the following:

"All flanges, gaskets, bolts, nuts washers and other appurtenances required for the execution of the work under this Contract shall be supplied and installed by the Contractor under this Contract and shall comply with the following:

1. **The sizes and drillings shall comply with SANS 1123** as shown on the drawings or as scheduled in the Bills of Quantities.
2. **Flanges shall be sized and drilled to Table 16 as a minimum unless otherwise specified in the drawings or in the schedule of quantities. Flanges** shall be sized and drilled to match the pressure rating of the adjacent fitting or pipe for pipes and fittings rated > 16 bar.
3. Flanges cut from steel plate shall be machined flat on the front face, but with a raised face.
4. All PE flange connections to PE or other materials shall be of the HP type unless otherwise stated.
5. For PE flanges, the spigots shall be of sufficient length to enable both HE butt welding and HW welding.
6. Backing flanges for PE shall be manufactured from galvanised or powder coated steel
7. The use of standard stub ends for PE pipes shall not be permitted.
8. The body of PE flanges shall be manufactured in the injection moulding process or alternatively, in the case of larger dimensions, from a piece of homogeneous semi-finished material. Semi-finished materials manufactured from wound rods or the subsequent application of other forms of reinforcing shall not be permitted.
9. Proof that flanges and accessories are manufactured in accordance with DIN EN ISO 9001 shall be provided.
10. No machining need be carried out on the back face (except where insulating flanges are to be installed) provided that face is sufficiently flat to ensure square bedding of the bolt heads and nuts and provided that all weld reinforcement is removed.
11. Temporary end covers shall be provided by the Contractor for protection of flanges, and prepared plain ends of pipes and fittings to prevent damage to internal lining during transportation and during handling on site.
12. All piping and flanged surfaces shall be cleaned before connections are made.
13. The (raised) faces of flanges that are in to be in contact with gaskets shall be masked and shall not be painted or coated. The mating flange shall then receive one coat of an approved rust inhibitor. Care shall be exercised to ensure that after the application of all coatings there are no runs or drips on the mating surfaces of the flanges and that the flange profiling is clearly visible over the entire face. Excessive coating build up in flange bolt holes that could snag bolts will not be permitted.
14. Flanged joints shall be connected with the specified bolts, nuts and double washers (one under the bolt head the other under the nut) all of which are to be supplied by the Contractor.
15. All bolts, tie-bolts, nuts and washers shall be galvanised to SANS 121: 2011 and shall comply with the relevant requirements of SANS 135: 2011 and SANS 136: 2008 where applicable.
16. The length of each bolt shall be such that after the bolt has been tightened, the end of the bolt shall project beyond the outer face of the nut, but not by more than two threads. Tie-bolts on restrained/anchoring couplings shall be fitted with “backing nuts” and washers.
17. Each flanged joint is to be fitted with an approved and suitably rated gasket and sealed watertight such that there will be no visible sign of leakage under the specified factory and field test pressures and under the in-service working conditions (pressures).
18. All bolts are to be tightened in a predetermined pattern with opposing bolts being tightened sequentially. When all bolts are tight, each bolt is to be torqued to the required/recommended torque in a predetermined pattern with opposing bolts being tightened sequentially.

All bolt threads shall be liberally coated with “Copper slip” or similar approved compound prior to assembly. Upon completion, bolt heads, washers and nuts shall be wrapped with the “Denso Mastic Blanket System” comprising of a priming solution, mastic blanket, petrolatum tape and lay-flat sheeting as described in PSL 3.9.3.8."

PSL 3.8.4 Loose Flanges

Add the following:

“Flange jointing material, when installed in the complete pipeline, shall be capable of withstanding transient pressures of up to the specified field test pressure. Under this condition no damage shall be caused or leakage shall occur through the joint. Bolts and nuts shall be galvanised to SANS 121: 2011 and shall comply with the relevant requirements of SANS 135: 2011 and SANS 136: 2008 where applicable. Upon completion, bolt heads, washers

and nuts shall be wrapped with the “Denso Mastic Blanket System” comprising of a priming solution, mastic blanket, petrolatum tape and lay-flat sheeting as described in PSL 3.9.3.8. “

PSL 3.9 Corrosion Protection

PSL 3.9.2 Steel Pipes

Delete Sub-Clauses 3.9.2.1 and 3.9.2.2 and replace with:

“Steel pipes, fittings, flanges and specials shall have their surfaces thoroughly cleaned by Grit blasting to a finish complying with the requirements of SIS 05 59 00 for a Sa 2½ finish. Grit for blast cleaning shall be in accordance with SABS 064.

Surfaces shall, within 4 hours after cleaning, be primed with the specified primer or if no primer is specified, with the first coat of the specified system.

All materials used shall be of the highest quality and in accordance with the manufacturer's requirements. Particular care shall be taken to ensure compatibility of all materials used with others forming part of the corrosion protected system. Manufacturer's application and overcoating times and specific instructions relating to curing periods and humidity limitations shall be strictly adhered to.

Corrosion protection systems shall not be applied over any surface containing traces of grit, grease, oil, loose rust, millscale or any contaminants or corrosion products. All surfaces shall be absolutely dry.

Welds and adjacent parent metal shall be ground smooth and all weld spatter removed. Sharp edges shall be avoided and where they are evident the removal shall be effected by grinding to a radius of not less than 3 mm.

The Contractor shall arrange for the Engineer or his representative to be present during surface preparation and coating application to ensure compliance with the specification.

Add the following new subclauses:

PSL 3.9.2.1 Holiday Testing

All Holiday Testing shall be carried out with an instrument approved by the Engineer. The sparking detection test shall conform to the standards as set out in SANS 1217:2001. The Contractor shall familiarise himself with the dielectric strength (breakdown strength) of all the coatings and linings he works with for the different pipe sizes. The Contractor shall also have an in depth knowledge of the Holiday Testing equipment he works with, in order to calculate the Corona discharge effect for the typical brush being utilised, with reference to the specific ambient conditions for any specific test.

All Holiday Testing shall be executed at a voltage which is set at 50% of the value of the dielectric strength of the lining or coating being tested. The Contractor shall carefully analyse the loss in test voltage as a result of the Corona Effect, specific to the ambient conditions surrounding the test. The test voltage of the Holiday Testing equipment shall be adjusted such that the voltage drop as a result of the Corona Effect will be taken into account when the actual 50% threshold of the dielectric strength is calculated.

The Holiday Test equipment shall be calibrated by an approved supplier and checked every 30 minutes or every time a test at a different location is started. Each piece of equipment shall have a unique identification number with calibration certificates and detail of equipment utilized shall be submitted to the Engineer for approval. Method statements for the process of holiday testing shall be submitted to the Engineer for approval.

The correct equipment for the type of application will be utilized. For example, where pin holes have been repaired and re testing for effectiveness of repair work being done, the Contractor shall utilize the correct equipment to effect same and this shall include the use of a pencil brush which concentrates the efforts of holiday testing at the repair. Where spark tests are performed on Tape Wrap systems, the minimum brush width shall be 300 mm. The brushes utilized shall be brass bristle cone brushes. The typical brush speed shall be 200 to 300 mm/sec when doing spark tests.

The Contractor shall, at his expense, test each and every surface area, that is internal lining (where applicable) as well as external coating, during construction as per this specification. Testing for holidays shall be done after

inclusion of materials, manufactured specials and equipment, as well as pipes, into the permanent works. Any defects found shall be repaired and the costs for remedial work shall be deemed to be included in the tendered rates for the construction of the pipeline. These tests and results shall be recorded on the quality control plan as approved by the Engineer.

"PSL 5.1.1.1 Inspection, Detection and Repair of Holidays

Complete sets of transistorised portable holiday detection equipment with adjustable output voltage with interchangeable 200 mm brush and full circle electrodes, adaptable for use on damp or dry surfaces of coatings of pipes, buried valve bodies, fittings and couplings of any diameter in the range DN 200 to DN 1200 are to be provided, tested, maintained and recharged when necessary by the Contractor, for use by the Engineer's Representative in inspecting coatings, wrappings and external protection of pipes, valves, fittings and couplings at the site of the Works and/or the point of delivery in accordance with the following:

When laying of pipes or fittings or covering of pipes, buried valve bodies, fittings or couplings with padding or concrete is proceeding in more than one 250 metre long section of the working strip on any day, the Contractor shall provide a sufficient number of complete sets of holiday detection equipment in addition to the holiday detection equipment required by his own staff to permit the person appointed by the Engineer to carry out holiday inspections simultaneously at each such section of the working strip.

The Contractor shall include in his tendered rates an allowance to cover the provision by him of all the necessary equipment for the Engineer's Representative as set out above as well as any and all extra labour and equipment necessary for all special handling of pipes, valves and fittings which is required in order to facilitate the following standard holiday detection operations which will be carried out by the Engineer or his Representative.

During laying operations the full circle electrode of the holiday detector will be passed over all the external surface of each pipe, except such area as may be covered by a belt sling or other approved handling tackle not exceeding 600 millimeters in total width used for supporting the pipe in the course of the laying operation immediately prior to lowering the pipe into its trench. Only if a holiday is detected in the course of the inspection described above, will the entire external surface of the pipe have to be inspected by passing the full circle electrode of the holiday detector over the full length of the pipe. At the laying site the holiday detection equipment will also be used to check the external coating of fittings before laying and to check completion of external coatings over welded joints or couplings after hydraulic pressure testing of the pipeline.

The Contractor shall so carry out his laying work as to provide reasonable time and access to the Engineer for the purpose of the inspections described above. The tendered rates for pipework shall be deemed to include for all holiday detection described in this Specification.

All work ordered by the Engineer in writing to be carried out by the Contractor in assisting in any holiday detection inspection which the Engineer may carry out in addition to the standard operations described above and proving of repairs mentioned below shall be carried out by the Contractor at agreed rates.

All holidays, voids, pinholes or other flaws in the coatings or wrapping or completed external covering to welds, couplings or buried valve bodies are to be made good by the Contractor at his expense. Holiday testing and repairs to free issue pipes prior to acceptance by the contractor are dealt with separately under Clause PSL 3.9 and items are included in the Bill of Quantities for the repair of such defects.

Protective coating or wrapping to pipes and fittings or completed external covering to joints and buried valve bodies which are inadequately bonded, damaged by abrasion, below the minimum thickness, do not comply with the materials specifications and are in any other manner defective must be removed and replaced at the expense of the Contractor. All pinholes and other defects located by means of the holiday detector shall be repaired to the satisfaction of the Engineer and proved sound by the holiday detector.

The coating of each pipe shall be inspected and holiday detected by the Contractor, immediately prior to being laid and these inspections will be witnessed and signed off by the Engineer or an appointed third party inspection authority. Two thirds of the circumference of each pipe and fitting will be inspected outside the trench, after the pipe/fitting has been transported to the construction site where it is to be laid. This inspection is to be carried out shortly before each pipe is hoisted for laying in the trench. The balance of the circumference of each pipe/fitting will be inspected once the pipe/fitting has been laid in the trench. This will require the pipe/fitting to be rotated to facilitate inspections.

All remedial work that is required shall be affected immediately upon detection of any holidays. The cost of holiday testing and effecting remedial work to the coating of the pipe at the installation location, as a result of construction or transportation or storage damage, shall be deemed to be included in the tendered rates for the laying of the pipe/fitting.

Each and every external coating make good at welded joints, shall be holiday tested around the full circumference and be subject to approval in terms of the relevant Quality Control Procedure. All costs associated with holiday detection and any costs of effecting remedial work, shall be deemed to be included in the tendered rates i.e. no special or "extra over" payments will be made for external repairs or make goods at joints.

All pipe specials being corrosion protected with an external epoxy coating, shall be holiday tested before being incorporated into the works as well as holiday tested after inclusion into the works. All the costs of holiday detection and any costs for effecting remedial work shall be deemed to be included in the rates for the laying of the pipe/fitting.

The corrosion protection systems on all fittings and manufactured specials shall be holiday tested once included into the permanent works. All the costs of holiday detection and any costs of effecting remedial work shall be deemed to be included in the tendered rates for the laying of the pipeline.

The appropriate wet sponge tests shall be conducted on the internal surfaces of all epoxy linings, and particularly on reinstated areas and make good at joints, and on manufactured specials and repairs to linings. This will be carried out from time to time and again before final cleaning of sections of the pipeline that are completed. All the costs associated with wet sponge holiday detection and any costs for effecting remedial work shall be deemed to be included in the rates for the laying of the pipeline.

PSL 3.9.2.1.1 Holiday Testing of Pipe at Pipe Yards (Free Issue Pipe Only)

In the case of free issue pipe, the external pipe coatings will be checked at the point of delivery, as supplied by the pipe manufacturer. All defects will be indicated on the Independent Third Party Test Reports. Some of the defect repairs will have been carried out under the pipe supply contract. The Contractor shall be required to repair the remaining defects at the cost of the Employer. Items will be provided for this purpose in the Bill of Quantities.

It shall be the Contractor's responsibility to detect defects in free issue pipes, including their ends, coatings and linings before taking receipt. The Contractor shall execute holiday detection tests on all the pipe coatings in the pipe yard before uplifting and transportation commences and this will be subject to witnessing and sign off by the Engineer or an appointed third party inspection authority. This will determine the baseline to be used when handling and transportation damage, if any, is assessed.

PSL 3.9.2.1.2 Holiday Testing of Pipe at Work Fronts

The coating and lining, if appropriate, of each pipe shall be inspected and holiday detected by the Contractor immediately prior to being laid and these inspections shall be subject to witnessing and sign off by the Engineer or an appointed third party inspection authority. Two thirds of the circumference will be inspected outside the trench, after the pipe has been transported to the construction site where the pipe will be laid, and the balance of the circumference will be inspected once the pipe has been laid into the trench and rotated 180^{o}. All testing shall be marked on the pipe from start of test point to completion of test point. All remedial work shall be effected immediately upon detection of any holidays. The cost of holiday testing and effecting remedial work to the coating of the pipe at the installation location as a result of construction or transportation damage by the Contractor shall be deemed to be included in the tendered rates for the laying of the pipe.

PSL 3.9.2.1.3 Holiday Testing on Tape Wrap Systems

Each and every external coating repair at welded joints, that are repaired with a tape wrap system, shall be holiday tested and subject to approval in terms of the relevant Quality Control Plan. All costs for the holiday detection shall be deemed to be included in the tendered rates for the laying of the pipe.

3.9.2.2 Hot Dip Galvanising

Where ordered or specified, galvanised steel pipework shall comply with SABS 934 and 763 and be entirely coated with zinc after fabrication by complete immersion in a zinc bath. The finished surface shall be clean and uniform and any excess being removed. The zinc deposit shall exceed the following:-

Coastal areas : 0.735 kg / m^2
Inland areas : 0.400 kg / m^2

Coastal areas shall apply to this contract.

PSL 3.9.3 Protection against Electrolytic Corrosion

Change the heading of this subclause to:

PSL 3.9.3 Protection against Electrolytic Corrosion and general repair and making good procedures for linings and coatings."

Add the following new subclauses:

PSL 3.9.3.1 Preparation of Steel Surfaces for Repairs and/or Reinstatement of Internal Lining and/or External Coating

The following method is applicable to the preparation of exposed steel surfaces prior to the carrying out of any repair procedure to internal linings and/or to external coatings. This specification is applicable to all steel surfaces that have been stripped of its corrosion protection layer, internally or externally, as a result of the manufacturing of specials, construction activities or pipe laying, welding and/or damages caused by handling or latent defects in application.

Degreasing:

All bare metal surfaces shall be degreased in order to remove grease and oil from the pipe surface as a first step in the preparation process i.e. before grit blasting and/or power brushing starts. Degreasing shall be carried out using an approved water based solvent degreaser such as that complying with SANS 1216 or, for use in enclosed systems, with SANS 1365. The surface shall then be cleaned with potable water and left to dry completely before the next step is taken.

Grit Blasting – Internal Lining Repair:

Grit blasting of bare metal surfaces shall take place after degreasing of the area. Abrasive material used for blast cleaning shall be free from oil or grease, as shall be the compressed air used in air blast cleaning.

The finished grit blasted surface shall be to Sa 2½ of ISO 8501-1 with a 75 micron angular profile. Hackles shall be removed with coarse abrasive paper.

Transition areas from internal lining to bare metal which has been grit blasted, shall be smooth without rough edges or flaking appearances.
All grit blasting within the pipe line that is under construction, shall be performed by way of a "vacuum blast" process in order to limit the generation of dust. Grit blasting shall, under all circumstances, be carried out using equipment suitable for the size of the work to be undertaken.

Damp hessian sacking or other suitable material is to be temporarily fixed around the pipe on both sides of the work areas to prevent damage to the adjoining pipe coating/lining.

All residual dust and debris shall be removed.

Before work commences, the Contractor shall provide the Engineer with a method statement for approval for each type/location of grit blasting.

Power Brush – External Coating Repair:

Power brushing of bare metal surfaces shall take place after degreasing of the area as specified. The area that has been power brushed shall be free from rust, laitance, dust, oil or other deleterious matter before the application of primer. Any areas in the region where power brushing took place shall be free from signs of disbonding of lining and/or coating. The surface finish, once power brushing has been completed, shall conform to minimum St 2 standard.

PSL 3.9.3.2 Preparation Mixing and Application of Epoxy Compounds

When mixing two part epoxies the base and activator shall be mixed in accordance with the manufacturer's instructions. Mixing in the original container will only be permitted by means of methods that ensure full integration of different parts of the compound into a homogeneous compound with the characteristics as intended by the manufacturer. The different parts of the compound shall not be diluted. Mixing shall only be allowed with full batches and reduction of volumes from mixing packs by means of weight or volume measurement, which will result in smaller portions to be mixed, will not be allowed. In the application of the epoxy the following shall be strictly in compliance with the manufacturer's instructions:

- Method of application (Type of brush or roller.)
- Over coating time.
- Temperature range for application.
- Method of mixing base and activator.
- Number of coats to achieve the specified thickness.
- Safety aspects e.g. Eye and hand protection, ventilation, fire precautions, etc.
- Note that roller and brush applicators shall be replaced once the product application expiry time has been reached on any specific applicator tool.

Uncured epoxy must be regarded as being toxic and shall be handled in accordance with the manufacturer's instructions. Adequate lighting and ventilation shall be provided whilst working within the pipeline.

Only solvent free epoxy repair kits shall be utilized to repair the internal linings of the pipe line. This specification refers to "two part epoxy" as an epoxy repair kit which consists of a base and an activator approved by the Engineer and could be products similar to "Denso ST100", "Sigma SF 523", "Nordbak", etc.

For the repair of cement mortar linings, "Epidermix 338" or similar approved shall be used.

The Contractor's tendered rates for the laying of the pipe shall be deemed to include for all the repairs and make-goods that have to be effected in order to deliver a serviceable and acceptable pipe line. (This excludes such repairs as instructed by the Engineer as a result of manufacturing defects, if any).

Two-part epoxy may only be applied on steel surfaces prepared as specified in PSL3.9.3.1.

PSL 3.9.3.3 Making Good of Cement Mortar Lining at Welded Joints

All cement mortar lined pipes shall have their cement mortar lining stopping a minimum of 25 mm from each plain end and from each end and it shall be 'chamfered' by 15 degrees to provide a positive dove-tail joint for the epoxy repair plug after field welding to another pipe.

When cement mortar lined straight steel pipes are cut, the cement mortar lining is to be cut back between 25 mm and 50 mm from the cut end of the pipe and "chamfered" by approximately 15 degrees to provide a positive dove-tail joint for the epoxy mortar repair plug after butt welding.

The surfaces are to be prepared as specified in PSL3.9.3.1.

In the case of plain ended pipes, after welding, a band of "Epidermix 338" or similar approved epoxy, shall be applied internally on the uncoated steel adjacent to the cement mortar lining to a width to suit the cement mortar lining "cut back" and to a thickness to suit the mortar lining thickness of the pipe.

In the case of collared or bell ended pipes, the repair shall be made using a mortar mix and the plain end of the adjoining pipe shall be pushed into the bellmouth (or into the external sleeve when there is no bellmouth) in such a way that the mortar band is compressed and makes contact with the transverse face of the cement mortar lining of both pipes as follows:

Immediately before joining the pipes, a slurry of Ordinary Portland Cement (OPC – CEM I 32.5) mixed with a suitable SBR Latex for use with OPC (Nitrobond SBR from Fosroc or similar) and clean water in the proportions 1:1 shall be applied to the shoulders of the cement mortar linings in the sleeve and spigot ends of the pipes to be joined. Thereafter a sufficient suitable mix of dry plaster sand and OPC (CEM I 32.5) in a proportion of 1:1 by mass and sufficient liquid (Nitrobond SBR mixed 1:1 by volume with water) to produce the correct consistency for plastering shall be troweled against the shoulder of the cement mortar lining in the sleeve end.

As the pipes are pushed together, the cement mortar lining in the spigot end shall be pressed against the mortar in the sleeve end to make a continuous lining. The excess material that is squeezed into the bore of the pipes is to be removed by drawing a suitable plug that is 5 mm smaller than the bore of the cement mortar lining across the joint. The plug that is used shall be such as to render an even and smooth finish to the mortar at the joint. The timing of when the plug is pulled through is critical and shall be carefully controlled.

PSL 3.9.3.4 Repair and Making Good of Solvent Free Epoxy Linings

All making good of internal solvent free epoxy linings at damaged areas and at welded and flanged joints that is required to ensure continuous internal corrosion protection to steel surfaces shall be carried out strictly in accordance with the solvent free epoxy manufacturer's specifications. The surfaces are to be prepared as specified in PSL3.9.3.1.

The epoxy material shall be sufficiently thixotropic that 500 micrometers dry film thickness can be achieved in one application without sagging. The material shall be applied to the clean, dry, abraded area so as to fully cover it and extend to no less than 50 mm of the edge of the abraded area. A "halo" of abraded area shall be visible around the repair material.

After curing, the repaired section and at least 250 mm of the surrounding area, shall be tested for electrical insulation defects as specified elsewhere. There shall be no electrical insulation defects.
The Contractor shall ensure that repairs and particularly the making good of linings at welded joints, is carried out progressively as the pipe is being laid and shall not be permitted to lag behind for more than three pipe lengths at each working front.

PSL 3.9.3.5 External Corrosion Protection of Welded Joints and Coating Repairs

All factory coated steel pipes will be supplied with the external coating cut back 100 mm from each pipe end. Where pipes are to be cut, either on site, or for the purpose of fabricating bends, fittings and specials, or in the event of the pipe coating being damaged, the pipe coating shall be cut back 100 mm from the intended cut area before the pipe is cut. Damp hessian sacking or other suitable material is to be temporarily fixed around the pipe to prevent damage to the pipe coating during welding operations. Once welding is complete, and all weld splatter and burnt coating has been removed, the welded pipe joints shall be wrapped in the following manner.

The following specification is based on "Denso" products and systems. Alternative products and procedures may be proposed by the Contractor and, if approved by the Engineer, they may be used. Irrespective of which products are approved by the Engineer and used by the Contractor, all procedures shall be carried out strictly in accordance with the Contractor's method statements which must conform to the manufacturer's recommendations.

A fundamental outcome is a sound and continuous coating that is free from wrinkles and that does not have any entrapped air pockets or any air bubbles.

Surface Preparation:

The bare metal shall be cleaned and wire brushed to minimum St 2 standard and, degreased with white spirit. The adjacent pipe coating shall be cleaned to a minimum of 300 mm either side of the joint and the edges "feathered" to achieve a tapered transition over a distance of 100 mm. The sound, parent coating surface shall be roughened with sandpaper over an area 250 mm either side of the joint.

Priming:

The entire pipe and coating surface over a length of 250 mm on either side of the joint shall be primed using "Denso Primer D" (or equivalent approved). Care shall be taken to obtain a thin even film with no runs or sags. The primer shall be allowed to cure until "tack dry" before the application of the tape commences. Priming may only be carried out on those areas that are to be wrapped that same day. If primed areas are to be left overnight, those areas shall be re-primed before wrapping.

Profiling Tape:

A 1,5 mm thick x 50 mm wide "Denso Mastic Sealing Tape" (or equivalent approved) shall be applied to the full circumference of the weld bead in accordance with the manufacturer's specifications. Care shall be taken to ensure

a smooth profile and to avoid air bubbles being trapped beneath the tape. (Note: The profiling tape may be omitted at the discretion of the Engineer. Tenderers shall nonetheless allow for the profiling tape in their tendered rates).

Tape Wrapping:

The joint shall then be wrapped (minimum 55 % overlap) with “Denso CPT 1250/300 Polyethylene/Bitumen” tape starting at the roughened section (250 mm from the welded joint) in accordance with the manufacturer’s requirements to create a 500 mm wide wrapping, centred over the welded joint. A 100% overlap is required on the first and last revolutions of the tape wrapping operation. It is important that tension in the tape be released when the wrapping of the last half circumference of the pipe. The Contractor shall ensure that the wrapping overlaps or covers a minimum of 150 mm of the pipe coating. A secondary or outer tape wrap layer is then to be applied over the first layer with a 10% tape overlap.

An alternative tape wrapping system that may be used is the “Densotherm 35 Hot Applied Bitumen Tape” system. The procedures are similar to those for the “Denso” system described above except that the underside of the tape shall be heated as it is applied and the overlaps and seams of the tape are to be sealed by means of a heated tool.

PSL 3.9.3.6 External Corrosion Protection of Shop-Fabricated Pipe Bends and Fittings

The external coating of shop fabricated bends and fittings shall be carried out as follows:

- Where a substantial part of the external coating on the parent pipe is intact, the coating repairs/make good shall be carried out in accordance with PSL 3.9.3.5 or
- Where black (uncoated pipe has been used), the coating shall be carried out with an approved solvent-free epoxy (SFE) system such as "Nordbak 1" or similar approved system or
- Where only a relatively small proportion of the external coating on the parent pipe remains, all of the remaining coating shall be removed and the entire bend/fitting shall be coated with an approved solvent-free epoxy (SFE) system such as "Nordbak 1" or similar approved system.

All crotch plates and wrappers/collars shall be coated with an approved solvent-free epoxy (SFE) system such as "Nordbak 1" or similar approved system.

After application of the SFE coatings to the crotch plates and collars/wrappers, approved mastic (refer PSL3.9.3.8) shall be placed in all crevices that may become moisture traps.

No additional payment will be made for any of this work as the costs are deemed to be included in the scheduled rates for bends and fittings.

PSL 3.9.3.7 External Corrosion Protection of Site-Fabricated Pipe Bends and Fittings

The coating repairs/make good shall be carried out in accordance with PSL 3.9.3.5.

PSL 3.9.3.8 Corrosion Protection of Flanges and Flexible Adaptor/Anchoring Joints in Chambers

All flanges and flexible joints and adaptor/anchoring joints and their associated bolts, nuts and washers, shall, notwithstanding that the flexible and adaptor/anchoring joints will be epoxy coated as specified elsewhere, be protected as described below.

(Note: This specification is based on a “Denso” system. Alternative products may be used, subject to approval by the Engineer).

Surface Preparation:

The entire surface area of the flange/adaptor/anchoring joint, and its bolts, nuts and washers, up to no less than 250 mm either side of the joint, shall be cleaned of all dirt and other deleterious matter. The cleaned area, up to 200 mm either side of the flange/adaptor/anchoring joint, shall then be wire brushed.

Priming:

The cleaned flange/adaptor/anchoring joint, bolts, nuts, washers and the adjoining 200 mm length either side shall be primed with “Denso Priming Solution”, or if moisture is present, with “Denso S105 Paste”.

Application of Mastic Blankets:

Narrow strips cut from "Denso Mastic Blanket" shall be applied to the flange/ adaptor/anchoring joint to achieve a smooth profile with a 50 mm splayed fillet being formed at the joint/pipe interface. Care shall be taken, particularly at bolts, to avoid the formation of air pockets. Complete "Denso Mastic Blankets" shall then be applied (mastic side down) to the flange/adaptor/anchoring joint until the flange/adaptor/anchoring joint is completely enveloped.

The blanket shall be overlapped at least 50 mm and shall extend at least 150 mm along the pipe barrel on each side of the flange/adaptor/anchoring joint. The ends of the blanket shall be bound to the barrel of the pipe on each end with 100 mm wide "Denso Tape". The "Denso Tape" overlaps shall be 50 mm and shall extend 100 mm onto the blanket and 150 mm onto the pipe barrel.

Application of Protective Sheeting:

The entire flange/adaptor/anchoring joint shall then be wrapped with 350 micron polyethylene sheeting which shall end 400 mm beyond the joint. The protective sheeting shall be secured to the pipe barrel and along the seam with 48 mm wide "Denso Adhesive Tape"

PSL 3.9.3.9 Wrapping of Permanently Exposed and Cast-in Pipes and Fittings

All coated and/or galvanised steel pipes which are to be permanently exposed or encased in concrete shall, in addition to the specified corrosion protection at flange/adaptor/anchoring joints, be protected with the "Denso Acrylic Pipeline Tape (Steelcoat 500)" system or similar approved UV resistant coating. The pipe surface shall be prepared and the coating applied in strict accordance with the manufacturer's instructions. In the case of cast-in pipes, the wrapping shall extend for at least 150mm on either side of the soil/concrete/air interface.

Surface Preparation:

(i) Remove all Grit and/or dust before priming at the average spread rate as specified by the manufacturer.

(ii) The adjacent coating shall be cleaned to a minimum of 300 mm beyond the section to be wrapped.

(iii) Grease and oil shall be removed with a non-volatile solvent. The surface shall then be cleaned with potable water and allowed to dry completely.

Priming:

(i) "Denso Primer D" shall be applied to the prepared surfaces extending 300 mm on either side of the area to be wrapped at a nominal coverage rate of 8 m² per litre. Care shall be taken to obtain an even film with no runs or sags. Only those areas that are to be wrapped the same day shall be primed to avoid any recontamination to the pipe. If primed areas are to be left overnight, these areas shall be re-primed before wrapping. Any surface oxidation, or other foreign agents shall be removed by reprocessing through the necessary cleaning steps.

(ii) The flow of primer shall be regulated so that the pipe surface is entirely covered. Solvents shall be allowed to flash off for a minimum of 30 minutes before application of tape or mastic. Uncoated, flooded, or areas primed over improperly cleaned pipe, shall be cleaned to the satisfaction of the Engineer and re-coated.

Tape Wrapping:

The joint shall be spirally wrapped (minimum 55% overlap) with "Denso Acrylic Tape" (or approved equivalent) in accordance with the manufacturer's requirements, to at least 150mm beyond the concrete/soil or concrete/air interface and at least 1 000mm beyond the soil/air interface in the case of pipes extending above ground. A 100% overlap is required on the first and last revolutions of the tape wrapping operation. Care shall be taken to ensure a smooth profile and to avoid air bubbles being trapped beneath the tape. The tape shall not be stretched and it is important that tension in the tape be released when the wrapping of the last half circumference of the pipe.

In the case of pipes cast in to concrete, the profiling tape shall stop 20mm short of any puddle flange.

Final Coating:

One coat of "Densoflex Fire Retardant" shall be applied to the exposed pipe at a nominal application rate of 3 m² per litre."

PSL 3.9.3.10 Repair of Cement Mortar Lining

Free issue pipes with linings damaged prior to acceptance by the Contractor shall be marked and recorded by both the Contractor and the Engineer's Representative and then repaired by the Contractor. The payment rate for repair shall be made at the scheduled rate. Once the Contractor has completed any repairs (if necessary) and accepted the pipes from the Employer, any subsequent damage to the lining in the pipes shall be repaired by the Contractor at his expense.

Any repairs necessary on pipe supplied by the Contractor shall be carried out at the Contractor's expense.

All repair procedures shall be subject to the prior approval of the Engineer. Generally, a crack is to be ground out using a mechanical grinder down to the steel wall to form a "dove-tail" groove with a minimum width of 8 mm. Care must be taken not to grind any of the steel pipe wall. The groove shall be rendered free of laitance, dust, oil, grease, fractured aggregate and other deleterious matter. The steel pipe wall internal surface shall be rendered free of rust and other deleterious matter by wire brushing (apply white spirit if necessary). The groove shall be filled with "Epidermix 338" (or equivalent approved), mixed and applied in accordance with the procedure set out in PSL 3.9.3.3.

PSL 3.9.3.11 Repair of FBMDPE Coating (Large Areas)

A large area repair is defined as an area larger than 650 mm^2.

Free issue pipes with external coatings damaged prior to acceptance by the Contractor shall be marked and recorded by both the Contractor and the Engineer's Representative and then repaired by the Contractor. The payment rate for repair shall be made at the scheduled rate. Once the Contractor has completed any repairs (if necessary) and accepted pipes from the Employer, any subsequent damage to the coating in the pipes shall be repaired by the Contractor at his expense.

Any repairs necessary on pipe supplied by the Contractor shall be carried out at the Contractor's expense.

All damaged and blistered FBMDPE coating caused by welding or other mechanical means shall be removed back to sound coating by mechanical grinding or other approved means.

The exposed steel surface shall be power wire brushed to remove dirt, scale, rust and other foreign matter to a surface profile equivalent to a Class St 2 finish. Weld spatter shall be removed by chipping or grinding to a smooth surface flush with the surrounding steel. Welds shall have a smooth contour free from sharp edges, protrusions and undercut. Sharp edges and protrusions shall be removed by grinding to a smooth radius of curvature of not less than 3 mm.

Degreasing of the exposed steel surface shall be done in terms of Clause PSL 3.9.3.1.

The surrounding sound FBMDPE surface shall be feathered from steel surface to maximum thickness and then abraded to a distance of 100 mm beyond the defective area. The abrasion shall be carried out with clean emery paper of 80 to 100 mesh so as to produce a suitably rough surface profile without causing the removal of excessive amounts of protective material. Virgin Sintakote powder is to be melted into the defect to ensure proper mechanical bonding with the steel surface and chemical bonding with the existing Sintakote. The melting of the virgin material shall be such that melting is not effected with an open flame. The melted powder shall be shaped with a hot spatula to form a smooth surface over the repair area.

Under no circumstances will patching of damaged areas by means of pieces of tape wrap, be allowed.

PSL 3.9.3.12 Repair of FBMDPE Coating (Small Areas)

A small area repair is defined as an area less than 650 mm^2.

A small area repair is effected by means of the application of a hot spatula to repair the defect, provided that there is a residual layer of polyethylene adhering strongly to the steel surface. Alternatively, virgin Sintakote powder

material may be melted with heated spatula over the damaged area, to fill the mechanical damages in the coating and fuse with the surrounding coating material, all as per the manufacturer's recommendations.

At each pinhole detected by the Holiday test, the surrounding area shall be abraded to 25mm beyond the defective area. The abrasion shall be carried out with clean emery paper of 80 to 100 mesh so as to provide a suitably rough surface profile without causing the removal of excessive amounts of coating material. A hot spatula shall be utilized to work Sintakote into the pinhole defects. It is noted that any cluster of pinholes within a radius of 25mm shall be regarded as one defect.

PSL 3.9.3.13 Repair of Three Layer Polyethylene Coatings

Free issue pipes with linings damaged prior to acceptance by the Contractor shall be marked and recorded by both the Contractor and the Engineer's Representative and then repaired by the Contractor. The payment rate for repair shall be made at the scheduled rate. Once the Contractor has completed any repairs (if necessary) and accepted pipes from the Employer, any subsequent damage to the coating in the pipes shall be repaired by the Contractor at his expense. All making good of the exterior coatings at damaged areas that is required to ensure continuous corrosion protection to steel surfaces shall be carried out strictly in accordance with an approved method statement that is to be prepared by the Contractor.

Any repairs necessary on pipe supplied by the Contractor shall be carried out at the Contractor's expense.

The basic requirements are the careful cut back of the outer sleeve and removal of the residual adhesive layer. The exposed surfaces are to be prepared as specified in PSL3.9.3.1 and this is to be followed by the application of an approved epoxy material followed by the application of a shrink sleeve covering the whole of the affected area with an overlap of no less than 50 mm.

The epoxy material shall be sufficiently thixotropic that 500 micrometres dry film thickness can be achieved in one application without sagging.

After curing, the repaired section and at least 250 mm of the surrounding area, shall be tested for electrical insulation defects as specified elsewhere. There shall be no electrical insulation defects.

PSL 3.9.3.14 External Coating Repair on Continuity Bonds

Electrical continuity bonding shall be carried out by a cathodic protection sub-contractor.

After successful testing of each weld in the presence of the Engineer's Representative the pipe coating shall be repaired in accordance with PSL 3.9.3.4.

The cable ends shall be covered with "Denso" mastic prior to tape wrapping.

PSL 3.9.3.15 Corrosion Protection of Buried Valves, Flexible and Flanged Joints or Buried Pipes

Every buried cast iron/steel coupling, joint, flange, and valve, or pipe where scheduled, shall be protected by the following "Denso" or equal approved anti-corrosion system:

After the pipework has been satisfactorily tested (and bonded at the couplings for electrical continuity if applicable) the exposed portion of the coupling, joint or flange and the unsheathed portions of the pipes at the joint and the bodies of all buried valves are to be covered with an approved petroleum based mastic/cloth system applied strictly in accordance with the manufacturer's instructions and then covered with two layers of approved adhesive PVC tape. The external sheathing system, which shall be to the approval of the Engineer, shall be carried out as follows:

All loose dirt, rust, mill scale and flaking paint shall be removed by wire brushing all exposed metal surfaces. An approved priming solution shall be applied by brush with care being taken to ensure all exposed metal surfaces are coated.

"Denso", "Corromastic" or equal approved mastic is to be packed around the joint and/or valve body to form an even contour for the application of tape. A fillet is to be formed between the flange and the pipe barrel/valve body and, in the case of flexible couplings, mastic is to be packed around the bolts to a height of 3 mm above the bolts. Care must be taken to ensure that no air is entrapped.

A layer of impregnated tape/cloth is to be spirally applied with a minimum overlap of 50 mm. All air pockets are to be removed.

An overwrap consisting of two separate layers of approved, 300 micron thick adhesive PVC tape is to be spirally applied with a minimum of 25 mm overlap and with at least two laps over the untreated sheathing on either side of the joint.

The whole sheathed area of the joint and pipe is to be subjected to holiday detection and, if proved sound and approved by the Engineer, may be covered with "padding" sand."

PSL 3.9.3.16 Payment for Inspection and Testing

Repairs by the Contractor will be subject to inspection by the Engineer and the Employer's Third Party inspection agent. Should additional expenditure be incurred by the Employer's inspector, due to any failure of the prescribed tests, then such additional expenditure shall be reimbursed to the Employer by the Contractor and shall be deductible from the Payment Certificates.

PSL 3.9.5 Joints, Bolts, Nuts and Washers

All joints, bolts, nuts and washers shall be hot-dip galvanised in accordance with SABS 763 unless stated otherwise. Electroplating shall not be permitted.

PSL 3.9.6 Corrosive Soil

All fittings and joints shall be protected against corrosion in accordance with clause PSL 3.9.3.15 regardless of the corrosivity of the soil.

Add the following new sub-clause:

PSL 3.10 Valves

Change the heading of this clause to the following and add:

PSL 3.10 Valves and Other Mechanical/Electronic Accessories

PSL 3.10.1 Isolation Valves (General)

The Contractor is referred to the Umgeni Water Particular Specification for Valves. Where conflict exists, the requirements in this specification shall take precedence.

Unless otherwise stated, all isolation and scour valves shall be of the Waterworks Pattern Sluice Valve type.

The following general requirements shall be met:

a) The valve class shall be at least equal to that of the pipework in which it is to be installed. All valves shall be rated for a working pressure of at least 1,6 MPa (Class 16), unless otherwise specified in the drawings and schedule of quantities.

b) The valves shall be supplied with non-rising type spindle. Spindles shall be threaded such that two turns of the hand wheel shall effect a movement of 25 mm on the valve gate. This allows for easy identification of the valve diameter.

c) The valves shall be fitted with a cast iron cap attached to the spindle by means of a Stout brass screw with hexagonal head or with a handwheel as indicated on the drawings or specified in the Schedule of Quantities. The handwheel shall indicate the direction of closing.

d) The valves shall be ***CLOCKWISE CLOSING.***

e) The design of the valve guides shall be such that all valves supplied can be mounted in any position.

f) The stuffing box may either be of the conventional type with gland packing with a gland secured with 2 No. bolts and nuts. The nuts shall be of the Tee pattern and the gland stuffing box shall be capable of holding four rings of a standard size of gland packing. The gland stuffing box shall be capable of being repacked under working pressure, preferably with the gate in the open position. The gland shall fit neatly and snugly into the stuffing box. The base of the gland and the stuffing box shall be chamfered to force the packing against the spindle.

Alternatively the sealing of the spindle in the body may be by means of O-rings which are retained in position by means of machined Grooves in the valve body and which seal against the spindle. If this type of valve is offered, tenderers should indicate with their tender the cost of a service head for each size of valve offered. Such service head shall be supplied complete with seals, gate, spindle and cap.

g) The valves shall be double flanged and drilled in accordance with SABS 1123 appropriate to the Class of valve required/specified.

h) Each valve shall be supplied with 2 No. full face gaskets and the requisite number of bolts, nuts and washers to suit the valves. Sufficient bolts, nuts and washers shall be supplied for both faces of the valves. The cost of these items shall be included in rates tendered.

i) The valves shall be drop tight at the specified working pressure applied to one side of the gate and the other side subject to open end conditions.

j) In addition to the above conditions (i) when called for in Schedule of Quantities, valves for installation on fire hydrants shall be drop tight when subjected to working pressures within in range 345 kPa to 1380 kPa under unbalanced open end conditions, and chattering of the gate in its guides during operation of the valves shall be reduced to a minimum to prevent damage to the valve seats.

Every valve shall be internally and externally fusion bonded epoxy powder coated to a minimum 250 micron DFT, as standard.

PSL 3.10.1.1 Resilient Seal Valves

a) General

Valves shall be double flanged and be resilient seated and unless otherwise specified, the valves shall be of the non-rising spindle type.

The valves shall be capable of withstanding the nominal pressure and specified test pressure and shall have the capability to seal drip tight bi-directionally. The valves shall generally be manufactured in accordance to SABS 664.

b) Gate Design

The gate shall be fully rubber encapsulated inside and outside therefore to ensure drip tight sealing and avoid corrosion. The gate shall further have a drain hole, preventing stagnant water or impurities from collecting.

Rubber utilised in the coating of the wedge shall be inert and shall not impart odour, taste and colour and shall be suitable for drinking water applications. The gate nut shall not be fixed to the wedge, thereby reducing opening torques.

c) Gate and Body Design

The gate shall have optimally placed guides of wear resistant plastic so as reduce the torques as well as reduce wear between the rubber and the coating on the body. The bore of the body shall be straight through design in order to allow cleaning with a badger.

d) Valve Bonnet

The valve shall utilise 3 independent bonnet seals which shall include a set of stem steels embedded in non-corrosive material, a back seal to prevent leakage when changing seals, and wiper ring to protect against debris entering the valve.

Two friction washes (sizes 50mm – 200mm) and thrust ball bearings (250mm – 600mm) shall be in incorporated to ensure smooth spindle operation as well as to reduce opening and closing torques.

A full circle thrust collar shall be utilised to ensure low torque operation. O-ring stem seals shall be replaceable under pressure for sizes 50mm – 200mm.

e) Spindle

Spindles shall be made of stainless steel. The stem threads shall be rolled to maintain steel structure and increase strength and, to ensure smooth thread edges and consequently a low operating torque.

f) Body and Bonnet Assembly

The rubber bonnet gasket shall fit in a recess in the valve bonnet preventing blow out of the seal under surge conditions. The bonnet bolts shall pass through the gasket and sunk into the bonnet and sealed for corrosion protection.

An edge protecting ring shall permanently be fitted around the body and bonnet joint in order to protect the coating during transportation and installation.

PSL 3.10.1.2 Wedge Gate Valves

Wedge Gate Valves shall be of the Waterworks Pattern Sluice Valve type and be manufactured to a standard of not less than that specified in SABS 664.

The following special requirements shall be met:

a) The lugs on the gate and the spindle are to conform to 3.2.3 of SABS 664 and are to be machined to a good fit and finish.

b) Valve trim shall be either Type B (Gun metal trim) or Type C (Stainless Steel trim) as specified in SABS 664 Clause 3.5.5. Tenderers must indicate in their tender what type of trim is offered.

c) Seat rings shall comply with Clause 3.5.6 of SABS 664 and shall be pinned into position.

d) The stuffing box may either be of the conventional type with gland packing with a gland secured with 2 No. bolts and nuts. The nuts shall be of the Tee pattern and the gland stuffing box shall be capable of holding four rings of a standard size of gland packing. The gland stuffing box shall be capable of being repacked under working pressure, preferably with the gate in the open position. The gland shall fit neatly and snugly into the stuffing box. The base of the gland and the stuffing box shall be chamfered to force the packing against the spindle.

e) Valves which incorporate a thrust plate of the horseshoe type will NOT be considered.

f) Every sluice valve shall be provided with substantial guides cast on each side of the gate, preferably extending to the top of the nut box and operating along corresponding guides cast in the sides of the valve body. (Brass trim only).

g) When called for in the Schedule of Quantities, valves shall, in place of the guides described in (f) above, be fitted with machined bronze guide shoes on either side of the gate operating in accurately matching machined bronze guide channels fixed on the sides of the valve body. The bronze guides shall be of phosphor bronze to B.S. 1400 PB 2-0.

The gate valves shall be supplied with the gland packing installed and shall be either "Maxmech Style M57, Chesterton 1724" or similar approved.

3.10.1 4 Butterfly Valves

The valves shall be manufactured in accordance with BS 5155 (cast iron and carbon steel butterfly valves for general purposes), as far as is applicable.

The Contractor is referred to the Umgeni Water Particular Specification for Double Flanged Butterfly Valves for sizes from 400NB where working pressure does not exceed 40BAR (4000kPa) and the Umgeni Water Particular Specification for Valves.

Where conflict exists, the requirements in this specification shall take precedence. Thereafter the Umgeni Water Particular Specification for Double Flanged butterfly valves shall take precedence over the Umgeni Water Particular Specification for Valves

The following criteria for construction shall be met:-

a) Body

Where wafer-lug type butterfly valves are specified, these shall be of the wafer-lug type, with drilled/tapped bolt holes, to allow the valve to be used at maximum working pressures of respectively 20 and 16 bars in terminal positions. This is to allow downstream pipework to be disassembled with the upstream pipework under pressure.

Valves designed for to allow the valve to be used at maximum working pressures of 16 bars at terminal positions unless otherwise specified in the drawings or schedule of quantities.

Bodies shall be one piece casting Ductile Iron, UTS 400 MPa, YP 250 MPa, (elongational 12%) grade EN GJS-400-15 to BS EN 1563 or equivalent for sizes up to 1500mm. Sizes above shall be of cast steel grade 480 to BS 1504-161. Bodies shall never be in contact with the fluid conveyed and shall be fully protected internally by the resilient seat.

b) Disc

Shall be cast or stamped, spherically machined and positively splined or keyed internally to the driving shaft. (Use of plinths or bolts is totally prohibited).

Selection of the disc material shall be made taking into account the aggressivity of the fluid. (Cupro-aluminium or stainless steel 316 or equivalent).

c) Shaft

Butterfly valve technology shall be such that the shaft will never be wetted. (Dry shaft) Stainless Steel, AISI 420 of high mechanical characteristics shall be used.

It shall be positively splined or keyed to the disc. The upper and lower shaft and tie-bolt, when assembled to the disc, shall give in effect a one-piece shaft/disc assembly. At least three bearing assemblies, consisting of steel outer shell, with sintered bronze inner lining, coated with Teflon, facing shall be used.

The upper shaft shall be carried in two bearings, the lower in one.

d) Liner

The resilient, synthetic rubber seat shall be easily replaceable (bonded liners are prohibited) and shall entirely cover the inside of the body overlapping over the sides to form the seal between the body and matching pipework.

Where necessary, it shall be keyed to the body with annular grooves in the bore of the valve. The design shall be such as to allow the disc to seal drop-tight to the liner so that there is no ingress of fluid to the shaft area.

e) General

Valves with “0” Ring Shaft Backup Seals shall not be considered. The Manufacturer shall be able to offer alternative grades to cope with various fluids.

Quarter-turn handles shall be supplied for valves up to and including 150mm nominal diameter. The handle shall be lockable in all intermediate positions and be adaptable to the valves.

For valves larger than 150mm a gear shall be used. The gear operator shall be designed with a worm and nut system. The gear operator shall be irreversible in any position. The gear shall have a handwheel and an indicator protected by plexiglass, showing the position of the disc. If specified, limit switches shall be fitted, mounted in a waterproof and dustproof housing.

The direction of opening of the butterfly blade shall be such that the bottom of the blade moves in a downstream direction.

All handwheels shall be fitted with a suitably sized shear-pin that shall fail before damage can be done to the drive gearing of the valve.

Where specified, U-section wafer-type valves, as described in BS 5155, shall be acceptable, provided that:

the valve is suitable for individual bolting of each flange and the dimension between the inside faces of the flanges is not less than 3D, where D is the diameter of the flange bolts as specified in BS 4504: Part 1, or SABS 1123

PSL 3.10.2 Air Release Valves

The Contractor is referred to the Umgeni Water Technical Specification for Air Release and Vacuum Break Valve. Where conflict exists, the requirements in this specification shall take precedence.

a) Function

The required valves shall provide any of the functions, or combination of functions, described below as specified in the schedule of quantities:

- Pipeline filling
- Uninterrupted high volume air discharge through the large orifice.
- Pipeline draining or Column Separation
- Uninterrupted high volume air intake through the large orifice.
- Pipeline full and operating
- Discharge of disentrained pressurized air through the small orifice.
- Rapid Filling / Column Separation

The valve must incorporate an integral surge alleviation mechanism which will automatically dampen surge pressures due to rapid air discharge or the subsequent rejoining of separated water columns.

b) Construction and design

The air release and vacuum break valve shall be of a compact single chamber design with solid cylindrical High Density Polyethylene control floats housed in a tubular stainless steel or corrosion protected body with stainless steel ends secured by means of stainless steel tie rods.

Large orifice sealing shall be effected by the flat face of the control float seating against a nitrile/EPDM rubber ‘O’ Ring housed in a dovetail Groove circumferentially surrounding the large orifice. Discharge of pressurized air shall be controlled by the seating and unseating of a small orifice on a natural/EPDM rubber seal affixed to the control float.

The intake/discharge orifice area shall be equal to the nominal size of the valve i.e. a 150mm (6”) valve shall have a 150mm (6”) intake/discharge orifice. The air valve class shall be at least equal to that of the pipework in which is to be installed, with a minimum working pressure of at least 1,6 MPa (Class 16).

Surge Alleviation Mechanisms

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.

Relief mechanisms shall activate at a maximum differential pressure of 5kPa between the inside and outside of the valve.

Where specified, the air valve shall be fitted with a stainless steel spring or similar device to immediately active the air release function to the surge alleviation mechanism.

c) Performance Requirements

The valve design shall be proven and performance criteria shall have been confirmed by a recognized independent authority.

The selected air valve range shall have factory test results which verify the claimed air intake and air release performance characteristics.

Air valve ranges without verified factory performance tests will not be accepted.

PSL 3.10.3 Float Control Valves

Float Control Valves shall be hydraulically controlled dual diaphragm end line type control valves with either a direct or remote pilot to facilitate automatic control of levels in tanks and reservoirs with an inherent slow closing characteristic to automatically reduce induced pressure when closing.

Float valves shall have a concentric cast iron body and bonnet, which shall be coated and lined with fusion bonded epoxy powder coated to 250 microns.

The spacer piece and plug assembly shall be manufactured from solid HDPE and the diaphragms shall be manufactured from proprietary elastomer as specified by the manufacturer. The internal filter mechanism shall be manufactured from LG2 brass and 304 stainless steel. The control orifice, trim and fasteners shall all be manufactured from Grade 304 stainless steel.

Valve construction shall be such that deformation, leaking or damage of any kind does not occur when the valve is subjected to testing pressures of 1.5 x the designed working pressure.

The valve shall be supplied with a direct or remote (as specified), magnetic two level latch type pilot with a fixed deadband. The pilot shall be constructed of brass with stainless steel trim and shall be fitted with an “Eclipse shallow pot” type magnet. The pilot float arm shall be constructed from stainless steel and the ball from polypropylene.

The pilot shall be able to remain “closed” or “open” when the water surface is turbulent and shall only change state at either end of the deadband.

Where a filter is specified to prevent debris from entering the valve, it shall be a cone filter manufactured from powder coated mild steel.

Float valves shall be supplied with stud connections suitable for alignment to flanges conforming to PN16 ratings of BS EN 1092 standards, or as otherwise specified in the drawings or specifications.

Float valves shall be suitable for operating under a static pressure of 16 bar and shall be able to operate at a residual pressure of at least 0.1 bar.

PSL 3.10.4 Meters

PSL 3.10.4.1 Woltmann Type

Water meters used in this application in nominal bore sizes from 40mm to 150mm must comply with the South African Bureau of Standards Specification No. 1529-1:1994 and Section 18 of the Trade Metrology Act No. 77 of 1973 and Regulation 80 of Part II of the Trade Metrology Regulations.

All Water Meters, sizes 40 mm to 100 mm, must be tested and sealed by an authorised officer in a SANAS (S.A.B.S. 0259) accredited laboratory, situated within the borders of the Republic of South Africa.

The Water Meter must be of the Woltmann WP helical vane inferential velocity type with the following capabilities:-

METER SIZE (mm)	**40**	**50**	**80**	**100**	**150**	**200**	**250**	**300**
Max. Flowrate **qs** ± 2% (m³/h)	90	90	200	250	600	1000	1600	2000
Permanent Flowrate qp ± 2% (m³/h)	50	50	120	180	450	700	1000	1500
Transitional Flowrate qt ± 2% (m³/h)	1.0	10	2.0	2.0	4.0	6.0	11.0	15.0
Minimum Flowrate q min ± 5% (m³/h)	.35	0.35	0.5	0.6	2.0	4.0	6.0	12.0
Starting Flow (m³/h)	0.15	0.16	0.22	0.25	0.90	1.2	1.8	1.8
Maximum Working Pressure (Kpa)	1600	1600	1600	1600	1600	1600	1600	1600
Body Length (mm)	311	200	200	250	300	350	450	500

In addition, the meters offered must comply with the following:-

- Epoxy coated cast iron body.
- Counter to be encased in a Copper can with mineral glass lens sealed to IP 68 standards to prevent condensation from forming under the lens, thus providing clear reading in any environment.
- Scratch resistant mineral glass counter window able to withstand the impact of a 25mm steel ball dropped onto the centre from a height of one metre.
- Counter unit must be equipped to generate pulse outputs, as per the following:

Meter sizes 40 mm to 100 mm	One pulse per 10 litres One pulse per 1 000 litres
Meter sizes 150 mm & 200 mm	One pulse per 100 litres One pulse per 10 000 litres

Meter must have the following features to facilitate convenience of on-site replacement :

(a) Fully shrouded, pre-calibrated replaceable mechanism.
(b) Helical vane fitted in a shrouded cartridge designed to direct the entire volume of water through the measuring element ensuring body impact is negligible on the accuracy.

- Must be suitable for Vertical, Horizontal or Inclined Installation.
- Meters must be capable of measuring reverse flows within the same Class B accuracy envelope as per the Specification (No. 1529-1, 1994) for forward flow, i.e.± 5% q min & 2% qp to qs.
- Meter must be provided with a pressure tapping (1/4 BSP), into which a pressure gauge or pressure transducer can be fitted to measure the downstream pressure of the meter.
- Suitable for water temperatures up to 50°C and maximum working pressure of 1 600 kPa, unless otherwise specified in the drawings and schedule of quantities.

- All internal plastic components to be constructed of virgin materials.

- The meter must perform within the legal accuracy specification, with a length of pipe, the same diameter as the meter, three diameters long, free from fittings and valves, fitted at the inlet to the meter body and one diameter long fitted to the outlet of the meter body.

- Each Meter must be backed with a two year warranty against faulty workmanship and/or materials.

Spare parts for all Water Meters offered must be available in South Africa and still be available for a period of ten years after the purchase of the water meter.

3.10.4.2 Electromagnetic Type

The magnetic flow meters shall be flanged to SANS 1123 for process connection sizes and pressures specified in the BOQ. Installation shall form part of the mechanical portion of the Works. The primary element casing shall be of 3CR12/mild steel, appropriately coated, painted and treated for corrosion protection. The tube material shall be at least of 304 stainless construction with a polyurethane lining. The electrodes shall be constructed of 316 stainless steel. The sensor shall have an environmental protection rating of IP68 with factory potted terminal housing and shall be equipped with integral cables long enough to reach the transmitter. No cable joins will be permitted. The transmitter shall have microprocessor-based electronics with local flow rate and total indication in an IP65 enclosure. The transmitter enclosure must be installed above any flood level.

The transmitter shall conform to the following:

Power supply	:	230V AC power supply 50Hz
Outputs	:	4 x OCT digital programmable outputs Isolated (Fwd Pulse, Rev Pulse, Empty pipe, low battery) 1 x passive 4-20mA
Range	:	0.1-10m/s
Accuracy	:	Error better than 1% of full scale > 0.5m/s
Repeatability	:	0.2% of span

The transmitter shall have Profibus, Hart Ethernet configurable connections.

3.10.4.3 Ultrasonic Type

No strap-mounted or clamp-on type ultrasonic flow meters shall be accepted.

The ultrasonic flow meters shall be the in-line type and shall be flanged to SANS 1123 for process connection sizes and pressures specified in the BOQ. Installation shall form part of the mechanical portion of the Works.

The primary element casing shall be of mild steel, appropriately coated, painted and treated for corrosion protection. The tube material shall mild steel construction with a polyurethane lining. Where a stainless steel casing and tube is specified, the grade shall be EN 1.4404 (AISI 316L). The wetted transducers and transducer holders shall be constructed of stainless steel EN 1.4404 (AISI 316L).

The sensor shall have an environmental protection rating of IP68 with factory potted terminal housing and shall be equipped with integral cables long enough to reach the transmitter. No cable joins will be permitted.

The transmitter shall have microprocessor-based electronics with local flow rate and total indication in an IP65 enclosure. The enclosure shall be of die-cast aluminum or stainless steel (EN 1.4404) construction. The transmitter enclosure must be installed above any flood level.

All externally mounted flowmeters and components shall be of stainless steel construction unless otherwise specified. All internally mounted flowmeters and applicable components shall be of mild steel construction unless otherwise specified.

The transmitter shall conform to the following:

Power supply	:	230V AC power supply 50Hz

Outputs	:	4 x OCT digital programmable outputs Isolated (Fwd Pulse, Rev Pulse, Empty pipe, low battery) 1 x passive 4-20mA
Range	:	0.1-10m/s
Accuracy	:	Error better than 1% of full scale > 0.5m/s
Repeatability	:	0.2% of span

The transmitter shall have Profibus, Hart Ethernet configurable connections.

3.10.4.4 GSM Data loggers

GSM data loggers shall be 3.6V lithium battery powered and in an IP65 wall mount enclosure with extended battery pack for the line pressure transducer. The data logger should have 2 x digital inputs and 5 x Analogue inputs. Logged data should be transferred to the Mycity server at 24hr intervals. The data should be accessed via a approved password protected website. Data should display graphically in graph and table format for user selectable periods. The data must downloadable in Excel format.

The flow transmitter and data logger for the flow meters shall be installed remotely and above any flood level in a wall mounted IP65 enclosure.

PSL 3.10.5 Strainers

All strainers shall be “Y” type configuration and shall conform to the following:

- Cast iron body and lid and shall be fusion bonded epoxy coated both inside and outside.
- Face to face dimension of all flanged strainers shall be according to EN 558-1 GR 1. Strainers shall be supplied with stud connections suitable for alignment to flanges conforming to PN16 ratings of BS EN 1092 standards, unless otherwise specified in the drawings and schedule of quantities..
- Strainers shall be suitable for operating under a static pressure of 16 bar, unless otherwise specified in the drawings and schedule of quantities.
- The screen shall be a fine-meshed double screen manufactured from stainless steel able to restrain parts bigger than 0.5mm for sizes DN 40mm – DN 150mm, and able to restrain parts bigger than 0.6mm for sizes DN 200mm – DN 300mm.
- All fastening bolts and nuts to be stainless steel.

PSL 3.10.6 Reflux Valves

The Contractor is referred to the Umgeni Water Particular Specification for Valves. Where conflict exists, the requirements in this specification shall take precedence.

a) General

Reflux valves shall be double-flanged, for horizontal and vertical mounting, of robust construction and suitable for the operating head and close drop tight, unless otherwise permitted in the Project Specification.

Bodies shall be one piece casting Ductile Iron, UTS 400 MPa, YP 250 MPa, (elongational 12%) grade EN GJS-400-15 to BS EN 1563 or equivalent for sizes up to 1500mm. Sizes above shall be of cast steel grade 480 to BS 1504-161.

The body, cover and door shall be of the Ductile Iron grade EN GJS-400-15 to BS EN 1563 or equivalent approved/ The door shall be fitted with a zinc-free phosphor-bronze face, closing on a corresponding bronze face, in the body.

The valves must be of the “non-slam” type, for horizontal or vertical installation. Unless otherwise specified, all reflux valves shall be fitted with an external counterweight arm to ensure non-slam closure.

External spring assisted closure will also be permitted. Valves with a stainless steel perforated cone, or resilient conical diaphragm, are also acceptable.

Wafer-type reflux valves shall have ductile iron bodies with domed 316 stainless steel gates. Seats shall be machined with a dove-tail groove to accommodate an O-ring to ensure drip-tight sealing.

Valves shall be installed between suitable retaining flanges, which shall be independent of any other piece of equipment.

Valves shall be guaranteed to be leak tight in their particular application.

Valves shall be coated (externall) and lined (internally) in accordance with the Umgeni Water Particular Specification for Valves.

b) Nozzle-type Reflux valves

Nozzle-type or “Silent” check valves shall be double flanged. The “globe” style of construction shall be used.

The design shall be such that the disc does not rely on back flow for closure. Closure shall be performed by a stainless steel spring that pushes the disc against the stainless steel seat.
The valve shall be fully open under normal operating conditions.

Discs shall close with a positive action and no possibility of slamming shut during any stage of the closing or opening operation. The spring assisted low inertia internal components must ensure rapid closing and minimise secondary slam even at high flow deceleration rates. The disc shall at all times stay perpendicular to flow.

The valve disc shall be of ductile iron grade EN-GJS-400-15 construction. Valve rings shall be of EN 1.4404 construction.

The bearings shall be of bronze construction or superior.

All internal components shall be of stainless steel construction, including the shaft, stopper, spring, bolts, nut, and setscrew.

External fasteners (flanged connections) shall be mild steel (hot dip galvanized).

PSL 3.10.7 Flow Limiting Valves

The Contractor is referred to the Umgeni Water Particular Specification for Valves. Where conflict exists, the requirements in this specification shall take precedence.

The limiter valve shall consist of a wafer pattern with rubber control ring orifice inserts, which effects a consistent flow control within ± 10% of the rated flow for a differential pressure across the valve over a range as specified. The valve must sit between two flanges.

The valve body shall be of stainless steel grade 316 construction. The control rings shall be made of flexible nitrite elastomer rubber and shall be able to move on a tapered seat in the body as the flow increases and be replaceable. The valve shall be complete with control rings for the specified flow.

The valve design shall be proven and performance criteria shall have been confirmed by a recognized independent authority.

The valve class shall be at least equal to that of the pipework in which it is to be installed. All valves shall be rated for a working pressure of at least 1,6 MPa (Class 16), unless otherwise specified in the drawings and schedule of quantities.

PSL 3.10.8 Knife Gate Valves

The design of the knife gate valve shall be of a type suitable for the operation environment and fluid medium described elsewhere in the document.

Preference shall be given to double flanged units.

Valves and their method of actuation shall be designed to operate under the full pressure rating of the valve.

Valves shall have cast iron bodies unless otherwise specified. The knife gate shall be of stainless steel (AISI 316) construction. The handwheels shall be of cast iron, or of stainless steel (where specified).

The valves shall have chamfered blade edges and resilient body seals. Blade faces shall be surface ground or otherwise provided with two flat, parallel surfaces.

The blade seal shall be protected by a non-metallic scraper or similar device.

It shall be possible to adjust the blade seal while the valve is in line under pressure.

All fasteners on the body of the valve shall be of EN Grade 1.4401 (316), or better (this does not necessarily apply to flange bolts).

Valves shall be droptight. Blade seals shall not leak.

The valve shall be capable of operating reliably at any point in the specified range.

The valve shall be provided with manual handwheel operation or shall be provided with electric actuation with manual override, as specified elsewhere. The operation shall be smooth and handwheels shall not require a peripheral force greater than 250N (i.e. the sum of the forces on both sides shall not be greater than 250N).

Corrosion protection shall be to the Client Particular Specification for Valves, or superior.

PSL 3.11 Manholes and Surface Boxes

Add the following sub-clause:

PSL 3.11.7 Pipeline Markers

Where so instructed by the Engineer or as shown on the drawings, the Contractor shall erect pipeline markers. These markers will be precast concrete units manufactured out of 25 Mpa concrete to the dimensions shown on the drawings and shall comply with SABS 1200 GA Concrete (Small Works)."

Add the following new sub-clause:

PSL 3.12 Padlocks for Manholes, Air Valve Chambers, Reservoirs etc.

All padlocks for use in locking manholes, air valves chambers, valve chambers, reservoirs etc shall be "lock-a-like" 70 mm Discus Lock with all working mechanisms treated with copper slip. The cost of padlocks will be deemed to be included in the Contractor's rates for the manhole cover and/or locking bar."

PSL 4 PLANT

PSL 4.1 Handling and Rigging

Add the following:

"The plant and rigging equipment used for the handling of pipes shall be such that no pipe shall be overstressed during any operation.

In the transportation, loading and unloading of pipes, the Contractor shall at all times operate and maintain an adequate fleet of vehicles to ensure that pipes or their protective linings and coatings are not damaged. In particular, the use of excavation equipment for handling of pipes will not be permitted.

Pipes shall be moved with the use of padded slings of width sufficient to prevent damage to the coating. Chain slings, hooks, wire ropes, rope slings without canvas covers, composition belt slings with protruding rivets an any

other equipment liable to damage the coating shall not be used. Slings shall be suitably rated for the loads to be handled and in good condition. The use of deteriorating and frayed slings is prohibited.

All pipes are to be lifted and handled with the aid of a "spreader" lifting beam. Special care shall be taken to ensure that no damages occur to pipes or coatings as a result of pipes sliding on or hitting adjacent pipes. The dragging or skidding of pipes and specials in contact with the ground shall not be permitted.

Whenever pipes are stacked, or otherwise stockpiled, or are transported, use shall be made of suitable resilient material as dunnage which shall not disintegrate of deteriorate when exposed to the elements for prolonged periods or under loads from adjacent pipes (See PSL 4.1.1 below). Pipes shall be stacked with a minimum clearance of 50 mm between adjacent pipe walls and a minimum of 75 mm clear of the ground.

The ends of the pipes should be kept covered by suitable end pieces to prevent damage through the intrusion of foreign matter. Level, cleared ground, free of vegetation should be chosen for the stacking site.

Fire breaks are essential, and pipes must be protected from damage by vandals or animals"

Add the following sub-clauses:

"PSL 4.1.1 Stacking and Storage of HDPE Pipes

All pipes shall be delivered in 9m or 12 m lengths.

Pipes of different PN designations shall not be transported or stacked together. Stacks shall be kept separate and carefully marked.

PE pipes must be evenly supported in order to prevent distortion. All bearing surfaces must be free from contact with sharp objects. Any projecting sections such as stub flanges must be supported to prevent damage.

The pipes shall be stacked in uniform stacks, as described below:

The area for stacking of pipes shall provide a suitably regular surface onto which to place the pipes.

Care should be taken to ensure that, prior to commencement of stacking, the area is free of rocks and other debris that may cause damage to the pipes.

Pipes shall be stored on timber planks (dunnage) of minimum dimension 75mm x 75mm placed directly on the prepared surface at a maximum 1.5m centers. The planks shall be of sufficient length that, once the pipe or multiples of pipes are chocked, the plank extends to at least 100mm beyond the outside edge of the outside chock. Every pipe shall be chocked, regardless of whether it is constrained by pipes on either side and pipes shall be chocked such that a gap of at least 50mm is maintained between pipes. All chocks are to be secured (screwed/nailed) to the spacer plank to ensure that they cannot be moved/removed.

Pipes shall not be stored more than 3 (three) high and all the requirements for stacking and chocking between layers of pipes shall be as set out above.

Add the following sub-clause:

PSL 4.1.2 Stacking of Ductile Iron Pipes

The pipes shall be stacked in uniform stacks, sockets at the same end, as described below:

Bottom Layer: The bottom layer shall be laid on 2 timbers, arranged in parallel; one timber being 1m from the socket end and the other 1m from the spigot end. The pipes shall be laid parallel with one another. The sockets touch and shall not be in contact with the ground.

The pipes at the two ends shall be secured at the socket and spigot with large wooden wedges nailed to the timbers. The intermediate pipes shall be secured at the spigot end only, using smaller wedges.

Upper Layers: Each tier consists of parallel pipes laid in line vertically. Each tier is separated by timbers slightly thicker than the difference in diameter (socket – barrel).

Fittings and accessories shall be packed in robust timber crates and secured in position to prevent chaffing in transit.

The contractor shall supply all necessary timber dunnage/crating necessary to stack the pipes in accordance with the above specification. Timber dunnage shall be sufficiently robust to prevent crushing or breaking and shall be of sufficient size to prevent contact with the ground.

Add the following sub-clause:

PSL 4.4 Packing

Goods should be suitably packed in such manner as will ensure safe and efficient transport by road or rail, and the Contractor shall include in his prices for whatever packing may be necessary in this respect. Small items particularly liable to damage or loss in transit should be crated. All crates and packing material shall, after use, become the property of the Employer, unless distinctly specified otherwise, or if returnable, shall be so at the Contractor's expense.

PSL 5 CONSTRUCTION

PSL 5.1 Laying

PSL 5.1.1 General

Add to the Sub-Clause:

"The Contractor will be responsible for clearing the areas required for pipe storage that shall include the removal of rock, stones and all combustible material. He/she shall also be responsible for maintaining the area in a clean and tidy condition for the duration of the Contract.

The Contractor is to allow for any and all costs in regard to the storing of pipes in his tendered rates for supply and delivery in the case of pipes supplied by the Contractor or the rates for collect from storage and transport to site in the case of free issue pipes should he require secondary storage of the free issue pipes.

Upon delivery of the pipes, fittings, specials and valves, these will be inspected jointly by the Engineer's Representative and the Contractor. Any items found to be damaged shall be returned to the factory for repair or replacement, in which case the costs of additional transport, repair or replacement shall be borne by the Contractor if the pipes were supplied by the Contractor and not by the Employer.

The Contractor will be held fully responsible for the care and safety of all pipes and fittings, etc, on site, and shall bear the cost of all renewals, which may be necessary to make good losses, damages or breakages. Furthermore, he shall be fully responsible for handling and re-loading material at the storage areas and for transporting and offloading of all such materials to the Site of the Works.

Before commencing pipelaying, the Contractor shall properly distribute pipes, fittings and specials, along the trenches. Valves and couplings shall not be distributed until they are actually required for laying in their designed position."

Add the following new subclause:

PSL 5.1.2 Damage

Add the following:

"The Contractor shall be responsible for protecting pipes fittings and valves from grass fires at all times and shall keep grass cut short in the vicinity of all pipework items.

Should trenches be inundated by water, there is a risk of movement of the pipes by flotation. The Contractor shall ensure that trenches are not flooded by stormwater and that pipes laid in the trench are backfilled as soon as

possible after laying, except at joints made with couplings or flanges which must be kept visible until the pipeline has been satisfactorily tested.

Steel pipes with welded joints may, after all specified testing and corrosion protection has been satisfactorily completed and with prior approval from the Engineer, be backfilled at the same time as backfilling the pipeline.

Should movement of the pipes occur, the Contractor shall remove the pipes from the trench and thoroughly clean and relay the pipes. This work shall be carried out at the Contractor's expense."

PSL 5.1.3 Keeping Pipelines Clean

Add the following:

The Contractor shall take all of the steps necessary to prevent flooding of the Works and hence ensure that all work is carried out in the dry, and that the ingress of dirt and or dirty water into the pipes is pro-actively prevented. The ends of all laid pipes must be closed at all times when work is not being carried out.

Add the following sub-clauses:

"PSL 5.1.3.1 Cleaning Pipe Internals

The Contractor shall ensure that all pipe work installed is free from any internal contaminants. All traces of dirty water, slag, splatter, swarf, cuttings, coupons, welding rod ends, grinding dust, dirt and other debris are to be removed from the inside of the pipe as it is installed.

The relevant safety procedures are to be followed when entering pipes.

The Contractor shall ensure that all dust, grit and powder that accumulates in the pipe as a result of grit blasting for the repair of internal linings, be removed from the pipe in an acceptable manner before the internal lining repairs are carried out.

Once the lining repair has been completed, cleaned off and inspected, that specific section of the pipe shall be blocked off to prevent any further access by workers.

The Contractor shall take note that flushing of the completed pipeline may not be allowed after construction has been completed and therefore clean house keeping practices will be required under all circumstances during construction. The tendered rates for pipe laying shall include for the clean house keeping practices required.

Each section of the pipeline is to be internally inspected and passed by the Engineer once construction has been completed. If the pipework is not satisfactory, the Contractor shall re-clean the pipe at his own expense until the pipe is passed by the Engineer. The Engineer reserves the right to utilize cameras or any other means to inspect inaccessible areas.

PSL 5.1.3.2 Cleaning of Valves and Fittings

All flanges, valves, fittings and equipment may only be installed in pipe work after they have been thoroughly cleaned. Flange faces shall be checked for damage before being incorporated into the permanent works and any damage shall be reported to the Engineer."

PSL 5.1.4 Depths and Cover

Add the following:

"Water mains shall be so laid in road verges that the minimum cover from the finished surface level to the top of the pipe barrel is 800 mm. Under carriageways, water mains shall be laid horizontally and so that the minimum cover is 1 000 mm, the change to the cover under the carriageway from the verge being affected as specified in Subclause 5.1.4.2 of SABS 1200 L. Bulk supply mains shall be laid so that the minimum cover, in all situations, is 1 000mm."

Add the following new subclauses:

PSL 5.1.5 Working Inside Pipes and Protection of Internal Lining

All possible care shall be exercised during construction in order to avoid damage being inflicted to the pipe lining as a result of the installation and welding activities, and the following procedures shall always be adopted:

- Placing of rubber protection mats in the pipeline to ensure that no damage occurs as a result of foot traffic, falling tools and equipment, weld splatter and or grinding spray.
- On steep slopes, the mat is to be restrained from sliding down the pipe.
- Labourers working inside the pipe are to wear soft soled shoes.
- Wet sacking or rubber matting shall be placed on the pipe invert in the areas where welding or flame cutting operations are in progress to minimise the extent of damage to the lining from weld splatter or molten metal from flame cutting. This requirement shall be strictly enforced.
- Tools shall be placed on rubber foam or resilient rubber matting to protect the pipe lining against mechanical damage. Care must also be taken on steep slopes to restrain equipment and hand tools from sliding down the pipe during construction.
- Particular care is to be taken inside the pipe when tie-ins into the pipe are done for the purpose of fitting air valves, scour valves, by passes and other tie-ins.

Once internal work in a specific pipe sections has been completed and the pipe has been successfully cleaned, holiday detected and approved as being constructed to the satisfaction of the Engineer, the Contractor shall block off that section of pipe to prevent any further man entry into same.
The rates tendered in the Bills of Quantities shall include for all the measures required under this clause.

Detection of holidays in the internal epoxy lining will only commence once all internal activities in the pipe line have been completed. That is welding of joints, preparation of joints for epoxy reinstatement, as well as epoxy reinstatement in terms of the requirements of this specification. This excludes repair of epoxy lining as a result of damage incurred before the pipe is transported to the construction site as these defects will be repaired in the pipe yard.

Once all work is complete in a particular length of pipe, the Contractor shall arrange for the pipe to be thoroughly swept of all dust and debris. The pipe lining and joint repair will then be tested with a "wet sponge" detector set at 90 Volts in order to detect any electrical insulation defects."

The Contractor shall take note that flushing of the completed pipeline may not be allowed after construction has been completed and therefore clean house keeping practices will be required under all circumstances during construction. The tendered rates for pipe laying shall include for the clean house keeping practices required.

Each section of the pipeline is to be internally inspected and passed by the Engineer once construction has been completed. If the pipework is not satisfactory, the Contractor shall re clean the pipe at his own expense until the pipe is passed clean. The Engineer reserves the right to call for the use of cameras or any other means to inspect inaccessible areas; all at the Contractor’s expense.

PSL 5.1.6 Equipment for Inspecting Internal Surfaces of Pipes

The Contractor shall make the following equipment available for use by the Engineer for the inspection of the internal surfaces of pipes DN 700 and larger:

- One pair of boots having leather uppers and rubber soles
- One one-piece overall with at least one breast pocket
- One adjustable safety harness
- Two screw drivers, 5 cm and 10 cm long
- One small peen hammer
- A two-cell torch with a 10W light bulb with two sets of rechargeable batteries and a battery charger and spare bulbs
- A sufficient length of 16 mm diameter rope to suit the conditions on site.
- One trolley suitable for inspecting pipes of the appropriate diameter(s).

The equipment shall be kept in good condition and operating order throughout the duration of the Contract. No separate payment will be made for this equipment and the costs therefore will be deemed to be included in the tendered rates.

PSL 5.1.7 Pipe Support

Temporary pipe supports may be used to assist setting up and assembly. However, it is preferred that permanent pipe supports are installed as soon as possible to minimize double handling and/or omission during construction.

Permanent pipe supports shall be constructed as indicated on the drawings or as directed on site.

Before testing, all permanent supports shall be complete and all temporary supports removed, unless otherwise agreed by the Engineer.

PSL 5.1.8 End Caps

The Contractor shall, at the end of each day's work, fit end caps to the open ends of the pipeline under construction. The end caps shall be manufactured in such a manner that it can be fitted to seal off the pipeline to the extent that it is totally dust and water proof. The end cap shall be able to withstand a pressure of 5 m head of water externally when fitted.

End caps shall be maintained during non-working periods.

The tendered rates for the laying of pipe shall be deemed to include for the supply, fitment, and maintenance of the end caps."

PSL 5.2 Jointing Methods

PSL 5.2.2 Flanges (Steel Pipelines)

In the heading delete "(Steel Pipelines)"

Add the following:

"Before being brought together, the ends of the pipes, fittings, couplings and flanges are to be inspected and cleaned to ensure that all parts forming the joint are undamaged and clean.

When jointing flanges, the faces shall be cleaned thoroughly and an approved full faced jointing material (compressed fibre cement or other approved gaskets on flanged joints), cut properly to size, is to be inserted immediately before bringing the two flanges together. Before closing the joints, the flanges must be parallel to each other, with all bolts inserted in the bolt holes. After the fittings have thus been aligned and well supported, the joint shall be bolted up to a uniform tightness using torque wrenches to achieve the required compression force on the gasket.

Only full-face gaskets are to be used, the jointing material shall be flush with, or protrude beyond, the outer circumference of the flange (this is not applicable to raised face flanges). On completion of the joint, the flanges and bolts shall be protected as described in Clause PSL 3.9.3.8."

PSL 5.2.3 Welding (Steel Pipelines of Diameter 600 mm or Greater)

Delete the title and replace with "Welding (Steel Pipelines and Specials)".

Delete the 1st sentence and replace with:

Field and shop welding of steel pipes, bends and fittings shall be carried out in accordance with the relevant requirements of the latest version of API 1104. Prior to commencement of welding, the Contractor shall produce a qualified welding procedure in accordance with the latest version of API1104, for the intended sizes, processes, positions, and consumables to be used on the project.

Welding shall be carried out by welders who are competent in terms of the procedure approval test given in API 1104. Prior to commencement of welding, the current qualification of each welder must be produced in accordance with the welding procedure. Should constant repairs be required on welds carried out by one particular welder, the Engineer may require that the welder be re-tested or removed from the project."

Add the following Subclauses:

PSL 5.2.3.1 Radiographic Examination of Welds

The Contractor shall include in his tendered rates for supply (if appropriate), handle, lay and bed of all pipes, bends, fittings and other specials for the cost of carrying out, under the supervision of an inspector appointed by the Engineer or Employer, examination of shop and field welds on the following basis:

a) Field Welds:

All welds will be tested and adjudicated in accordance with API 1104. Radiographic testing is to be carried out on 100% of the welds.

Repairs of welds will be permitted in accordance with approved repair procedures. Repairs shall be re-examined using the relevant non-destructive testing method. All costs associated with the repair of defective welds will be borne by the Contractor.

b) Fabrication of Bends, Fittings and Specials

i) ONE HUNDRED percent radiographic examination of all weld deposited manually or semi-automatically in bends, fittings and specials which cannot be hydraulically tested because they have a plain end.

ii) FIFTY percent radiographic examination of all welds deposited manually or semi automatically in all flanged bends, fittings, and specials which are to be tested hydraulically.

c) On-Site Fabrication of Bends, Fittings and Specials

ONE HUNDRED PERCENT radiographic examination of all weld deposited manually or semi-automatically in bends, fittings and specials.

The Engineer will, in all cases, determine which welds are to be radiographed on the quantity basis specified above. All radiographs and records thereof shall be made available to the Engineer to enable him to determine whether the welds are acceptable or not and no lining or wrapping of pipes, bends or fittings shall be permitted until the welds have been accepted by the Engineer. To avoid any unnecessary delays, at the option of the fabricator, radiographs may be approved by the manufacturer's inspectors subject to them being subsequently submitted to, and approved by the Engineer.

When a section of the weld is shown by radiography to be unacceptable and, if the limits of the deficient weld are not defined by the radiograph, additional radiography shall be carried out at the Contractor's expense until the limits of the deficiency are determined.

In the event of any welded joint proving unsatisfactory when the pipeline is subjected to radiographic tests, the Contractor shall be held responsible for all costs involved in repairing the joint or cutting it out and welding a new section of pipe, as may be ordered by the Engineer, and thereafter restoring the lining and wrapping, if these have become damaged, all to the satisfaction of the Engineer.

All repair welds shall be identified with a stamp marking, indicating which welder conducted the repair. Repaired welds shall be tested at the Contractor's expense.

After jointing and testing, the protective lining and wrappings are to be rendered continuous with the same materials as applied to the body of the pipe. Holiday detection tests shall be carried out in the field to ensure continuity of lining and wrapping

The tendered prices for supplying (when appropriate), transporting, laying, jointing and testing of pipes are to include for all the work described above and for the supply of all necessary materials, including welding, all necessary plant and labour.

d) Production Testing of Welds (Not applicable to pipes supplied by the Employer)

The Contractor shall also include in his prices for the supply of pipes the cost of carrying out at the factory, non-destructive tests of shop production welds (additional to the qualification tests for welding procedure) on the following basis:-

One pipe from each one hundred pipes produced shall be selected at random and specimens for two guided cold bend tests and one transverse tensile test shall be cut therefrom and tested in accordance with SABS 719:1971, Section 7.

In the case of the guided cold bend tests, where welding is carried from one side only, bend - specimens shall be tested with the rest of the bend in tension; where welded from both sides the specimens shall be tested with the inner and outer welds in tension alternately.

Tensile tests shall be carried out as for the qualification tests.

The pipes from which successfully tested specimens have been taken shall be trimmed to the maximum possible length and shall be accepted by the Employer for payment purposes as full standard pipe lengths.

In the event of the welds of any pipe failing to reach the standard of acceptance, such pipe shall be rejected. Two further plate coupons shall be prepared from different pipes, selected at random by the Engineer, for each specimen that has failed to reach the required standard. In the event of such additional tests proving to be satisfactory repairs to the pipe originally failing any test will be permitted by the Engineer and such repairs and subsequent re-test shall be at the Contractor's expense. In the event of the additional tests also failing to reach the required standard the Engineer shall have the right to reject the entire batch of pipes from which the coupon plates were cut.

PSL 5.2.3.2 Welding Procedure

Welding shall, unless otherwise prescribed in the approved welding procedure, commence at the top of the joint and proceed downwards. In addition to the root weld, at least two further passes shall be made, none of which is to exceed 3 mm in depth but this is subject to the approved welding procedure.

PSL 5.2.3.3 Aligning

The alignment of abutting ends shall be such that the offset does not exceed 1,5 mm. Line-up clamps (“dogs”) shall not be used for the “fit-ups”. The use of “bridges and wedges” or any other method that may reduce the pipe wall thickness when removed or in any way introduce unnecessary stresses into the pipe is forbidden.

PSL 5.2.3.4 Weather Conditions

Welding shall not be performed under conditions that could affect the quality of the welded joint (e.g. high moisture or windy conditions). Windshields may be used where practical.

PSL 5.2.3.5 Clearance

The minimum clearance around the pipe during welding shall be 500 mm or such other minimum distance that may be required to facilitate compliance with the approved welding procedure. When welding in the trench, adequately sized “fox holes” shall be excavated/formed so as to provide adequate access for the welders. The cost of which is to be included in the submitted rates for excavation of trenches

PSL 5.2.3.6 Visual Inspection

ONE HUNDRED percent of each joint will be examined and the following criteria shall be met:

All welds shall be substantially uniform in appearance with the inner and outer weld beads not exceeding 1 mm and 3 mm in height respectively unless otherwise required in terms of the approved welding procedure.

Undercut will not be permitted under any circumstances.

The weld, heat affected zone, and surrounding parent metal shall be free from cracks, porosity and trapped slag.

All weld splatter must be removed prior to corrosion protection application.

PSL 5.2.3.6 Non-Destructive Testing After Construction

The Employer's Cathodic Protection Professional Services Provider will carry out coating integrity surveys along the full length of the pipeline as prescribed in the Employer's Cathodic Protection Specification.

Any defect(s) found in the pipeline coating, as a result of the PCM or DCVG testing shall be located and repaired by the Contractor at his expense.

In the case of PCM testing, all coating defects identified with an area greater than 0,5 square centimetre per 12 metre length of pipeline shall be located and repaired.

In the case of DCVG surveys, all coating defects identified with a value greater than 3% IR (or such other value as may be determined and agreed following analyses of the results of the first section which undergoes DCVG testing) shall be located and repaired. The agreement between the Contractor and the Engineer on this baseline, will be set as the criteria for the coating repair requirements by the Contractor on the whole pipeline.

Depending on the extent of the defects identified during PCM or DCVG testing, the Engineer may call for a further survey after the initial defects have been repaired by the Contractor, the cost of which testing shall then be borne by the Contractor.

PSL 5.2.3.7 Quality Control

Records of which welds were carried out by each individual welder as well as non-destructive testing results shall be submitted to the Engineer monthly. Should there be repetitive or serious defects, this information shall be forwarded to the Engineer immediately."

Add the following new subclauses:

"PSL 5.2.5 Polyethylene (PE) Pipes and Fittings

PSL 5.2.5.1 Unreinforced PE pipes

Unless otherwise specified, any of the following may be used to joint pipes together:

a) Mechanical joint compression fittings that comply with the requirements of SANS 14236
b) Suitable push-fit fittings recommended by the pipe manufacturer
c) Heated-tool socket weld or electrofusion fittings that comply with the requirements of SANS 4427-3
d) Butt fusion as per SANS 10268
e) Ductile iron fittings that comply with the requirements of SANS 52824;
f) Mechanical jointing systems that comply with the requirements of SANS 4427-3. Note that the use of standard stub ends for PE pipes shall not be permitted. (PSL 3.8.3)

PSL 5.2.5.3 PE Pipe Welding Requirements

PSL 5.2.5.3.1 Applicable Standards

All pipes, fittings, welding processes and equipment are to comply with the relevant standards:

- SANS 10270 - Welding of Thermoplastics – Approval of welding Procedures and Welds
- SANS 10268-1 – Welding of Thermoplastics – Part 1: Heated Tool welding
- SANS 10268-2 – Welding of Thermoplastics – Part 2: Electrofusion welding
- SANS 10268-10 – Welding of Thermoplastics – Part 10: Weld defects
- SANS 10269 – Welding of Thermoplastics – Testing and approval of welders
- SANS 1671-1 – Welding of Thermoplastics – Machines and equipment – Part 1: Heated Tool Welding
- SANS 1671-2 – Welding of Thermoplastics – Machines and equipment – Part 2: Electrofusion Welding
- SANS 6269 – Welding of Thermoplastics – Test Methods for Welded Joints

PSL 5.2.5.3.2 General Welding Requirements

Welding must take place in a dry and protect site. Suitable measures must be taken to protect the welding operation from adverse ambient conditions (rain, high humidity, wind). Ambient temperature must be recorded for each weld. . The welding machine and the supports of the pipes must be erected so that they cannot move in any direction during welding.
The contractor must apply for approval of welding procedures and welds in accordance with SANS 10270. The Welding Procedure Specification Qualification Report must be signed by the inspector with one copy handed to the Engineer. The Qualification file as described in Clause 9 of SANS 10270 must be handed to the client prior to commencement of any production / construction site welding activities.
Welding is to be carried out only by welders certified by the National approved training body (Thermoplastics Joining Committee – National Panel of Examiners). The operator's current and valid welding certificate must be presented to the Engineer before any welding commences.

PSL 5.2.5.3.3 Butt Fusion Welding

Butt Fusion Welding may only be used to join pipes of the same SDR (Standard Dimension Ratio).

Only automated, approved, and calibrated welding machinery will be permitted. A calibration certificate must be presented to the Engineer before any welding commences. Every welding machine shall be marked in accordance with Clause 4.7 of SANS 1671-1, with the following items:

a) The manufacturer's name
b) Type of welding machine
c) Manufacture date
d) Serial number of machine
e) Safety information for the operation of the machinery

The welding machinery shall allow for control and adjustment of the various welding parameters in accordance with Clause 4.5 of SANS 1671-1.

Instructions for the safe and correct operation, maintenance, servicing and calbration of the welding machinery must be supplied and shall include, as a minimum, the items a) to e) in Clause 4.8. of SANS 1671-1.

Process reports for each weld with the information listed in items a) to m) of Clause 4.5.4.1 of SANS 1671-1 must be complied and handed to the Engineer prior to commencement of any welding activities.

Heated tools shall comply with Clause 5.4 and the specific requirments of Clause 6 in SANS 1671-1. Surface coatings for heated tools are permitted to allow for easy cleaning with the exception of PTFE spray and galvanic coatings containing copper and cuprous material. The requirements of Clause 5.4.3 in SANS 1671-1 shall be adhered to should PTFE be used as a surface coating. The heating plate shall be cleaned with an appropriate non-oil based cleaning solvent using the method described in Clause 5.1 of SANS 10268-1.

Pipe joint ends shall be prepared using the method described in Clause 5.2 of SANS 10268-1. This includes proper alignment of the joint (maximum offset limited to 10% of pipe wall thickness), machine facing to ensure a smooth joint end and cleaning with an appropriate solvent such as isopropyl alcohol. All measures shall be taken to prevent contamination of the joint surface by grease, dirt and dust.

The Butt Welding jointing process shall comply with Clause 5.4 of SANS 10268-1. Should the pipe manufacturer's specification and instruction differ from Clause 5.4, the maufacturer's instructions shall apply.

PSL 5.2.5.3.4 Electrofusion Welding

Electrofusion welding may be used to join pipes of different SDR. Only automated, approved, and calibrated welding machinery is permitted. A calibration certificate shall be presented to the Engineer before any welding activities commence.

Only bar coded fittings and Electrofusion Control Units shall be used. The computerised printouts of the weld parameters and information for each weld shall be compiled and handed to the Engineer upon his/her request. Every welding machine shall be marked in accordance with Clause 8 of SANS 1671-2, with the following items:

a) Manufacturers name
b) Serial number of machine
c) Type of machine
d) Input and outlet volatages
e) Frequency
f) Insulation protection class (to SANS 60529) and
g) Duty cycle

Instructions for the safe and correct operation, maintenance, servicing and calibration of the welding machinery must be supplied and shall include, as a minimum, the items a) to e) in Clause 9 of SANS 1671-2.

Joint surfaces must be prepared in accordance with Clause 6.1 of SANS 10268-2. The pipe must be cut square and all oxidation shall be removed using a purpose made reaming/scraping tool, suitable for the outside diameter of the pipe to be reamed, immediately before welding. The external surfaces of the pipes to be joined and the inside surface of the electrofusion coupling shall be wiped clean with a suitable solvent such as isopropyl alcohol as described in Clause 6.1.4.2 of SANS 10268-2.

The manufacturer's instructions for the electrofusion welding process must be strictly adhered to and only approved, certified and calibrated machinery may be used. Welding is to be carried out only by welders certified under the Thermoplastics Welding Institute of South Africa (TWISA) or the Plastics Federation of South Africa.

The Electrofusion welding jointing process must comply with Clause 6.3 of SANS 10268-2. Should the pipe manufacturer's specification and instruction differ from Clause 6.3, the manufacturer's instructions shall apply. All completed welds will be visually inspected and will be recorded on an appropriate weld defects check sheet in accordance with SANS 10268-10. Weld assessment Class III will be applicable

PSL 5.2.5.3.5 Fittings

(a) Tees and Bends

Injection moulded fittings shall be used wherever possible. Where factory fabricated fittings are to be used for tees and bends their pressure class shall be de-rated in accordance with the appropriate standard. Injection moulded fittings are deemed to be fully rated and need not be de-rated as in the case of fabricated fittings.

(b) Saddles

Only electrofusion type saddles are permitted. Electrofusion saddles shall comply with ISO 4427 – 3 and ISO 4427 – 5.

(c) Compression Fittings

Compression fittings may be used to join pipes with diameter size smaller than DN 100. Compression fittings shall comply with SABS 533 and shall conform to ISO 4427.

(d) Mechanical **Couplings**

Mechanical couplings must be of the tension resisting type to counter the shortening of the pipe and resultant induced longitudinal stresses when pressurised due to Poisson effect and thermal contraction. External restraints must be provided for anchorage of the pipes to be joined, and specialist suppliers of pipes and fittings should be consulted for suitable jointing solutions.

The use of flexible couplings ("V.J couplings") is expressly prohibited under all conditions and circumstances.

(e) Flanged Connections

Flanged connections comprised of butt welded HDPE stub flanges and steel backing rings which are bolted to other flanges. The body of the PE fitting must be manufactured in the injection moulding Process or from a piece of homogeneous Semi-finished material. **Semi-Finished Materials Manufactured From Wound Rods Or The Subsequent Application Of Other Forms Of Reinforcing Are Not Permitted.** Bolts are to be numbered and tightened in a cross pattern sequence. Bolt torque must be as per the guidelines of the supplier of the stubs. Bolts are to be re-torqued 24to 48 hours after initial tightening in accordance with the manufacturer's specification to counteract reduced tension in the tie bolts resulting from visco-elastic relaxation of the HDPE material under stress thus maintaining sealing pressures and ensuring leak free joints. Gaskets are not required provided that the mating faces of the HDPE stub flanges have not been damaged.

PSL 5.2.5.4 Steel-mesh-reinforced Polyethylene (PE) pipes

Steel-mesh-reinforced PE pipes shall be joined by means of either electrofusion couplings or flanged fittings that comply with the requirements of SANS 371.

PSL 5.2.6 Cut pipes

Cut pipes may be used where required as closure lengths. The cut ends shall be dressed square and to a smooth even finish which shall not be inferior to that of the ends of uncut pipes. The finished dimensions of ends cut on site must be within the tolerances applicable to the ends of the particular types of pipes to be laid. The cost of cutting and trimming pipes shall be included in the rates tendered for laying and jointing pipes."

PSL 5.3 Setting Valves, Specials and Fittings

Add the following to the Subclause:

"Valves are to be set correctly in the positions indicated and supported on concrete stools, except where not so required by the Engineer. Valve spindle guide brackets and stays where provided shall be secured into position against concrete work and set and carefully adjusted in order to give true vertical alignment of the spindle."

PSL 5.10 Disinfection of Potable Water Pipelines

Delete the clause and replace with:

"The entire pipeline disinfection will be monitored by the Engineer's Representative and/or the Employer's personnel. The disinfection criteria are stringent and the Contractor shall keep the pipeline clean throughout the Contract.

The Contractor will be required to submit a detailed method statement for approval by the Engineer. A minimum requirement will be that the method statement deals with the method of dosing and how the dosing rate will be

controlled to ensure a uniform distribution throughout the pipeline being disinfected, the chemicals to be used, the anticipated range of dosing rates and equipment to be used, and the name and qualification the Contractor's person supervising the disinfection.

Once a successful hydraulic test of the entire pipeline has been achieved and the connections have been completed, the pipeline shall be drained. The pipeline shall then be re-charged in accordance with PSL 7.3.4 – "Initial Filling of the Pipeline". Whilst being charged, a sodium hypochlorite solution shall be dosed at a temporary connection(s) made at an air valve(s), which will be confirmed by the Engineer in order to achieve a theoretical total chlorine concentration of 25 ppm (mg/l).

Once the entire pipeline has been filled in this manner, it shall be left for a 24-hour period. Thereafter, total chlorine concentrations shall be measured at each scour point. A concentration of 20ppm total chlorine will be considered acceptable. Should this concentration not be achieved at all scours, the Contractor shall take all steps considered necessary by the Engineer to achieve satisfactory disinfection, at his/her own cost.

Once satisfactory disinfection has been achieved, the pipeline shall be drained via the scour valves (or by other means approved by the Engineer) and sufficient sodium thiosulphate (typically 1 part of total chlorine) shall be dosed into the scour-wet wells to fully neutralise the chlorine before discharging to watercourse.

The pipeline shall then be re-charged in accordance with the stated procedure and, after 24 hours, samples shall be taken and sent to an approved laboratory for analysis (at no cost to the Employer). Should the following limits not be achieved, the Contractor shall carry out at his/her own cost, all steps deemed necessary by the Engineer to achieve satisfactory disinfection.

Water Quality Limits:

PARAMETER	COUNT
e. coli	0
Coliforms	0
Faecal Streptococci	0

The cost of the provision of water and all chemicals for disinfection shall be deemed to be included in the tendered rates"

Add the following new subclause:

"PSL 5.11 Pipeline Markers

Markers are to be erected 300 mm off the edge of the pipe trench to the left of the trench and at right angles to the trench centre line at all horizontal changes of direction and on both sides of all road and river crossings, at valve chambers and at intermediate intervals of 50m unless agreed with the Engineer.

At bends the marker will be erected at the P.I. point of these 300 mm offset lines."

PSL 5.12 Cement Stabilising Bedding and Selected Fill around Pipes

Where shown on the drawings or directed by the Engineer, the bedding and selected material around the pipe shall be stabilized with 8% by mass of OPC. This is applicable to water course crossings, under trafficked areas and on steep slopes.

In all cases, the cement shall be added to the bedding / selected fill material outside the trench and in such a manner so as to achieve full dispersion of the cement in the material and achieve Optimum Moisture Content when placed and compacted around the pipe. Excess water content is to be avoided so as not to create a 'concrete encasement' of the pipe.

PSL 6 TOLERANCES

PSL 6.2 Control Points

Add the following:

"On completion of the contract, the Contractor shall provide the Engineer with a list of as built coordinates (Accurate to 0.1 m) for all air valves, scour valves, isolation valves and standpipes. The cost of providing this information shall be deemed to be included in the rates tendered for the individual items."

PSL 7 TESTING

PSL 7.2.1 Dye-Penetrant Test

all fillet welds shall be subject to dye penetrant testing the cost of which shall be deemed to be included in the tendered rates for pipelaying.

PSL 7.2.2 Radiographic Examination

butt-welded joints and bell-end joints shall be radiographically tested in accordance with PSL 5.2.3.

PSL 7.3 Standard Hydraulic Pipe Test

Option 1: All measures required for obtaining, purchasing, tankering, pumping and/or piping the water for testing and disinfection of the pipeline shall be deemed to be included in the tendered rates for laying of the pipeline.

Option 2: Were possible, water used for one filling of the pipeline for hydraulic testing will be provided by the Employer free of charge. Additional water used due to unsuccessful hydraulic tests will be charged at the Employer's bulk rate per kilolitre that is charged to the employer by DWS. Filling of the pipeline for hydraulic testing shall be carried out slowly to enable air to escape and under the direction of the Engineer.

Where the Employer is unable to supply water for testing, an item to collect and convey water from a specified source shall be scheduled for payment.

PSL 7.3.1 Test Pressure and Time of Test

Add the following to the subclause:

"The sections in which the pipeline may be tested will be at the discretion of the Contractor, except that the pipeline shall be tested in sections not exceeding a maximum allowable length of 2 000 m unless otherwise agreed by the Engineer. The Contractor shall make due allowance in the construction program and in the tendered rates for the entire testing operation including for the provision of temporary end stops (flanges or bullnoses) and any other costs incurred associated with testing the pipeline.

The pipe shall not be tested until the associated structural concrete for anchorage has cured for 28 days or until such concrete has attained the specified design strength. In the case of cement mortar lined pipes, once filled, the pipe shall be left for 24 hours to permit maximum saturation of cement mortar linings.

The section to be tested shall be pressurised to the specified pressure and left for 24 hours, during which period, the pressure drop (if any) and the quantity of water required to be pumped in to restore the test pressure shall be measured and recorded. In addition, all flexible and flanged joints shall be visually inspected and there shall be no sign of leakage.

The permissible leakage for welded and flanged steel pipelines is zero (0) litres.

At all times when there is water in the pipeline, and particularly during filling, testing and draining of the pipeline, all air valves shall be in operation and their individual isolating valves shall be open."

PSL 7.3.1.2 Delete the contents of this subclause and replace with the following:

"Subject to the provisions of 7.3.1.3 and 7.3.1.4, the test pressure for field testing shall be 1.25 times the designated working pressure at any point on the longitudinal section of the pipeline up to a maximum of 1.0 MPa, above which it shall be the designated working pressure plus 0.5 MPa.

For the purposes of this calculation, the designated working pressure shall be taken as the pressure rating of the pipe."

PSL 7.3.1.4 Delete the contents of this subclause and replace with the following:

The field test pressure shall not exceed the appropriate of the values in the following table.

Type of pipe	Applicable materials standard	Maximum field pressure at any point of the pipeline
Steel	SANS 62-1, SANS 62-2, SANS 719	50% of the hydraulic test pressure
Ductile iron	SANS 50545	Allowable site test pressure (PEA)
Reinforced concrete	SANS 676	75% of hydraulic test pressure
Prestressed concrete	SANS 975	75% of hydraulic test pressure
Fibre cement	SANS 1223	75% of hydraulic test pressure
GRP	SANS 1748-1	1.5 times the rated pressure class
Polyethylene (PE)	SANS 4427	1.5 times the rated pressure of the pipe
Steel-mesh-reinforced PE	SANS 370	1.5 times the rated pressure of the pipe
Polypropylene	SANS 15874-2 and SANS 15874-3	1.5 times the rated pressure of the pipe
uPVC	SANS 966-1	1.5 times the rated pressure of the pipe
mPVC	SANS 966-2 or SANS 1283	1.5 times the rated pressure of the pipe
oPVC	SANS 16422	1.5 times the rated pressure of the pipe

Add the following new subclauses:

PSL 7.3.4 Initial Filling of Pipeline

The entire process for filling the pipeline at any time during testing or disinfection shall be carried out under the supervision of the Engineer and will also be monitored by the Engineer and/or the Employer's personnel. Under no circumstances will the Contractor be allowed to carry out filling of the pipeline without the supervision of the Engineer, neither shall he/she permit any other persons to carry out such filling without the written permission of the Engineer.

Any damage to the pipeline caused by non-compliance with this Sub-Cause shall be rectified at the Contractor’s expense.

PSL 7.3.5 Connections after Testing

The connections of the new pipework to the existing pipework shall only be carried out after the pipeline testing has been completed and accepted by the Engineer. For this reason, testing must be carried out against a blank flange or bullnose end cap at these locations.

PSL 7.3.6 Remedial Measures

In the event that a pipe section fails a test, the Contractor shall carry out all remedial measures necessary to obtain a successful test of each individual section and the entire pipeline, at his/her own expense. Such remedial measures shall in no way compromise the original pipeline specifications.

PSL 7.3.7 Draining of the Pipeline

The pipeline may have to be drained to carry out remedial measures and it must be drained before the disinfection process commences. The pipeline shall be drained via the scour valves in a manner that does not cause erosion of the streambeds or negatively impact on the environment in any way. All such drainage of the pipeline shall be carried out under the supervision of the Engineer's Representative.

Add the following subclauses:

PSL 7.5 Testing of Valves

All valves shall be pressure tested according to SABS 664 or other applicable code at the appropriate test pressure. Test certificates shall be issued to the Engineer upon delivery to site.

No separate payment shall be made for testing of valves and hydrants and the scheduled rates for the supply and installation of valves shall include for all costs in respect of testing.

PSL 7.6 Commissioning

The pipeline will be considered to have been commissioned and practically complete once all the associated structures are sufficiently complete to carry out their structural and hydraulic function and the hydraulic test and disinfection of the entire pipeline has been successfully completed."

PSL 7.7 Water Tightness Test for Chambers

Add new Sub-clause:

On completion of each concrete chamber, and prior to completion of the backfilling around the chamber, a water tightness test shall be undertaken by the Contractor. This shall be carried out by excavating a trench approximately 0,5 m deep around the periphery of the chamber and continuously (for at least 4 hours) maintaining it full of water. Should there be any noticeable leaks into the chamber, the Contractor shall carry out at his/her own expense whatever measures are necessary to waterproof the chamber to the Engineer's satisfaction.

PSL 7.8 Testing of PE pipes and materials

PSL 7.8.1 Raw Material Acceptance Tests:

The material used for the production of the pipes and fittings shall be a high density polyethylene PE 100 complying to SANS ISO 4427 Part 1. To ascertain the quality of this product the following tests shall be performed, prior to manufacture of the pipes or fittings.

- Density
- Melt Flow Index
- Carbon Black Content
- Thermal Stability

Copies of all test schedules and manufacturer's quality control records shall be available for examination by the Employer and/or the Engineer.

The following documents are required:

- Certificate of Registration – SANS ISO 9001:2008 or National Equivalent
- Permit Certification – SANS 4427 for PE 100
- the Quality Control Plan (QCP shall include Raw Material and Product Test Certificates)
- SABS or National Equivalent Quality Systems Audit Reports – Last 2 Audits

PSL 7.8.2 Testing of Pipes:

Testing as contained in the SANS 4427:1996/ ISO 4427:1996 specification Part 1 and 2 will be used as guidelines. Tests shall also be conducted ad-hoc by a registered and authorised testing authority.

PSL 7.8.3 Destructive Testing of Welds

The testing of welds shall comply with the requirements of SANS 6269 Edition 1.1.

The standard destructive tests described are as follows:

- Tensile test;
- Tensile-creep test; (not required unless specified normally for chemical high end applications only)
- Bend test; and
- Peel test for electrofusion joints only.

PSL 7.8.4 Non-Destructive Testing of Welds

The testing of welds by non-destructive testing will be conducted by the Engineer's Representative on site and before any production weld is made by the contractor on site. The following procedure shall be followed:

- The Contractor shall not undertake any welding without the presence of Engineer's Representative;
- The testing machinery shall be checked and approved by the Engineer's Representative before testing commences;

PSL 7.8.5 Field Pressure Testing Procedure for HDPE pipes

The method described below describes the procedure to be followed for field pressure testing of HDPE pipe:

- Fill the pipe with water
- Bleed off any trapped air
- Over a period no longer than 10 minutes, increase the pressure at a constant rate to the specified field test pressure (the Field Test Pressure Horizon is shown on the small scale long section drawing)
- Maintain the test pressure by continuous pumping for 10 minutes, then stop pumping
- Close the shut-off valve to the pipe and monitor the pressure for a period of 60 minutes. Inspect the pipe visually for leaks during this time.
- If the pressure has dropped more than 30% at the end of the 60 minute period, the pipe shall not have passed the pressure test. Continue to look for leaks and repair as necessary.
- If the pressure has dropped less than 30% at the end of the 60 minute period, rapidly decrease the pressure in the pipe by 2,0 bar (200 kPa) by releasing water from the pipe.
- Monitor the pressure for 60 minutes. If the pressure remains constant or increases during this time the pipe is deemed to have passed the pressure test.

If the pipeline does not pass the pressure test:

- Remove the test pressure
- Permit the test section to 'relax' for not less than 8 hours
- Repeat the above procedure.

PSL 8 MEASUREMENT AND PAYMENT

PSL 8.2 Scheduled Items

PSL 8.2.1 Supply, Lay and Bed Pipes Complete with Coupling…….....Unit : m

Rename this subclause PSL 8.2.1 a) and add the following:

"A maximum payment of 80 % of the tendered rates will be made for a completed section of pipeline which has not yet been hydraulically pressure tested and disinfected. A further payment of 20% of the tendered rates will be made upon successful completion of the pressure testing and disinfection for the relevant section of pipeline.

The rates tendered for the laying and bedding of pipes, bends, fittings, and valves, shall be deemed to include the costs associated with the field pressure testing and disinfection of the pipeline.

Pipelines will be measured by length over all lengths as laid. No deduction will be made for specials and valves. Separate items will be scheduled for each diameter and each type and class of pipe laid."

Add the following subclause:

PSL 8.2.1 b) Collect from Designated Pipe Yard/s, Transport, Lay and Bed Pipes Complete with Coupling……. Unit : m

Pipelines will be measured by length over all lengths as laid. No deduction will be made for specials and valves. Separate items will be scheduled for each diameter and each type and class of pipe laid.

The rates shall cover the cost of the collection of the pipes from pipe yard, transportation to the site of the works, offloading and placing/stringing to suit the contractor's laying methods, handling, inspecting, bedding, laying, jointing, cutting, testing and, when relevant, disinfecting the pipes and the joints.

A maximum payment of 80 % of the tendered rates will be made for a completed section of pipeline which has not yet been hydraulically pressure tested and disinfected. A further payment of 20% of the tendered rates will be made upon successful completion of the pressure testing and disinfection for the relevant section of pipeline."

PSL 8.2.2 Extra-over 8.2.1 a) and 8.2.1 b) for the Supplying, Laying and Bedding of Specials Complete with Couplings.

Add the following:

"A maximum payment of 80 % of the tendered rates will be made for a special once installed in the pipeline which has not yet been hydraulically pressure tested and disinfected. A further payment of 20% of the tendered rates will be made upon successful completion of the pressure testing and disinfection for the relevant special.

The rates for the supply and installing of valves and specials shall cover the cost of any cutting, trimming, and jointing of pipes required for the installation of valves, bends and fittings in the positions shown on the drawings. Unless specific provision is made in the Bills of Quantities, no separate payment will be made for forming of any additional joints and/or for the supply of additional jointing materials which may be required for the connection of cut pipes.

The rates tendered for the laying and bedding of pipes, bends, fittings, and valves, shall be deemed to include the costs associated with the field pressure testing and disinfection".

PSL 8.2.3 Extra-over 8.2.1 a) and 8.2.1 b) for the Supply, Fixing and Bedding of Valves

Add the following:

"A maximum payment of 80 % of the tendered rates will be made for a valve once installed in the pipeline which has not yet been hydraulically pressure tested and disinfected. A further payment of 20% of the tendered rates will be made upon successful completion of the pressure testing and disinfection for the relevant special.

The rates for the supply and installing of valves and specials shall cover the cost of any cutting, trimming, and jointing of pipes required for the installation of valves, bends and fittings in the positions shown on the drawings. Unless specific provision is made in the Bills of Quantities, no separate payment will be made for forming of any additional joints and/or for the supply of additional jointing materials which may be required for the connection of cut pipes.

The rates tendered for the laying and bedding of pipes, bends, fittings, and valves, shall be deemed to include the costs associated with the field pressure testing and disinfection".

PSL 8.2.15 Special Wrapping in Corrosive Soil

Change the heading of this subclause as follows:

PSL 8.2.15 Special Wrapping of Pipes, Specials, Valves and Fittings

a) **Corrosion Protection of Flanges and Flexible Adaptor/Anchoring Joints in Chambers……...Unit: No.**

Separate items will be scheduled for flanges, flexible joints and adaptor/anchoring joints of each diameter and type. The unit of measurement shall be the number (No) of paired flanges/joints wrapped as specified. The rate will include for all materials, manufacturing, delivery, painting and erection of each unit.

b) **Corrosion Protection of Buried Valves, Flexible and Flanged Joints and pipes……Unit: No or m**

Separate items will be scheduled for valves, flexible and flanged joints and pipes of each diameter and type. The unit of measurement shall be the number (No) of buried paired couplings, joints, flanges or valves as specified or the length of pipe as specified. The rate will include for all materials, manufacturing, delivery, painting and erection of each unit.

In the case of valves, the rate shall include for protection of the whole of the valve body, all flanges integral to the valve, the connecting flanges to the valve i.e. including the two flanges of the pipework connected to either side of the valve, and the packing of mastic (without tape or sheathing) over the gland adjusting bolts and nuts."

c) **Wrapping of Permanently Exposed and Cast-in Pipes and Fittings……Unit: No or m²**

If Separate items are scheduled for each diameter of pipe to be wrapped and the length of encasement, the unit of measurement shall be No of completed wrappings. If not the unit of measurement will be square metres of completed wrapping as detailed.

Add the following new payment items:

PSL 8.2.16 : Pipeline Markers…… Unit : No

The unit of measurement will be the number of markers erected and accepted by the Engineer and the rate will include for all materials, manufacturing, delivery, painting and erection of each unit.

PSL 8.2.17 : Valve Markers…… Unit : No.

The unit of measurement will be the number of markers erected and accepted by the Engineer and the rate will include for all materials, manufacturing, delivery, painting and erection of each unit."

PSL 8.2.18 Cutting into and Connecting to Existing Pipeline ……Unit : Sum

Cutting into and connecting to existing pipeline

The rate for cutting into and connecting to existing pipelines shall cover the cost of liaison with the Employer's Operators, isolating and draining the existing pipeline, cleaning and preparing the pipe for cutting, cutting, preparing the pipe ends for jointing, welding / jointing and connecting the new pipework, making good internal linings and external coatings, re-commissioning the pipeline, and including all temporary supports, bedding and backfilling.

PSL 8.2.19 Cement Stabilising Bedding and Selected Fill around Pipes……Unit : m³

An item, extra-over laying and bedding pipes, will be measured for payment for cement stabilising the bedding and selected fill around the pipes where directed by the Engineer. Separate items will be scheduled for stabilising on steep slopes and for stabilizing at watercourse crossings.

The tendered rates shall cover all additional costs associated with supplying the cement at the percentage specified and mixing it in and achieving Optimum Moisture Content for compaction around the pipe.

"PSL 8.2.20 Mitre Cut Joints..... Unit: No.

Mitre cuts (two piece bends) up to 15^{o} in steel pipelines may be carried out in the field only if ordered/permitted by the Engineer.

The rate shall cover the cost of cutting, forming, and bevelling the ends of the pipes at the joint, all welding, testing and forming joint holes in all materials and for making good the internal linings and external coatings on the welded joints.

PSL 8.2.17 Cutting Pipes

c) Extra over for forming scarf joint……Unit: No.
d) Extra over for cutting pipe as closure……Unit: No.

Payment will only be made where shown on the drawings or where instructed by the Engineer's Representative. No payment will however be made for cutting pipes to suit the installation of bends, fittings, and valves that are shown on the drawings.

The rates shall cover the cost of cutting, forming and bevelling the ends of the pipes at the joint, all welding, testing and forming joint holes in all materials and for making good the internal linings and external coatings on the welded joints.

PSL 8.2.18 Repair of FBMDPE Coatings Defects

a) Repair defect smaller than 650mm^2 (Small Areas)……Unit: No

Repair defects in FBMDPE coatings of size smaller than 651 mm^2 according to PSL 3.9.3.1 & PSL 3.9.3.12

b) Repair defect larger than 650mm^2 (Large Areas)…….. Unit: No

Repair defects in FBMDPE coatings of size between 651 mm^2 and 1000 mm^2 according to PSL 3.9.3.1 & PSL 3.9.3.11

c) Repair defect larger than 1000mm^2 (Very Large Areas)…….. Unit: m^2

Repair defects in FBMDPE coatings of size between 651 mm^2 and 1000 mm^2 according to PSL 3.9.3.1 & PSL 3.9.3.11

PSL 8.2.19 Repair of 3 Layer PE Coatings Defects…….. Unit: m^2

Repair defects in 3 Layer Polyethylene coatings according to PSL 3.9.3.1 & PSL 3.9.3.13

PSL 8.2.20 Repair of Cement Mortar Lining Defects…… Unit: m^2

Repair defects in CML lining according to PSL 3.9.3.1 & PSL 3.9.3.10

PSL 8.2.21 Repair of Damage due to Thermic Welding…….. Unit: No

Repair defects in pipe coating and lining arising from thermic welding for continuity bonding according to PSL 3.9.3.14

PSLB BEDDING (PIPES) (SABS 1200 LB)

PSLB 2.3 DEFINITIONS

Main fill:
Delete "150 mm" in second line and substitute "300 mm".

PSLB 3 MATERIALS

10.

PSLB 3.1 Selected Granular Material

Replace with the following :-

Selected granular material shall be silty to fine sand having a stiffness ratio of not less than 5,0 MPa. Furthermore, the origin of the materials should, preferably, be river transported since it is preferable that the larger grains (3,0 to 4,8 mm in size) be rounded and not sharp and angular. Such as clean river sand or any other granular, non-cohesive, vegetation free material subject to the approval of the Engineer. The maximum particle dimension shall be 10 mm. This material may occur in-situ, be imported or selected from trench excavations. The maximum compatibility factor shall be 0,4.

All bedding used for the cradle beneath and surrounding the pipes shall comply with the following requirements:

GRADING ANALYSIS RANGE	
SIEVE SIZE (mm)	*PERCENTAGE PASSING*
6,7	98 to 100
4,76	85 to 100
2,36	55 to 95
1,18	30 to 75
0,60	20 to 50
0,425	16 to 38
0,30	13 to 27
0,15	5 to 18
0,075	0 to 12

The Contractor will be required to carry out his/her own quality control testing of the material to ensure that it meets the padding sand requirements and complies with this specification at all times. At least one grading analysis shall be carried out for every 100 lineal meters of bedding placed. The results of these tests shall be forwarded to the Engineer within 24 hours of completion of the test. Should the material not comply with the specification, the Contractor shall remove and replace it with approved material at his/her own cost.

PSLB 3.2 Selected Fill Material

Replace with the following :-

Not required. All material up to the underside of backfill shall be measured as selected granular.

PSLB 3.3 Bedding

All medium pressure pipes shall be classed as flexible pipes and shall be bedded in accordance with Drawing LB 2 of SABS 1200 LB.

All concrete pipes shall be classed as rigid and shall be bedded in accordance with Drawing LB 3 of SABS 1200 LB.

Depending on the actual material supplied by the Contractor, the moisture content may be critical to enable satisfactory placing and compaction and the Contractor will be deemed to have allowed in his tendered rate for any and all adjustments required to the moisture content of the bedding material at all times.

No extra payment will be made for forming or filling joint holes (pockets).

PSLB 3.4 Selection

PSLB 3.4.1 Suitable Material Available from Trench Excavation

Delete the Sub-Clause and substitute the following:

The excavation of a pipe trench shall comply with the requirements of Sub-Clause 5.4 of SABS 1200 DB and the provisions of Sub-Clause 3.7 of SABS 1200 DB (in terms of which, for the purposes of providing bedding materials, the Contractor is not required to use selective methods of excavating) shall apply. Nevertheless the Contractor shall take every reasonable precaution to avoid burying or contaminating material that is suitable and is required for bedding or covering the pipeline. If, in the opinion of the Engineer, bedding material can be produced from the excavated material, the Contractor shall, if so ordered by the Engineer, screen or otherwise treat (as scheduled) the excavated material in order to produce material suitable for bedding (see also Sub-Clause PSLB 8.1.2).

PSLB 5 CONSTRUCTION

PLSB 5.1 GENERAL

PSLB 5.1.4 Compacting

Delete the second line and substitute: top of the pipeline) shall be 93% mod AASHTO.

Add to Sub-Clause 5.1.4:
Steps will have to be taken by the Contractor to ensure that flexible pipes do not deform excessively in cross-section during and after construction and backfilling operations. The maximum deflection which will be acceptable at any stage during or after construction is 2% of the pipe diameter horizontally or vertically. The Contractor will be required to provide the necessary apparatus and to monitor deflection during construction.

Pipe deformations will only be maintained within the specified tolerances by correct backfilling practice. No heavy compaction equipment will be permitted for compaction of any pipe bedding, only pneumatic or hand rammers being acceptable. To this end, and to achieve the 93% compaction specified it is required that the bedding material be brought up evenly on either side of the pipe. The use of complete saturation of the material as a method of achieving the specified compaction may, subject to the Engineer's approval, be used. However, in this regard, Tenderers are advised that the presence of excessive quantities of water in the pipe trench could lead to flotation of the pipe.

Prior to the commencement of pipe laying the Contractor will be required to submit, to the Engineer, for his approval, his proposed methods of placing, and compacting methods which he proposes to implement in order to ensure compliance with the specification.

PSLB 5.1.5 Testing

Flexible and flanged joints shall be left exposed with a minimum of 300 mm clearance around the bottom of the pipe during hydraulic pressure testing of the pipe to facilitate inspection.

PSLB 5.2.5 Stone Bedding

In areas where waterlogged conditions exist or where ordered by the Engineer, special drains consisting of a 150 mm thickness (See PSDB 5.5) of single sized stone with a geofabric filter surround ("Bidim" Grade A4 or similar approved) extending the full width of the trench shall be provided below the bedding to the pipes. The excavation for these drains will be measured in cubic metres at the contract rate applying to unsuitable excavation below the bottom of the trench. The stone filling will be paid for per cubic metre and the geofabric filter will be paid for per square metre. All measurements in this connection will be to a width equal to the base widths and depths ordered.

PSLB 5.3 Placing and Compacting Flexible Pipes

PSLB 5.3 (a) Bedding Cradle

Delete the sub-clause and substitute the following:

The pipes shall be bedded on a minimum 100 thick layer of compacted granular bedding material on which a 50 mm thick layer of uncompacted granular bedding material has been placed and spread. Loose granular bedding material lying next to the pipe shall be placed into the haunch area and compacted with suitable hand tools (covered with rubber to prevent damage to the pipe coating), and additional selected granular material shall be added and compacted in 150 mm thick layers up to the mid point of the pipe diameter in the vertical plane. The remainder of the bedding i.e. the selected fill blanket, shall be placed in layers up the sides of the pipe, each layer being compacted until a level of 300 mm above the crown of the pipe is reached.

All bell (fox) holes shall be filled with bedding material.

PSLB 5.3 (b) Selected Fill Blanket

Delete "200 mm" from title.

PSLB 6 TOLERANCES

PSLB 6.1 Moisture Content and Density

Add to the Sub-Clause:

The permissible deviations applicable are to be those for Degree of Accuracy II class of work.

PSLB 8 MEASUREMENT AND PAYMENT

PSLB 8.1.3 Volume of Bedding Materials

Add the following:

The volume of bedding materials will be computed from dimensions shown on the drawings. The volume occupied by the pipe (measured to the outer diameter) shall be excluded from the bedding volume and will not be measured. No additional payment will be made for bedding material placed in bell (fox) holes

PSLB 8.1.6 Freehaul

Delete the Sub-Clause and substitute the following:

All haul will be regarded as free haul. No overhaul will be paid for under this Contract.

PSLB 8.2.3 Concrete Bedding Cradle

Add the following paragraph to the Sub-Clause:

All concrete bedding to pipes will require formwork. The rate for concrete bedding shall include for the supply, installation and stripping of all formwork.

PSLB 8.2.4 Encasing of Pipes in Concrete

Delete the fifth and sixth lines and substitute the following:

encasing the pipe in concrete 150mm thick each side of the pipe and to 150mm above the crown of the pipe including the cost of formwork, (if any), etc. and the cost of formwork to form stop ends on either side of collars, couplings, joints etc if instructed by the Engineer.

The rate for concrete encasing shall include for the supply, installation and stripping of all formwork.

PSLB 8.2.6 Drainage Layer (New Sub-Clause)

Add the new sub-clause:
Supply and place beneath pipe, 150mm crushed stone layer as ground water drainage layer. The excavation for these drains will be measured in cubic metres at the tendered rate applying to unsuitable excavation below the bottom of the trench (SABS 1200 DB 8.3.2 c).

PSLB 8.2.6 a) The rate for stone filling shall be per cubic metre of stone fill, measured according to a width equal to the base widths and depths ordered……..Unit : m^3

PSLB 8.2.6 b) Supply and installation of geofabric filter material (BIDIM Grade A4 or similar) around stone. The rate shall be per square metre of geofabric to enclose the stone material, measured net according to a width equal to the base widths and depths ordered……Unit : m^2

PSLC CABLE DUCTS (SABS 1200 LC)

PSLC 3 MATERIALS

Add the following clause

PSLC 3.5 Classes of Excavation

"For this contract, the classes of excavation will be subdivided as follows:

(a) Labour Intensive Excavation

(i) Soft Excavation

Soft excavation shall be that excavation in material, which in the opinion of the Engineer, can be efficiently excavated and loaded by means of hand-held tools excluding pneumatic or hydraulic breaking tools. Soft excavation shall include all boulders with a volume of less than 0.125 m3 and a maximum dimension of 500 mm, which can still be removed by hand methods.

(ii) Hard Excavation/Hard Rock

Hard excavation shall be excavation in material, which in the opinion of the Engineer, can only be removed efficiently with mechanical equipment such as jackhammers, drilling & blasting etc. Hard excavation shall also include boulders with a volume > 0.125 m3 and the maximum dimension > 500 mm, which cannot be broken down and removed by hand methods.

(b) Machine Based Excavation

In cases where heavy excavation equipment is permitted, the classes of excavation will be subdivided as follows:

(c) Soft excavation

Soft excavation shall be excavation in all materials and boulders which in the opinion of the Engineer can be efficiently excavated and loaded by a 30t excavator fitted with 'rock bucket' (excavator bucket typically fitted with not more than 3 tines designed to loosen weak rock material).

(c) Hard Excavation / Hard Rock

Hard excavation shall be excavation in materials and boulders, which in the opinion of the Engineer, can only be removed efficiently with mechanical equipment larger than a 30t excavator, or with jackhammers, drilling & blasting, expanding grout etc.

PSLE STORMWATER DRAINAGE (SABS 1200 LE)

PSLE 3 MATERIALS

PSLE 3.1(a) Precast Concrete Pipes

Delete the sub-clause and substitute:

Concrete pipes shall be of reinforced concrete and shall comply with SABS 677 and be of the class as indicated on the drawings or scheduled in the Bill of Quantities.

PSLE 3.1 (d) Skewed Ends

Add to the Sub-Clause:

Wherever required skew ends may be cut on site.

PSLE 3.1 (f) Pipes for Subsoil Drains (new Sub-clause)

Add new Sub-Clause:

Pipes for subsoil drains shall have the specified internal diameter, which shall not be less than 100 mm, and shall be slotted uPVC or HDPE pipes with a wall thickness in accordance with Class 4 pressure pipes to SABS 966 or SABS ISO 4427.

The size of the perforations in perforated pipes shall in all cases be 8 mm + 1,5mm diameter and the number of perforations per metre shall not be less than 26 for 100 mm pipe and 52 for 150 mm pipe. Perforations shall be spaced in two rows for 100 mm pipes and four rows for 150 mm pipes.

Slotted uPVC or HDPE pipes shall have a slot width of 8 mm with a tolerance of 1,5mm in width. The arrangement of slots shall be to the Engineer's approval but the total slot area shall not be less than specified for the perforations.

PSLE 3.4.1 Bricks

Add to the Sub-Clause:

Cement bricks complying with the relevant requirements of SABS 1215 shall be considered as being acceptable.

PSLE 3.6 Concrete (new Sub-Clause)

Concrete shall comply with the relevant requirements of SABS 1200 G or SABS 1200 GA, whichever is included in the project specification.

PSLE 3.7 Permeable Material for Groundwater Drains

Add the following new Sub-Clause:

Permeable filter materials for groundwater drains shall consist of crushed stone of suitable grading.

Permeable materials shall conform to the following requirements:

Crushed stone shall be clean, hard single sized stone and shall be free from shale, clay and other deleterious substances.

The aggregate crushing value of the stone shall not exceed 30 when tested in accordance with TMH 1 Test Method B1.

PSLE 5 CONSTRUCTION

PSLE 5.1.4 Culvert Construction after Earthfill

Add to the Sub-Clause:

Wherever possible pipes and rectangular culverts shall be laid under trench conditions.

The compacted fill shall first be constructed to a height of 300 mm above the culvert before excavating for the culvert.

The trench width shall not exceed the outside diameter of the pipe plus 600 mm. A working width of 600 mm each side shall be allowed for rectangular culverts.

PSLE 5.2.2 Pipe Culverts

Add to the sub-clause:

The bedding for stormwater pipes shall be to the requirements of SABS 1200 LB as amended by the project specification and shown on the drawings.

The ogee joints shall be fitted with 200 mm x 6 mm rubber sealing collars conforming to the latest SABS 974 Specification and with a Shore hardness of approximately 40 degrees, or alternatively, the ogee joints shall be primed and double wrapped in accordance with the manufacturer's recommendations with 200 mm wide impermeable wrapping tape to the Engineer's approval.

PSLE 5.2.3 Concrete Casing of Pipelines

In second line of the Sub-Clause substitute "Grade 15/19" for "mix 15".

PSLE 5.2.6 Construction of Groundwater Drains

Add the following Sub-Clause:

On completion of excavation the trench shall be lined with geotextile as specified or shown of the drawings.

A layer of permeable material of the class and thickness as shown on the drawings shall be placed on the bottom of the trench and lightly tamped and finished to the required gradient.

Pipes of the type and size required shall then be firmly bedded on the permeable material true to level and grades coupled where required and the trench backfilled in layers not exceeding 100mm with further permeable material to such height above the pipes as shown on the drawing or directed by the Engineer. The permeable material shall be lightly compacted and finished to the required level. The trench shall be specially protected against the ingress of water before completing the impermeable layer.

When placing successive layers the lower layer shall not be walked on or disturbed more than can be avoided. Care shall be taken to prevent the contamination of permeable material during construction of the groundwater drains and all permeable material contaminated by soil or silt shall be removed and replaced by the Contractor at his own expense.

Where plain butt joint pipes are used they shall be laid firmly together to prevent infiltration of backfill material. Perforated and slotted pipes shall be joined by couplers. Perforated pipes shall be laid with the perforations at the bottom, as instructed.

The higher end of groundwater pipe drains shall be sealed off with a cap or loose concrete cap of Class 20/19 concrete, as shown on the drawings, and at the lower end the pipe drain shall be built into a concrete headwall providing a positive outlet or connected to stormwater pipes or culverts.

PSLE 5.8 Open Drains (new Sub-clause)

Add new Sub-Clause:

Open drains are to be constructed to the details shown on the drawings, or as directed by the Engineer, to the correct line, levels and cross-sections. The material excavated from open drains is to be stockpiled for future use.

Measurement of open drain excavation shall be calculated from natural ground level or, in the case of drains within a road reserve, from the reduced level in the road excavation, and payment will be made on a rate per m^3 basis irrespective of depth. The rate is to include for all work required to trim the drain(s) to the correct lines and levels.

PSLE 5.9 Stone pitching (new Sub-Clause)

Where ordered by the Engineer, open drains, stormwater outlets, etc, shall be pitched with stone. Notwithstanding the provisions of SABS 1200 DK Clause 3.2.1 Table 2 pitching for lining drains and stormwater outlets shall have a minimum size of 100 x 100 x 75 mm deep. In all other respects the provisions of SABS 1200 DK as amended by the Project Specification shall apply. Before pitching is commenced, all slopes and surfaces to receive pitching shall be carefully trimmed and dressed to the correct lines and grades. The pitching stones are to be laid with joints broken as much as possible and are to be hammered solidly into position to present a regular and uniform surface. All joints are to be grouted to their full depth with 4:1 cement:sand mortar.

PSLE 5.10 Cutting of Pipes (new Sub-Clause)

As far as is possible culvert lengths shall be such that pipe units need not be cut. Should any straight or skew cuts be necessary, such cutting will not be measured and paid for separately in terms of Sub-Clause 8.2.4 since all additional work required in cutting the pipes as well as the wasted pipe ends shall be regarded as being included in the payment for the supply, lay, joint, bed and test of the relevant pipe culverts, as per Sub-Clause 8.2.1.

PSLE 8 MEASUREMENT AND PAYMENT

PSLE 8.2.1 Supply and Lay Concrete Pipe Culverts

Delete the title of the sub-clause and substitute:

Supply, Lay, Joint, Bed and Test Pipelines

Add to the Sub-Clause:

The bedding shall be to the requirements of SABS 1200 LB as amended by the project specification and shown on the drawings.

Add to the Sub-Clause:

The rates shall cover the cost of providing the pipes as well as the cost of laying, bedding, jointing and making connections into manholes, including dealing with stormwater flow and testing the pipeline.

PSLE 8.2.4 Extra over Items 8.2.1 and 8.2.2 for Cutting End Units for Culverts on Site

Delete this Sub-Clause as no extra payment will be made for cutting end units for culverts.

PSLE 8.2.14Minor Drainage Structures (new Sub-Clause)

Catchpits, manholes, drop inlets and headwalls constructed will be measured and paid for as complete units.

Item : Supply, construct and install drainage unit of the type, size category and depth stated in the Bill of Quantities;:…… Unit : No

The unit of measurement shall be the number of the particular type, size and category of drainage units supplied, constructed and installed in accordance with the drawings.

The tendered rate shall include for all materials, plant labour, supervision and incidentals for the construction of the drainage units complete and in accordance with the drawings.

The tendered rate shall further include for all necessary excavation in all materials, backfilling and disposal of surplus materials, formwork, concrete, benching, concrete finish, reinforcement, precast elements, steel channels and grids, step irons and all other items not specifically measured elsewhere, necessary for completion of the unit in accordance with the drawings.

The tendered rate shall include for all costs involved in complying with the requirements of the relevant specifications in respect of the individual types of work involved in completion of the units.

The tendered rates shall exclude for excavation in intermediate and hard material, payment for which shall be made as an extra over in the Schedule of Quantities.

PSLE 8.2.15Stone Pitching (new Sub-Clause)

Payment for stone pitching (PSLE 5.9) will be made at a rate per unit finished area and the rate is to include for all trimming and dressing of the excavation, laying of the stones and grouting of the joints:. Unit : m^2

PSM ROADS (GENERAL) (SABS 1200 M)

PSM 5 CONSTRUCTION

PSM 5.1 Traffic Control/Safety measures

Add the following Sub-Clause:

When roads to be constructed under this contract join onto existing trafficked roads, the Contractor shall take all the necessary precautions to ensure the safety of the traveling public. To this end, signs warning through traffic of vehicles encroaching into the travelled way shall be erected by the Contractor prior to such work being undertaken. These control measures shall be checked and recorded on a daily basis.

Under no circumstances shall drums be permitted to be used as traffic demarcation devices.

All signs must comply with the latest edition of the South African Road Traffic Sign Manual.

PSM 7 TESTING

PSM 7.1 General

Add the following to this Sub-Clause:

The random sampling method of TMH 5, for the location of positions, for field density testing will not necessarily be applied by the Engineer's Representative. Density testing shall be carried out where, in his opinion, the density of the compacted layer is suspect. The Contractor shall present the full width of the layer, between the stated linear stake values, for acceptance. Only in exceptional cases will partial widths of a layer be accepted for testing.

PSM 7.3 Routine Inspection and Testing

Add the following to this Sub-Clause:

The request for acceptance of a layer shall be submitted in writing, specifying the exact location of the section and type of layer. On receipt of all these details the Engineer's Representative will arrange for the necessary inspections and tests to satisfy himself that the road layer complies. Testing will be carried out as expeditiously as possible, and the results will be available within 24 hours of receipt of test request. The Contactor shall backfill the test holes left in the layer with a similar material to that of the layer tested and compact the material to a similar density. Concrete shall not be used."

PSM 7.4 Compaction Control

Add the following to this Sub-Clause:

Density test shall be carried out by the Contractor on each layer of the selected subgrade, subbase, base-course and shoulders/layers as soon as possible but not later than twenty-four hours (24) after compaction of that layer has been completed, and the results of the test shall be submitted to the Engineer without delays and in any case not later than twelve hours (12 hours) after they become available.

The Contractor shall locate and test any soft or wet areas evident in any layer and shall, if these tests fail, re-compact and retest such areas for density before requesting the Engineer to carry out check tests.

The Contractor shall provide adequate equipment and facilities for carrying out the tests required to be performed by him. Should the Engineer at any time consider that the equipment and facilities are inadequate for this purpose, he may instruct the Contractor to cease work on the completion of subgrade, sub-base and base course until such time as the Contractor has remedied the deficiency of equipment, labour and facilities.

The results of the test carried out by the Engineer shall be regarded as final.

PSM 7.5 Engineer's Discretion

Notwithstanding the provision of clause 7 of SABS 1200 M, testing of a section of completed work shall be at the sole discretion of the Engineer who may refuse to check test and consequently not approve a section of work which contains obvious defects such as loose patches, over-wet material etc.

PSMF BASE (SABS 1200 MF)

PSMF 8 MEASUREMENT AND PAYMENT

Replace the following Sub-Clause heading:

8.3.5 Process base material by the following processes, as relevant, and use in base (as applicable to 8.3.1 or 8.3.2, or both)

With the following:

8.3.5 Process base material by the following processes, as relevant, and use in base (as applicable to 8.3.1 or 8.3.2 or 8.3.3, or All)

C3.4.3 PART C – PARTICULAR SPECIFICATIONS

In addition to the SABS Standard Specifications and Variations to the Standard Specifications, the following GIBB Particular Specifications shall apply to this contract. Although part of this Volume, they are not printed and bound in the issued hardcopy of this Volume, but are issued separately as under the Annexure C5.1 Gibb Particular Project Specifications" .

GIBB 001 Setting out and Survey (Lidar)

Note: All items numbers listed in the above specification are to be prefaced with the number of the Specification listed here before each clause numerical value.

GIBB 002 General Mechanical

Note: All items numbers listed in the above specification are to be prefaced with the number of the Specification listed here before each clause numerical value.

GIBB 003 General Pumps

Note: All items numbers listed in the above specification are to be prefaced with the number of the Specification listed here before each clause numerical value.

GIBB 004 Project Specific Pumps

Note: All items numbers listed in the above specification are to be prefaced with the number of the Specification listed here before each clause numerical value.

GIBB 006 Hydro Mechanical

Note: All items numbers listed in the above specification are to be prefaced with the number of the Specification listed here before each clause numerical value.

GIBB 007 Painting and Corrosion Protection

Note: All items numbers listed in the above specification are to be prefaced with the number of the Specification listed here before each clause numerical value.

GIBB 008 Cranes, Gantries, Hoists and Winches

Note: All items numbers listed in the above specification are to be prefaced with the number of the Specification listed here before each clause numerical value.

GIBB 011 General Electrical

Note: All items numbers listed in the above specification are to be prefaced with the number of the Specification listed here before each clause numerical value.

GIBB 012 Building Works

Note: All items numbers listed in the above specification are to be prefaced with the number of the Specification listed here before each clause numerical value.

GIBB 020 Mechanical And Electrical Project Specific Pumping Station Performance Specification

Note: All items numbers listed in the above specification are to be prefaced with the number of the Specification listed here before each clause numerical value.

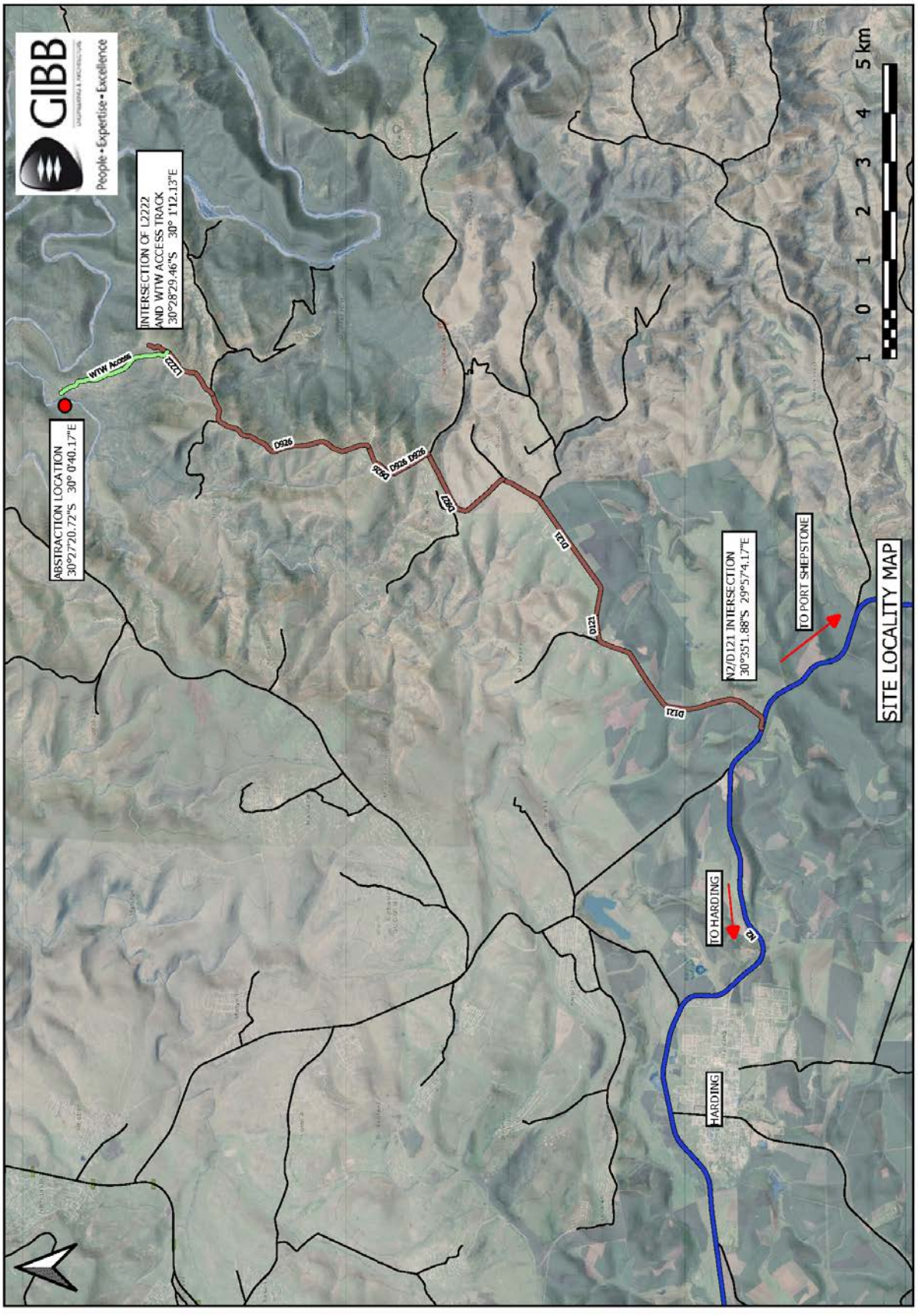
GIBB 021 Accredited Training

Note: All items numbers listed in the above specification are to be prefaced with the number of the Specification listed here before each clause numerical value.

C4 SITE INFORMATION

TABLE OF CONTENTS

C4.1 SITE LOCALITY PLAN



C5 ANNEXURES

TABLE OF CONTENTS

C5.1 GIBB PROJECT PARTICULAR SPECIFICATIONS

HARRY GWALA DISTRICT MUNICIPALITY

CONTRACT NO: HGDM748/HGM/2021

CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM AND RISING MAIN: CIVIL, MECHANICAL AND ELECTRICAL

PARTICULAR SPECIFICATION

GIBB 001 – SURVEY AND SETTING OUT (BASED ON LIDAR)

Table of Contents

List of Annexures

1 SCOPE

This Section deals with the requirements for the setting out of the Works, survey control and measurement required for survey of the Works.

2 DEFINITIONS

"Beacon" means a subsidiary survey control point that is to be used for setting out of the Works. All subsidiary survey beacons and bench marks that are placed, either by the Engineer or Contractor, for control and setting out of the Works shall be set out with reference to the Project Reference Marks.

"Bench Mark" is a control point that is used for fixing levels on the construction Works.

"LiDAR – Survey/Aerial mapping" is an aircraft-based remote sensing technology, using laser scanning to measure the shape of the ground surface.

"Project Reference Marks" mean the primary survey control points which have been fixed within the applicable coordinate system by the Employer for the purpose of survey reference and setting out.

"Absolute accuracy" is defined as the accuracy of any individual reference mark within the Survey Network.

"Relative accuracy" is defined as the accuracy of a reference mark relative to its closest neighbouring reference marks.

3 GENERAL

All reference points given on the Drawings are based on the Project coordinate system. Dimensions of structures given on Drawings are corrected for the mean level of the Works above sea level unless specifically stated otherwise and shall be used without further correction.

To avoid any errors, only the Project Reference Marks, location and survey coordinates indicated on the design Drawings should be used for all construction setting-out and level purposes.

All necessary sight rails, pegs, and other items required for the proper alignment of the Works shall be erected by the Contractor to the satisfaction of the Engineer. The Contractor shall record all field observed data calculations for setting out and check surveying in a suitable permanent form, which shall be available to the Engineer on request at all times. These records shall accompany field setting out sketches showing the setting out marks, templates, stakes, batter boards, beacons and pegs, etc., and their relation with the Permanent Works. The Contractor shall supply two copies of any such calculations to the Engineer on request.

The Contractor shall, at his own expense, make all templates where necessary for the proper setting out of the Works and support of items to be built in.

The Contractor shall have available on Site at all times a sufficient number of properly maintained total stations, levels, laser equipment, accurate steel tapes, ranging rods, boning rods, and other instruments and appliances as may be necessary for the correct setting out of the Works and control of the construction process.

4 PROTECTION OF NATURAL FEATURES

The Contractor shall not deface, paint, damage or mark any natural features (e.g. rock formations, trees etc.) situated in or around the Site for survey or other purposes. Any features affected by the Contractor in contravention of this clause shall be restored / rehabilitated to the satisfaction of the Engineer.

5 CONTROL BEACONS

5.1 Project Reference Marks and Line Control

Project Reference Marks (PRMs) have been provided by the Employer adjacent to the Works. These PRMs shall be the sole points of reference for setting out and levelling purposes. The Contractor will however be required to check the internal consistency of the PRMs.

These PRMs consist generally of a 16mm or 12 mm round steel peg placed in 250 mm diameter concrete, 200 mm deep. Where these PRMs are located outside of the servitude area they should be marked with at least 3 clearly visible Y-standards painted white, spaced equally around the PRM, of appropriate length to be visible above grass and shrubby vegetation, placed adjacent to the PRM.

The coordinates and reduced levels of the PRMs are provided on the Drawings and in an Annexure to this specification.

5.2 Internal Consistency of Beacons

Before commencing construction of any part of the Permanent Works, the Contractor shall check that all the PRMs provided by the Employer in accordance with Clause 5.1 are internally consistent and are sufficiently accurate for the construction of the Works to the required tolerances. The Contractor shall either notify the Engineer in writing of any discrepancies found or confirm in writing his acceptance of the said PRMs.

5.3 Subsidiary Beacons, Survey Stations and Bench Marks

The Contractor shall establish, permanently tag and protect subsidiary beacons, survey stations and bench marks required for accurate setting out and level control during construction of the Works. Survey stations shall be of rigid construction and be protected from damage and the design and construction thereof shall be agreed with the Engineer. Pegs placed by the Engineer which may be disturbed during construction shall be referenced by the Contractor by surveying and placing other pegs nearby in safe positions and all such pegs shall be carefully protected to the satisfaction of the Engineer.

The Contractor shall supply the Engineer with the coordinates, levels and other relevant information relating to subsidiary beacons, survey stations and bench marks.

6 PRESERVATION AND REPLACEMENT OF PROJECT REFERENCE MARKS

Once the Site has been handed over to the Contractor he shall take responsibility for the safeguarding of all the PRMs which will be used to set out and construct the Works. If at any time during the Works the Engineer suspects that one of the PRMs previously established by the Employer has been disturbed, the Contractor shall have the PRM surveyed and the bench mark re-levelled. Any setting out which was undertaken after the PRM and/or bench mark was disturbed shall then be rechecked and corrected if necessary, including any remedial work required for the Works, by the Contractor without any additional payment.

Where a PRM, beacon or bench mark is likely to be disturbed during construction operations, the Contractor shall establish suitable replacement reference beacons or bench marks at locations where they will not be disturbed during construction. No PRM, beacon or bench mark shall be covered, disturbed or destroyed before accurate replacement reference beacons or bench marks have been established and details of the position and levels of such replacement beacons or bench marks have been submitted to the Engineer and approved by him. These replacement PRMs, beacons or bench marks shall be placed to avoid damage to property or injury to animals, and should be marked as required.

The Contractor's reference beacons or bench marks shall be of at least the same quality and durability as that of the existing PRMs and bench marks. Before constructing replacement beacons, the Contractor shall obtain the Engineer's approval for his proposals. Such requests for approval shall include the position, construction details and motivation for the proposed replacements.

The Contractor shall be responsible for the safety of any Government survey beacons, survey bench marks and boundary beacons encountered. If such beacons or bench marks are disturbed or destroyed by the Contractor, they shall be replaced without additional payment to the Contractor, within three weeks or a period agreed to by the Engineer where these points falls within the working area, by a Registered Land Surveyor.

7 SURVEY OF GROUND PROFILES

7.1 Original Ground Profiles

The Employer has through a LiDAR survey obtained original ground levels, to a resolution of 100 mm or better (for an estimated 80% of the results) in horizontal and vertical position, of the Contract area. The results of the LiDAR survey (x, y, z points) will be made available to the Contractor in electronic format on specific request.

The accuracy of the LiDAR survey is defined in the Annexure to this specification. For the purpose of the Contract, the LiDAR survey data shall define the original ground profiles (where applicable this will be modified to included "As-built" survey of any previous contracts).

7.2 Excavated and Final Ground Profiles

The Contractor shall survey all excavated and final surfaces for the purpose of recording as-constructed details and, where applicable, for the measurement of quantities.

Specifically the aims of this survey are:

a) Confirmation of actual rock levels: On completion of excavation to rock level and prior to commencement of drilling and blasting;

b) Confirmation of actual final excavation levels: On completion of the excavation and prior to commencement of placing bedding, backfill, concrete or other work;

c) Confirmation of backfilled levels: On completion of placing backfill, concrete or other work; and

d) Confirmation of Final Ground Profiles: On completion of landscaping and topsoiling.

The information so obtained shall be recorded by the Contractor on a Drawing or Drawings which shall be signed by both the Contractor and the Engineer. The Contractor shall then provide the Engineer with a reproducible copy of each Drawing to serve as a permanent record for the purpose of determining both the quantities of excavation and earthworks carried out in the construction of the Permanent Works and the extent to which Temporary Works shall be removed or temporary excavations shall be refilled upon completion of the Works. In addition to hard copies, the Contractor shall provide each Drawing in 3 dimensional digital format – "AutoCAD/DXF" or similar approved and ASCII files of the survey Y, X and level data.

8 SETTING OUT OF THE WORKS

8.1 General

The Contractor shall perform all setting out and check surveying of the Works in accordance with methods approved by the Engineer before work commences. Arrangements for access to private property shall be made by the Contractor in consultation with the Employers Agent. The methods and programme of checking shall be such as to ensure the construction of every part

of the Works to the correct line and level, subject to the tolerances specified. The Engineer may at any time request the Contractor to submit proof that the setting out has been satisfactorily checked.

The number of points required for setting out as well as the spacing between these points shall be determined by the Contractor together with the Engineer in accordance with the type of the work. In addition to any co-ordinated points and datum levels that the Contractor establishes for his own use, the Engineer may require that certain or all of the given points and datum levels be clearly tagged during construction in such a way that these tags can be retained after completion of construction. Where this is not possible for any reason, the Contractor shall inform the Engineer in writing and an alternative position will be agreed with the Contractor and confirmed in writing.

The Contractor shall not amend the approved method of survey control without the approval of the Engineer.

8.2 Setting Out for Underground Work

The Contractor shall use an approved system whenever possible to control the alignment of underground work and shall use suitable precision survey equipment for setting out and check surveying.

If at any time during the excavation, it is evident that the alignment of the excavations is outside the specified tolerances then, before proceeding further with the excavation, the Engineer and the Contractor shall agree the necessary corrections to the alignment, and the Contractor shall forthwith make the said corrections.

8.3 Setting Out for Pipe Works

The Contractor shall install sufficient sight rails, batter boards, pegs, level markers or other survey points to accurately control construction of the pipeline, structures and services. Where necessary or specified, the Contractor shall install a laser system to control construction of certain aspects of the work as applicable.

The Contractor shall check the actual ground cover above the top of the pipe as shown on the Drawings that can be obtained relative to the actual ground levels at the pipe centreline at least 21 days prior to commencement of the trench excavation. The Contractor shall notify the Engineer in writing at least 14 days prior to commencement of the trench excavation of any points where the actual achievable cover is less than 1.0 m or where the actual cover exceeds the specified cover by more than 0.5 m.

The equipment and methods employed by the Contractor for setting out and controlling excavation shall be subject to the approval of the Engineer.

The Contractor shall carry out an accurate survey of the levels of structures interfacing with the pipeline to ensure that the specified levels have been achieved.

9 SETTING OUT CHECKS

The Engineer will undertake regular check surveys during the course of construction and the Contractor shall cooperate with and provide assistance for this as required by the Engineer.

The Contractor is expected to liaise with the Engineer to programme the setting out check surveys to be carried out during non-production periods or in parallel such that the minimum delay or inconvenience is caused to production work, wherever and whenever possible. The Contractor shall afford the Engineer every cooperation and assistance in this regard including, but not limited to, the provision of drainage, lighting and ventilation and the removal or placing

of Contractor's Plant and other obstructions such that they do not interfere with the setting out checks.

10 MEASUREMENT AND PAYMENT

The rates tendered under this section shall not include for the general obligations and work deemed to be covered by the items provided in the preliminary and general payment items

No separate measurement or payment apart from that specified in item 10.1 below shall be made to the Contractor for his compliance with the requirements of the specification and compensation for the work involved and any inconvenience or delays to the Works caused by survey, setting out, and setting out checks by the Engineer shall be deemed to be included in the rates tendered for the respective items of work included under the Contract.

10.1 Internal survey consistency check

Internal survey consistency check ……Unit: lump sum (Sum)

A lump sum shall be priced by the Contractor for carrying out a check of the internal consistency of all the Project Reference Marks provided by the Employer. Such item shall include for the provision of all necessary equipment, apparatus, reports, transport and the like and all personnel necessary to perform the checks accurately.

10.2 Protection of beacons

Protection of beacons outside servitude ……Unit: (No)

A rate per unit (No.) shall be priced by the Contractor for supplying protection at PRMs and subsidiary beacons placed outside the pipeline servitude. Such rate shall include for the provision of all necessary material, Plant and labour to supply and erect such protection.

Annexure A: LIDAR SURVEY FOR PLANNING AND DESIGN OF GREATER MNQUMENI WATER SUPPLY SCHEME

SURVEY HOUSE
42 SUNBIRD DRIVE
LANGEBAAN
7357
SOUTH AFRICA

Tel: 022-772 2230
022-772 1741
Fax: 086-670 8452

Email: info@africansurveyors.com
Website: www.africansurveyors.com

Date: 8 January 2021

Project Description

LIDAR SURVEY FOR PLANNING AND DESIGN OF GREATER MNQUMENI WATER SUPPLY SCHEME

Surveyed By:

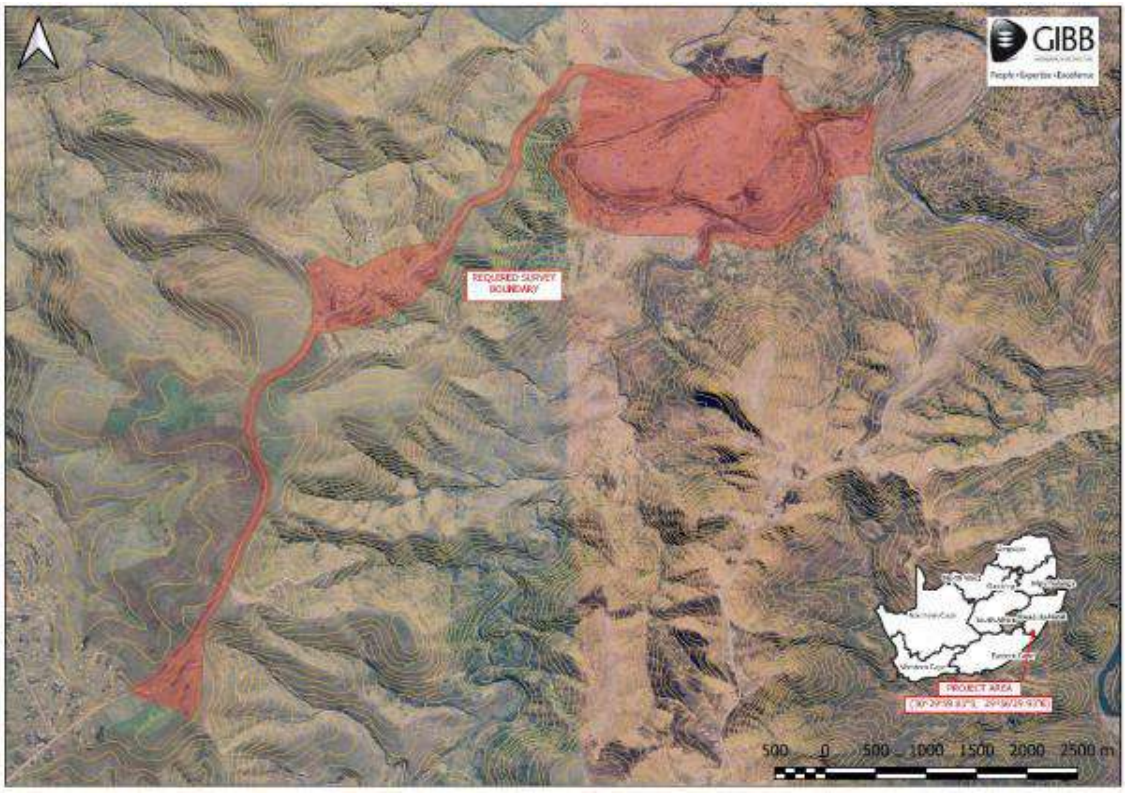
AFRICAN CONSULTING SURVEYORS
"When efficiency and precision matters"
www.africansurveyors.com

Description of the Project

1.1. Project Summary:

African Consulting Surveyors carried out an aerial LiDAR and photogrammetric Survey an area located approximately 10km northeast of Harding and 25km south of Umzimkulu, in southern area of KwaZulu-Natal.

The extents of the survey is as shown below.



Survey location and Extents

1.2. Project Duration:

The project was executed in the month of December 2020.

Ground control points were pre-marked prior on the 2nd of December 2020, and the project was flown on the 29th of December 2020.

The operational time of the flight was approximately 2 hours.

Data was then processed thereafter.

1.3. Coordinate System(s) used:

The LiDAR data was captured on the WGS84 ellipsoid and delivered in Hartebeeshoek94 WG29, Transverse Mercator.

2. Ground Control Survey

2.1. Methodology

The project entailed the building of five (5) control points for a LiDAR survey and placing of five (5) ground control stations. Due to the vicinity to local villages ACS decided to place one additional point for each point requested, in case of tampering.

The survey was based on trig by fixing and checking our control using the trig stations (3029/15 (Gugweni) and 3029/68(Baka)). 3029/15 (Gugweni) was selected as the primary adopted trig station.

All points were fixed by RTK using our 5800s Trimble base and Rover.

2.2. Final Coordinates

Survey System WGS84/29

STATION	Y	X	Z	Description
GUGWENI	-91613.220	3376495.440	886.800	Trig Beacon
BAKA	-92116.680	3375410.810	881.000	Trig Beacon
CP1	-91537.883	3376016.956	855.532	Control in Concrete
GCP1	-91533.001	3376014.031	854.945	Ground Control Point
CP2	-92158.098	3373747.198	853.440	Control in Concrete
GCP2	-92151.696	3373749.329	852.799	Ground Control Point
CP3	-94019.851	3371541.978	762.702	Control in Concrete
GCP3	-94014.873	3371537.748	763.068	Ground Control Point
CP4	-95640.081	3370247.268	547.629	Control in Concrete
GCP4	-95634.259	3370243.637	547.796	Ground Control Point
CP5	-97371.148	3371041.260	511.943	Control in Concrete
GCP5	-97366.686	3371037.396	511.511	Ground Control Point

2.3. Control Photos

2.3.1. GCP 1 & CP 1

2.3.2. GCP 2 & CP2

2.3.3. GCP 3 & CP 3

2.3.4. GCP 4 & CP 4

2.3.5. GCP 5 & CP 5

3. Aerial Survey

3.1. Equipment Utilised for the capturing of the data

3.1.1. Aircraft:

A Cessna 206 (ZS-ESK) was utilised for this project.

The aircraft is fully registered under an Aerial Operators Certificate (AOC) for commercial use approved by the South African Civil Aviation Authorities.

3.1.2. Airborne Laser Scanner and Camera

The airborne Lidar survey was captured using a Riegl VUX-240 flown at 100 knots. A Sony A7RIV camera was used for the photographs.

A Novatel GPS receiver captured GPS information and a 256 kHz IMU captured the trajectory detail in conjunction with the Novatel GPS.

3.2. Flight Information and Coverage

Data was captured on the 29th of December 2020. In total, the flight time was approximately 2 hours.

Data was captured at a flying altitude of 500 metres and a speed of 100 knots.

The aircraft mobilised to Margate on the 28th of December. The aircraft completed the project on 29 December and repositioned to Ladysmith to avoid the following day's incoming low clouds along the coast. Please see point 6 below.

Project specific information request:

1. A unique ID for each lift
- Single Lift operations

2. The take-off and landing times for each lift
- 09:09 – 12:11, 29 Dec 2020

3. The aircraft make, model, and tail number
- ZS-MBU (Cessna T210M)

4. The instrument manufacturer, model, and serial number
- Riegl VUX-240 Airborne Lidar System
- Serial #: S2226375

5. The data of the instruments most recent factory inspection/calibration
- See annexure D

6. General weather conditions
- Mild – 26 Degrees

7. General observed ground conditions
- Good

8. All inflight disturbances and notable head/tail/crosswinds
- No significant disturbances noted.

9. All inflight instrument anomalies and any inflight changes in setting
- None detected

9.1. Data processing and software utilised for the processing thereof

9.1.1. Software Utilized

To process the GPS ground survey data, the airborne laser points, the classification of the laser points, the generation of Orthophotos and the geoidal transformations the following software's were used:

- POSpac
- RiAnalyze
- Microstation
- TerraScan
- TerraModel
- TerraMatch
- TerraPhoto
- Agisoft Metashape
- Global Mapper

9.1.2. Point Classification

Points have been classified using macros into Ground and Non-ground points.

This is an automated process with manual checks on the points classified to ensure the classification is correct.

Model key points were extracted from the ground classification and used to generate contours with TerraScan and TerraModeller software.

10. Quality Control

10.1. Brief Description of Methodology employed on this project

10.1.1. Office checks

1.1.1.1. Point cloud checking

The first few phases of the point cloud processing, is an automated process, with physical intervention only to ensure that the processes are running correctly, and to start the next process. Vigorous macros are run on the point cloud to classify it into ground, non-ground and low points (error points). Once the computer processing has been completed, manual checks are run on the data. The project is split into blocks, and the ground model that has been created is manually checked to ensure that it has correctly classified the data. This process is performed by creating a surface in Terra Model and working your way through each block to ensure correctness.

Only once the project blocks have all been checked is the Model Key Point file extracted to create the Triangulated Irregular Network (TIN) model and DTM.

1.1.1.2. Checks on photos and line drawings in the office.

An in-house quality control system that has been developed over time has been employed in this project. Prior to submission, the project has been checked by at least two independent staff members who have not been involved in the production of the line drawings.

The two independent quality control staff members create a separate drawing file and reference in the line drawings and Orthophotos, and any errors or omissions that they observe are noted on their drawings. These drawings are saved with their dates as part of the file name to keep a record of the quality control.

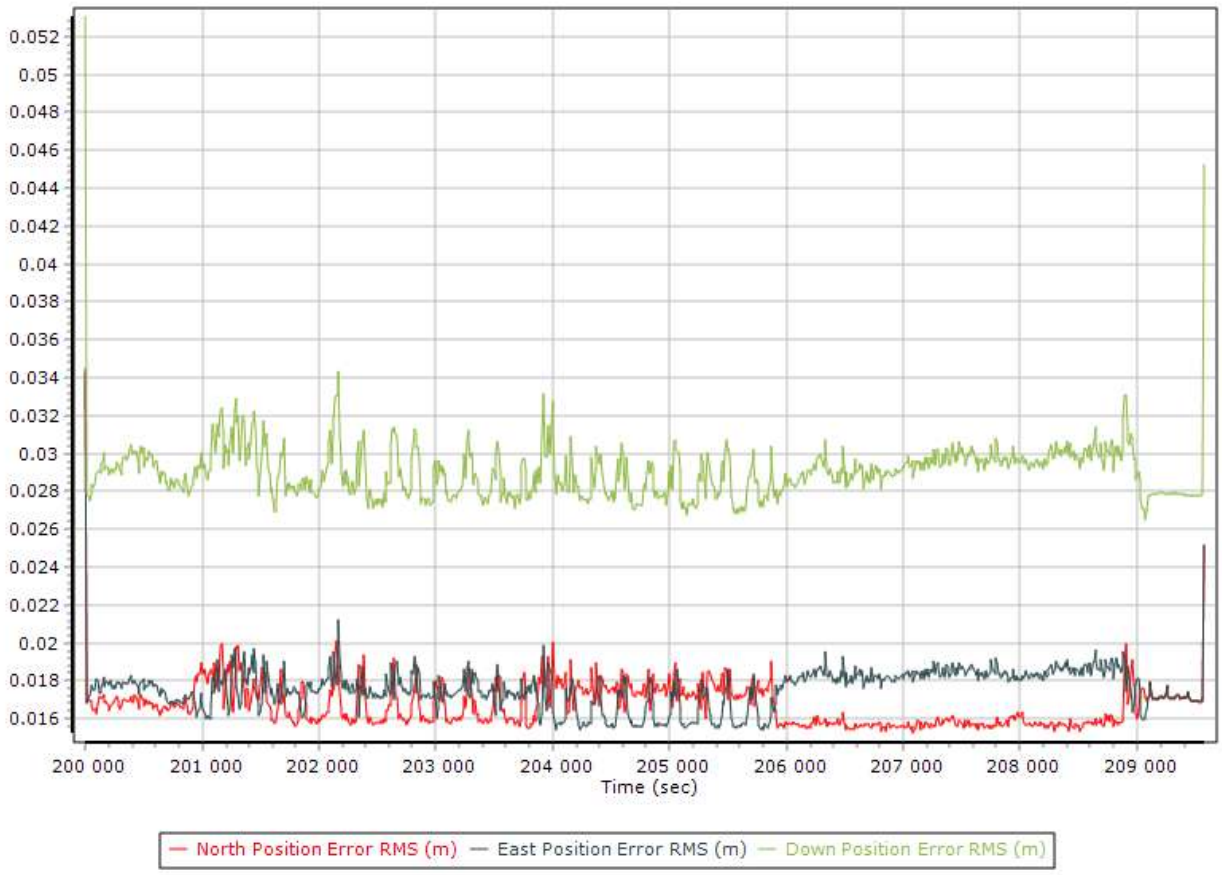
These QC files are then given back to the draftsmen for amendments, and the process is repeated until no more errors are observed.

The plans are then printed as hardcopies for a final office check.

10.2. Accuracies Achieved

10.2.1. Combined Positional Solution

As per the graph below, good results were achieved for this project.



An average of approximately 0.016 m was achieved in the x coordinates, 0.018 m in the y coordinates, and an average of 0.028 m in the z coordinates. These results translate to an accurate survey of below 0.030 m accuracy.

11. Orthophoto Production

Orthophotos were produced in Agisoft Metashape and finalised in Global Mapper.

The control provided by Umrathlal Geomatics were used to georeference the images and produce a georeferenced orthomosaic.

Two adjustements to the control were applied during processing of the data. The accuracies and adjustments made to the project based on the control provided are summarised below in the tables.

GUGWENI	91613.220	-3376495.440	886.800	885.780	-1.020
BAKA	92116.680	-3375410.810	881.000	880.050	-0.950
CP1	91537.883	-3376016.956	855.532	855.730	+0.198
GCP1	91533.001	-3376014.031	854.945	855.100	+0.155
CP2	92158.098	-3373747.198	853.440	853.590	+0.150
GCP2	92151.696	-3373749.329	852.799	852.930	+0.131
CP3	94019.851	-3371541.978	762.702	762.890	+0.188
GCP3	94014.873	-3371537.748	763.068	763.260	+0.192
CP4	95640.081	-3370247.268	547.629	547.840	+0.211
GCP4	95634.259	-3370243.637	547.796	548.010	+0.214
CP5	97371.148	-3371041.260	511.943	512.220	+0.277
GCP5	97366.686	-3371037.396	511.511	511.780	+0.269

Average dz	+0.001
Minimum dz	-1.020
Maximum dz	+0.277
Average magnitude	0.330
Root mean square	0.443
Std deviation	0.463

Accuracies after initial adjustment.

GUGWENI	91613.220	-3376495.440	886.800	removed	*
BAKA	92116.680	-3375410.810	881.000	removed	*
CP1	91537.883	-3376016.956	855.532	855.530	-0.002
GCP1	91533.001	-3376014.031	854.945	854.900	-0.045
CP2	92158.098	-3373747.198	853.440	853.390	-0.050
GCP2	92151.696	-3373749.329	852.799	852.730	-0.069
CP3	94019.851	-3371541.978	762.702	762.690	-0.012
GCP3	94014.873	-3371537.748	763.068	763.060	-0.008
CP4	95640.081	-3370247.268	547.629	547.640	+0.011
GCP4	95634.259	-3370243.637	547.796	547.810	+0.014
CP5	97371.148	-3371041.260	511.943	512.020	+0.077
GCP5	97366.686	-3371037.396	511.511	511.580	+0.069

Average dz	-0.002
Minimum dz	-0.069
Maximum dz	+0.077
Average magnitude	0.036
Root mean square	0.045
Std deviation	0.048

Accuracies after second adjustment, including Z accuracies achieved.

4. Calculation of GSD

The specification of the GSD for this project is 8cm. This calculation is made by taking the flight height and dividing it by the focal length and then multiplying it by the pixel size.

In our case:

Flying height	500 m
Camera Focal Length	24 mm
Pixel Size	3.76 Microns

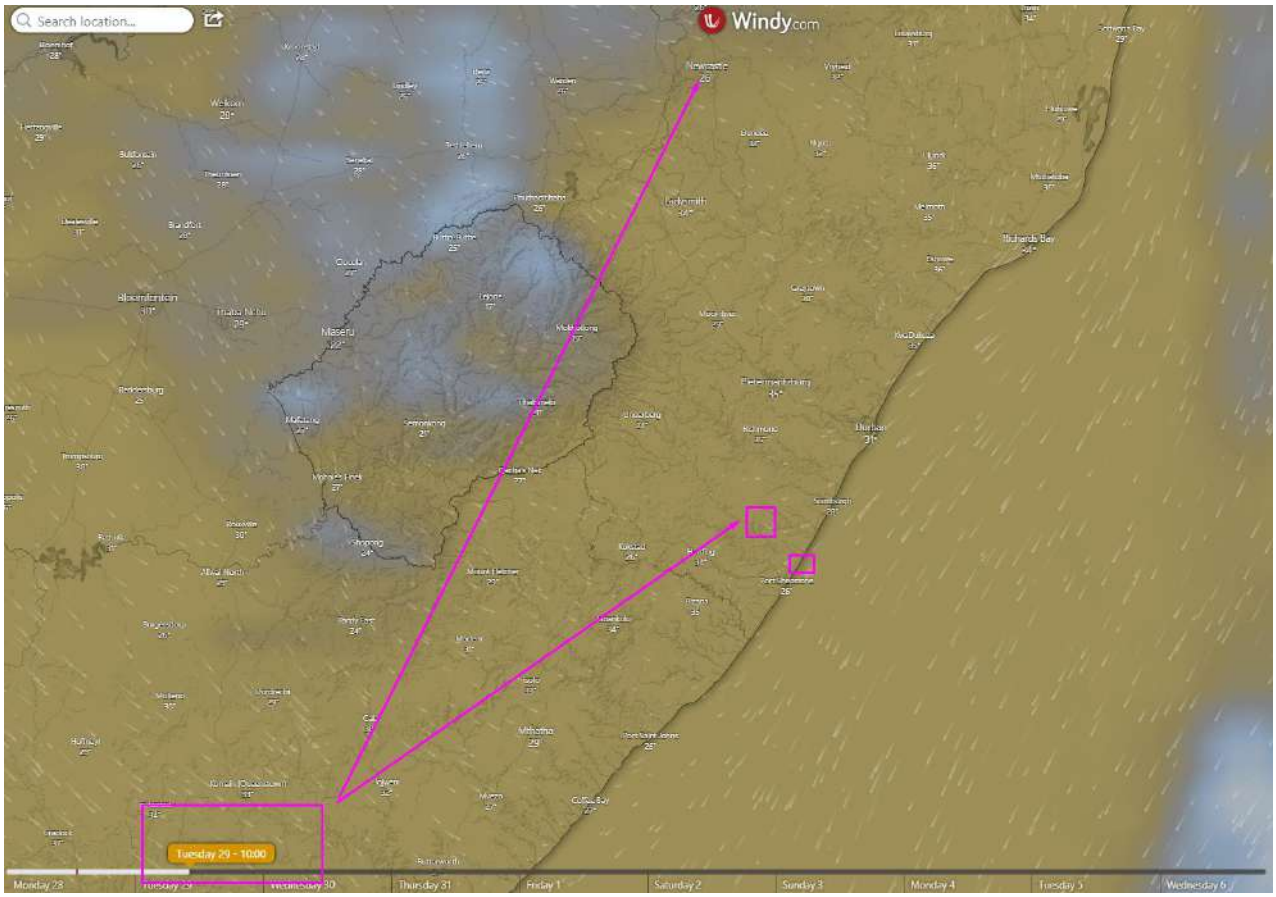
Therefore 500 m / 24 mm x 3.76 micron = **7.8 cm GSD**

12. Conclusion

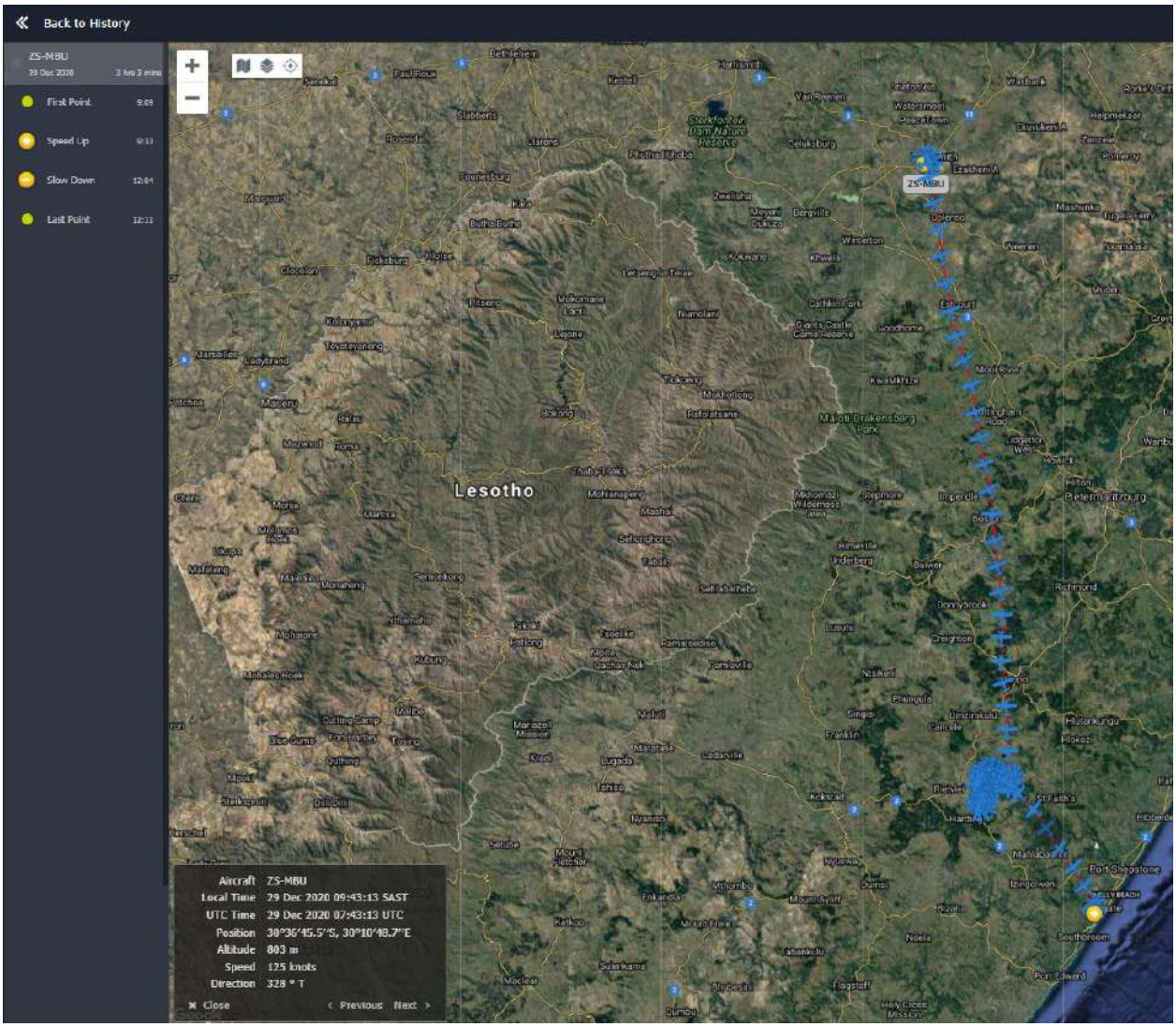
We are satisfied with the results and look forward to future projects.

James Jackson
Capturing Manager
07 January 2021

Annexure A: Weather



Annexure B: Flight Times



Annexure C: Pre and Post Flight Planning

AeroTrack | AERIAL OPERATIONS FLIGHT & FUEL PLANNING

Date	29 Desember 2020	Pilot	G.Jansen
Aircraft Reg Nr	ZS-MBU	Hectares	
Area	KWAZULU NATAL	Pesticide	
Dosage Rate		Volume p/ha	
Swath Width		Nozzle Type	
Spray Pressure		Height	
Humidity		Wind	

PRE-FLIGHT

Weather - 6, 12 ,18 hr TAF review: (Meteorological conditions at an airport during a specified period (usually 24 hours).	x	http://www.weathersa.co.za/city-pages/ https://www.windfinder.com/#3/5.79/-2.46
Notification & Indemnity	x	operations@aerotrack.co.za
Fuel – Available & Quantity Sufficient	x	

FLIGHT PLANNING

Confirm actual WX	x	
Confirm Take-Off Time & Route Planning	x	
Fuel – Available & Quantity Sufficient	x	

WEIGHT & BALANCE

Hang-Test Current	y	Expiry Date	
Mass & Balance Current	y	Expiry Date	

Configuration:
Pilot Max 130kg, min 75kg
Full Load
Full Fuel Load YES
Empty Mass

TOTAL
Less than MAUW yes

FUEL & PESTICIDE PLANNING

Type of Flight	To/From Area	Fuel Litres	Pesticide Litres
Ferry Fuel	As per sky demon		
Aerial Release			
Aerial Release			
Aerial Release			
Aerial Release			
Aerial Release			
Aerial Release			
Aerial Release			
Ferry			
TOTALS FUEL/PESTICIDE			

Form: OPS030 | Approval: CAA/G932D | Revision Date: 01 Apr 2019 | Revision No: 2 | Page 1 of 2

AeroTrack | AERIAL OPERATIONS FLIGHT & FUEL PLANNING

HAZARD REPORTING
Hazard: EXISTS in the PRESENT. Could lead to or contribute to an unplanned/undesired event
Risk: EXISTS only as a POTENTIAL future following a triggering event and is measure according to severity and probability

none

POST-FLIGHT Feedback/Hazards/Risks Area and Aircraft

none

SIGNED PILOT: G.Jansen

PCO NR: _____

TEL NR: 0834015833

Form: OPS030 | Approval: CAA/G932D | Revision Date: 01 Apr 2019 | Revision No: 2 | Page 2 of 2

AeroTrack | POST FLIGHT PLANNING & FUEL CONTROL CLOSURE

Date	29/12/2020	Pilot	Greyling Jansen
Aircraft Reg Nr	ZS-MBU		

PRE-FLIGHT - Check each function below to show completion, and attach the report as evidence

Weather - 6 , 12 ,18 hr TAF review submitted to Operations department (Meteorological conditions at an airport during a specified period (usually 24 hours).	http://www.weathersa.co.za/city-pages/ https://www.windfinder.com/#3/5.79/-2.48	N/A
Weather reports pulled and attached		N/A
Notification – SkyDemon Flight, Nav & Fuel Planning	operations@aerotrack.co.za	Y

HUMAN FACTOR PRINCIPALS

Date of Last Flight	28/12/2020
Date of Last off Day	26/12/2020
Personal Problems	NONE
Condition of Health	GREAT
On any Medication	NONE

FLIGHT PLANNING PRE & POST - Check each function below to show completion and attach the report as evidence

Estimate time of departure and arrival	DEP-09H00L ARR-12H30L	
Actual time of departure and arrival	09H00 12H16	
Fuel – Available & Quantity Sufficient	See SkyDemon	
Actual Fuel	320L SEE SKY DEMON	

WEIGHT & BALANCE PRE FLIGHT - Check each function below to show completion, and attach the report as evidence

Refer to SkyDemon	
Signed and emailed to Operations Department	

FUEL ACTUALS POST FLIGHT

Flying	Time	Fuel
Ferry		
Trip		
Approach & Landing		
Contingency (5%)	SEE SKY DEMON	
Alternate		
Extra		
TOTALS USABLE		

AeroTrack | POST FLIGHT PLANNING & FUEL CONTROL CLOSURE

POSSIBLE HAZARDS THAT MIGHT OCCUR DURING, PRE & POST FLIGHT
Hazard: EXISTS in the PRESENT. Could lead to or contribute to an unplanned/undesired event
Risk: EXISTS only as a POTENTIAL future following a triggering event and is measure according to severity and probability

NONE

POST-FLIGHT: REPORTABLE Feedback/Possible Hazards Area, Hanger, Runway, Aircraft, pilot etc.
Please refer to form: **SMS010_Hazard Report and Safety Analysis** in the case of any reportable Hazards.
Complete in full and return to Operations Office: operations@aerotrack.co.za

NONE

SIGNED PILOT: G.Jansen

Annexure D: VUX 240 Calibration Certificate

RIEGL

Test Certificate

Model: *RIEGL* VUX-240 Serial No: S2226375

☑ first delivery ☐ service / repair

Range Measurement Performance:

laser pulse repetition rate (rounded values)	mean amplitude [dB] meas. dist ≈ 620 m diffuse reflectance ρ_{target} ≈ 100 %	specified maximum distance ρ = 60 %	specified maximum distance ρ = 20 %	calculate maximum distance without attenuation [1)2)3)] ρ = 60 %	calculate maximum distance without attenuation [1)2)3)] ρ = 20 %	OK
150 kHz	15,3	1900 m	1200 m	1922 m	1284 m	☑
300 kHz	12,8	1400 m	850 m	1564 m	1023 m	☑
600 kHz	9,7	1050 m	650 m	1202 m	767 m	☑
1200 kHz	6,7	750 m	450 m	909 m	568 m	☑
1800 kHz	5,0	650 m	350 m	767 m	474 m	☑

1) Taking into account the atmospheric visibility in excess of 10 km. Ambiguity to be resolved by post-processing with RIMTA software.
2) For minimum amplitude of more than 3 dB.
3) Moderate ambient light conditions.

Measurement Accuracy and Precision:

target plate	nominal value	measured value	specified accuracy	standard deviation (1σ)	specified precision	OK
ρ ≥ 80 %	129,258 m	129,264 m	+/- 20 mm	2 mm	+/- 15 mm	☑
ρ ≈ 10 %	131,323 m	131,330 m	+/- 20 mm	3 mm	+/- 15 mm	☑

Measurement Rate:

maximum effective measurement rate	OK
up to 1 500 000 meas./sec.	☑

Scan Speed:

specified scan speed	OK
40 lines/sec.	☑
400 lines/sec.	☑

PA-0837-A, Rel. 02, HH, 12.02.2020

Page 1 of 2

RIEGL

Test Certificate

Temperature Test:

specified operating temperature range	tested operating temperature range	OK
-10 °C up to + 40 °C	-10 °C up to +40 °C	☑

Interfaces:

	tested
TCP/IP 1000Mbit/s interface	☑
GPS serial interface and pulse synchronisation	☑
USB interface (storage, debug)	☑
CAM interface	☑

Power Supply: 22 °C +/- 3 °C, after 10 min. warm up

operating voltage	current consumption scanner and laser ON @ maximum lines per second
11 V	4,78 A
15 V	3,40 A
24 V	2,10 A
28 V	1,81 A
34 V	1,52 A

Laser Safety and Classification:

	completed
parameters of laser beam measured	☑
laser classification protocol	☑

Parameter Settings:

	completed
parameters set to factory default values	☑

Instrument Labelling:

	attached
type plate with CE symbol & laser classification	☑
company logos	☑

tests performed: 17.9.20 Ulas Bianca
date, sign

product released: 17.9.2020 H. Grabner H. Kreuzer
date, sign

PA-0837-A, Rel. 02, HH, 12.02.2020

Page 2 of 2

HARRY GWALA DISTRICT MUNICIPALITY

CONTRACT NO: HGDM748/HGM/2021

CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM AND RISING MAIN: CIVIL, MECHANICAL AND ELECTRICAL

PARTICULAR SPECIFICATION

GIBB 002 – GENERAL MECHANICAL

Table of Contents

1 SCOPE

This Specification covers general technical requirements for mechanical plant and equipment for the weir, abstraction works, desilting works and high lift pump station mechanical, electrical and ancillary civil works

It shall be read in conjunction with the related Specifications below. Any particular requirements stated in those Specifications shall take precedence over this Specification.

It shall supersede the Umgeni Water Particular Specifications, which are contained in Section C3.3.

1.1 Related Specifications

GIBB-003	General Pump Specification
GIBB-004	Project Specific Pump Specification
GIBB-006	Hydro Mechanical Equipment
GIBB-007	Painting and Corrosion Protection
GIBB-008	Cranes, Gantries, Hoists, Winches
GIBB-009	Hydrocyclones
GIBB-010	Electric Actuators
GIBB-011	General Electrical
GIBB-014	Detailed Electrical
GIBB-017	Heating, Ventilation, and Cooling
GIBB-018	Fuel Management System
GIBB-019	Control, Integration and Commissioning

This Mechanical General Specification gives a general description of the requirements to be met, and provides the basic quality, safety, design and materials requirements of all of the mechanical plant and equipment that is to be supplied and installed under the mechanical section(s) of the Contract.

In the event of there being a discrepancy between any specification, including those specifications dealing with civil and building works, and/or the drawings and/or the Bills of Quantities, the discrepancy shall be drawn to the attention of, and resolved by, the Employer's Agent before the execution of any work associated with the discrepancy

This Mechanical General Specification, when read together relevant sections of the Project Specifications, indicates the minimum requirements. Where no specific requirement is indicated, it does not relieve the Contractor of any statutory or common law duty and the Contractor will still be required to comply with all relevant requirements and/or standards from any statutory body that is applicable to the plant and equipment being designed, supplied and installed.

2 INTERPRETATION

2.1 Definitions

In this Section the word or words:-

- **"design"** includes, as applicable, the submission of design documentation for acceptance by the *Employer's Agent*,
- **"supply"** includes, as applicable, the purchase of materials or goods, manufacture and fabrication, any specified corrosion protection measures and any off-site inspection or testing,
- **"installation"** includes, as applicable, all handling and transport from storage, if necessary, all erection and setting to work,
- **"Tests on Completion"** includes, as applicable, the dry and wet tests as specified,
- **"gate"** is a panel closing the entire passage of a waterway and may be wheeled or sliding.
- **"stoplog"** A sliding component used to close a waterway passage.
- **"hoists"** is a collective term referring to all hydraulic, electrical and mechanical equipment and Plant specified for raising and lowering the "gates" between their fully inserted (closed) positions and their fully raised (stored) positions and any intermediate position, together with other lifting devices for general use.

2.2 References

References made hereinafter to specifications of the South African Bureau of Standards (SABS/SANS) or the British Standards Institute (BS) or the International Standards organisation (ISO) or the American Society of Mechanical Engineers (ASME) or the American Standard for Testing and Materials (ASTM) shall be deemed to include all revisions of and/or additions, supplements, modifications to such specifications ruling four weeks prior to the closing date of tenders, unless otherwise specified.

2.3 Supporting Standards and Specifications

The following Standards are referred to in this specification:

SANS 121	Hot dip galvanized coatings on fabricated iron and steel articles - Specifications and test methods
SANS 719	Electric welded low carbon steel pipes for aqueous fluids (large bore)
SANS 936/7	Spheroidal graphite iron castings
SANS 1062	Pressure and vacuum gauges
SANS 1804	Induction Motors
SANS 1123	Pipe flanges
SANS 1186	Symbolic safety signs Part 1: Standard signs and general requirements
SANS 1200	Standardized Specification for Civil Engineering Construction
SANS 1431	Weldable Structural Steels
SANS 1700	Fasteners
SANS 10104	Handrailing and balustrading (safety aspects)
SANS 10108	The classification of hazardous locations and the selection of equipment for use in such locations
SANS 10111	Engineering drawings
SANS 10160	Basis of structural design and actions for buildings and industrial structures
SANS 10162	The structural use of steel

SANS 60034	Rotating Electrical Machines
SANS 61241	Electrical apparatus for use in the presence of combustible dust
BS 18	Method for tensile testing of metals (including aerospace materials)
BS 29	Specification for carbon steel forgings above 150 mm ruling section
BS 806	Design and construction of ferrous piping in connection with land boilers (used for arc welding specification of all pipe flanges)
BS 970	Specification for Wrought steel for mechanical and allied engineering purposes
BS 1649	Guards for Shaft Couplings
BS 1775	Steel tubes for mechanical, structural and general engineering purposes
BS 2633	Class 1 Arc welding of steel pipework.
BS 2971	Class II Arc welding of steel pipework.
BS 3100	Chemical composition, heat treatment and mechanical properties of cast steels.
BS 4360	Specification for Weldable Structural Steels
BS 4677	Arc welding austenitic stainless steel pipework.
BS 4080	Methods for Non-Destructive Testing of Steel Castings
BS 4124	Method for Ultrasonic Detection of Imperfections in Steel Forgings
BS 4871	Specification for Approval Testing of Welders Working to Approved Welding Procedures
BS 4872	Specification for approval testing of welders when welding procedure approval is not required.
BS 5135	Process of Arc Welding of Carbon and Carbon Manganese Steels
BS 5400	Steel, Concrete, and Composite Bridges
BS 7854	Mechanical Vibration – Evaluation of machine vibration by measurements on non-rotating parts
BS EN 1011	Arc welding carbon and carbon manganese steelwork.
BS EN 1092	Flanges and their Joints
BS EN 1563	Founding spheroidal graphite cast irons
BS EN 10025	Hot rolled products of structural steels
EN 10028-7	Flat products made of steels for pressure purposes
EN 10088	Stainless Steels
ASTM D297:	Test Methods for Rubber Products -Chemical Analysis
ASTM D395:	Test Methods for Rubber Properties - Compression Set
ASTM D412:	Test Methods for Rubber Properties in Tension
ASTM D413:	Test Methods for Rubber Properties - Adhesion to Flexible Substrate
ASTM D471:	Test Methods for Rubber Properties - Effect of Liquids
ASTM D572:	Test Method for Rubber Deterioration by Heat/Oxygen

ASTM D573:	Test Method for Rubber Deterioration in Air Oven
ASTM D1149:	Test Method for Rubber Deterioration by Surface Ozone Cracking
ASTM D2240:	Test Methods for Rubber Property-Durometer Hardness
DIN 53504:	Determination of tensile stress/strain properties of rubber
DIN 53505:	Shore A and D hardness testing of rubber and elastics
DIN 53509-1:	Determination of the resistance of rubber to ozone cracking under static load
DIN 53516:	Determination of abrasion of rubber
DIN 53517:	Testing of compression set of rubber at constant strain

3 SAFETY

3.1 Hazardous Locations

Equipment which is to be installed in areas zoned 0,1 or 2 for gasses and/or zoned 20, 21 or 22 for dusts in terms of SANS 10108, shall be designed to comply with the requirements of that Standard.

3.2 OHS Act and Safety

In addition to the safety requirements to be complied with during the construction of the Works on Site, the Contractor is responsible for ensuring that all equipment supplied and the complete installation complies with the Occupational Health and Safety Act, Act 85 of 1993, and the regulations promulgated thereunder.

Installations which do not comply with the OHS Act shall be corrected by the Contractor at no cost to the Employer.

Equipment which is potentially dangerous shall be designed in accordance with a relevant South African or international Standard.

Hazards must be avoided or guarded to the satisfaction of the Employer's Agent. Nip points shall be guarded. Sharp corners shall be rounded off. Items such as operating handles, supports and protrusions shall be kept clear of access ways or marked accordingly.

The Contractor shall cover all unsafe gaps and openings left in structures after installation.

Each motor driven device shall be provided with an emergency stop station in an appropriate position.

Trip wires shall be provided along the accessible side/s of moving conveyor belts, chains, etc., irrespective of operating speed and in addition to any guards provided. These shall stop the driving motor when pulled.

Any permanent fencing or other safeguards required to be erected around electrical Plant shall be completed as far as practicable before connection is made to the electricity supply, but where this is not practicable, the *Employer's Agent* may permit the use of temporary fencing or other safeguards.

If work in the vicinity of electrical Plant has to be carried out after connection has been made to the electricity supply, the *Contractor* shall comply with any "Permit to Work" system accepted by the *Employer's Agent*.

All equipment shall be designed and arranged to minimise the risk of fire and any damage which might be caused in the event of fire.

4 DESIGN

4.1 Design Principles

Mechanical engineering design shall ensure safety, robust construction, reliability, durability, prevention of avoidable corrosion, neatness as well as ease of maintenance and operation.

Design shall, as applicable, be based on:

a) The full range of duties which can be reasonably anticipated;

b) The maximum pressure or vacuum which can be produced by pumps, blowers and compressors under all conditions including blocked or closed inlet and outlet circuits;

c) Conservative service and safety factors based on approved standards or laid down in the printed specifications of reputable and approved manufacturers;

d) Twenty four hour per day operation (unless specified otherwise).

e) A minimum life of 100 000 hours for large items of equipment before repair or major part replacement;

f) Prevention of serious damage from normal operational problems such as blockages, blinding, jamming, seizure, malfunction and, as far as is practical, mal-operation (assuming that these occurrences cannot be avoided by good design).

g) The power and torque transmitted by the driver system under full load and stalled conditions;

h) Machines with non-overloading characteristics shall be selected wherever possible; eg: motors shall be sized so that they cannot be overloaded by the driven machine.

i) Generally, the design shall be such as to provide the maximum reliability under all conditions of service, coupled with safety and convenience of operation and maintenance under all conditions at the Site.

j) The design, dimensions and materials of all parts shall be suitable for the specified service and be such that the stresses to which they may be subjected shall not render them liable to buckling, breaking or excessive wear.

4.2 Vibration and Design Loads

a) Design loads shall be those set out in the relevant particular specification.

b) Special care shall be taken to ensure that all items of Plant are free of harmful vibration. Special care shall also be taken to ensure that resonance of any part does not occur as a result of harmonics which, although not apparent when the item in question is tested by itself, nevertheless give rise to objectionable vibrations when it is installed in its final position.

c) The mechanical vibration of machines measured at all important points such as bearings shall be lower than that specified as "good" for that class of machine in BS 7854 (ISO 10816).

d) Reciprocating machines shall be designed and installed so that the machine vibrations are isolated from the floor structure. Vibration isolation mountings which will eliminate not less than 90 % of the vibrations transmitted by the equipment shall be provided between the baseplate and the concrete plinth. When mounted on the vibration isolators, distortion of the baseplate shall be negligible in comparison with the permissible and acceptable misalignment of the equipment mounted thereon.

e) Shafts shall be designed so that the critical speed is outside the operating speed range.

f) All fastenings on Plant which may, notwithstanding the above provisions, be at risk of vibration under certain combinations of loadings and operating conditions shall be designed, by means of lock washers or by other accepted means, not to work loose due to vibration or other cause.

g) The *Contractor* shall, without additional payment, take whatever steps may be necessary after erection to remedy any vibration which the *Employer's Agent* considers harmful.

4.3 Permissible Stresses – General

Allowable stresses and safety factors for steel and structural steel design shall be determined according to SANS 10162: "The Structural Use of Steel" (all parts, latest versions), taking into account also the specifications of DIN 19704-1. Allowable stresses in welded connections shall be 90% of those permitted in SANS 10162, except where furnace stress relieved and 100% radiographed, in which case 100% of the allowable stresses is permitted.

The Plant shall be designed such that no part of the *works* under any loading condition shall impose any stress greater than those set out below on or in any concrete work:

- For compressive bearing stress: 12.0 MPa;
- For shearing stress: 1.7 MPa; and
- No tensile stress shall be allowed in concrete.

Except where otherwise specified, under the most severe operating and/or erection condition, stresses in castings and forgings expressed as percentages of tensile strength shall not exceed the figures set out in the Table below.

Table 1: Maximum Stress Percentages

DISCIPLINE	TENSION	COMPRESSION	SHEAR
Grey cast iron	10%	22%	6%
Nodular cast iron	22%	22%	12%
Carbon or low alloy cast steel	22%	22%	16%
High alloy cast steel	22%	22%	16%
Carbon and high alloy forgings	25%	25%	22%

The value of tensile strength to which the tabulated percentages shall be applied shall be the tensile strength (as defined in BS 18) of the proposed grade of metal as guaranteed by the supplier of the metal on the basis of tests carried out in accordance with BS 18.

4.4 Fail Safe Operation and Protections

Where damage can occur from normal operational or other foreseeable problems, plant, equipment and systems must be designed to be fail safe; i.e. must have built in redundant elements, or be fail-to-safe; i.e. must return to a safe condition where no further damage can be done in the event of a failure, malfunction, mal-operation, overload and, as far as practical, misuse. All reasonable and economically justifiable protections to prevent or limit damage to plant and equipment, particularly in high risk situations, must be incorporated.

Protections shall:

- Be directed at the source of the problem, limit forces to safe levels and act quickly enough to prevent damage (electrical thermal type overloads are inadequate);
- Stop or prevent from starting all equipment at risk;

- Activate an alarm with a labelled indicator on the control panel whenever a protection operates;
- Operate reliably after long inactive periods exposed to corrosive and dirty conditions.

Contractors shall highlight equipment limitations which can be exceeded during operation and cannot be guarded against.

4.5 Moving Parts

The following general requirements apply not only to machines but to all equipment with moving parts such as headstocks, extension spindles, swivelling davits, heavy duty hinges, pivots and the like:

a) All rotating or swiveling shafts, pins and the like, shall be adequately supported, guided and restrained by lubricated or self-lubricating bearings, collars and/or bushes.

b) Swiveling joints on linkages and the like shall be of the "universal" or fork and rod type with bearings or bushes fitted to the eyes or forks.

c) Abrasion resistant materials and slow speed operation shall be used for abrasive applications.

d) All applications associated with wastewater shall be regarded as corrosive and materials of construction shall be selected to suit.

e) Susceptibility to fatigue failure shall be minimised by proper design and manufacturing procedures. Sharp changes in section and welding shall be avoided in components subject to fluctuating stress.

f) The locking of nuts and pins in position shall be done to the approval of the Employer's Agent.

g) Wearing parts shall be designed for ease of removal and replacement.

4.6 Arrangement and Mounting

The arrangement and general design shall take the following requirements into consideration:

a) Lifting eyes, lugs, hooks, etc., shall be provided on heavy or large items to facilitate handling.

b) Castings or fabrications shall have machined pads for seating and be mounted on either soleplates or baseplates as appropriate.

c) Where accurate alignment is required, positioning pins and/or jacking screws shall be provided.

d) The needs of operation and maintenance including neatness, access, working space, safety, cleaning, adjustment, handling, assembly, alignment, disassembly, removal, etc.

e) With plant and equipment to be mounted on or against concrete or brick structures built by others, provision shall be made for adjustment in the mechanical design. Any special accuracy requirements must be specified on the Contractor's Documents.

5 CONTRACTORS DRAWINGS

5.1 Contractors Drawings – General

Drawings provided by the *Contractor* shall be size A1 and produced in hard copy and electronically in *.pdf and *.dxf format. Each drawing shall show the following particulars in the lower right hand corner:

- Name of *Employer*
- Name of *Employer's Agent*
- Name of *Contractor*
- Project title
- Contract number
- Title of Drawing (Location, item and detail)
- Scale
- Date of Drawing
- Details of electrical supply (where applicable)
- Drawing number
- Revision identification

Dimensions on all Drawings shall be metric.

A blank space 90 mm by 60 mm shall be provided as an extension of the title block for the *Employer's Agent*'s approval stamp. Provision shall be made for details of revisions to be recorded above the title block. Prints of Drawings shall be in the form of black lines on a white background.

5.2 Tenderer's Drawings

The Mechanical portion of the Tender Drawings provided are simply configuration guidelines to enable the *Contractor* to determine the Plant required to be designed and detailed by the *Contractor*.

Drawings submitted by the *Contractor* with his Tender shall give sufficient information to make a proper assessment of the Plant offered together with sufficient detail to enable the dimensions and general arrangement of the Plant to be determined. All the important parts shall be shown in detail, i.e. gate body, scaling arrangements, bearing arrangements, guides, wheels, etc.

They shall include details of parts to be built into, and loads to be transferred to, the civil engineering *Works*, routes and sizes of cabling, cable ducts or trunking, hydraulic pipework, description of erection methods, operating and control units, position indicators and details of connections to any other equipment.

5.3 Manufacturing / Shop Drawings

After the Starting Date but before manufacture commences, working Drawings containing general arrangements and assemblies for the Plant, including material schedules, standard parts etc., shall be provided for approval in principle by the *Employer's Agent*.

Drawings shall provide all the information required by the manufacturer to ensure full compliance with the Drawings and Specifications.

Drawings shall be prepared to acceptable industry standards complying with SANS 10111. An example of the Drawings shall be submitted for approval before draughting commences.

Approval by the *Employer's Agent* of any Drawing shall not relieve the *Contractor* of responsibility for correct fitment on site.

The *Employer's Agent* retains the right to suspend manufacture until approved working Drawings are in his possession.

5.4 Site Construction Drawings

Where appropriate, Drawings to enable site preparations to be completed shall be provided before the arrival of equipment, giving all details necessary for the programming of civil Works,

including foundation details and anchor bolts. These Drawings shall be provided not later than three weeks after approval of the layout Drawings has been given in principle.

5.5 Record Drawings

A complete set in triplicate of "as built" Drawings shall be produced. The Drawings shall be complete in all respects, drawn generally in accordance with SANS 10111; containing general arrangements, assemblies, parts lists (including part numbers) and complete component details. Drawings are to be to scale and in standard sizes, but not exceeding A1.

The Drawings shall be clear, black line on white paper and unfolded. They shall be suitable for microfilming. All legends shall be in English and all dimensions in the metric system. On each Drawing shall be stenciled in bold letters in the title block such information as is necessary to identify the equipment.

All Drawings shall also be submitted electronically in .pdf format, and in any other format required by the Employer's particular specification.

Drawings that do not conform to the above requirements will be returned to the *Contractor*.

5.6 Operation and Maintenance Manuals

Refer to the Umgeni Water Particular Specification for Operations and Maintenance Manuals.

6 QUALITY

Details regarding the Quality Assurance and Quality Control requirements are addressed in the **Umgeni Water Particular Specification on Quality Assurance Requirements** and in relevant particular specifications.

All enquiries made, and contracts placed by the Contractor for critical components, shall require suppliers and/or sub-contractors to comply with the requirements of the Contract. Responsibility for, and all associated costs of, compliance shall rest with the Contractor. In instances where SANS/ISO 9001 is not applicable, Tenderers must indicate what equivalent alternative Code of Practice is being implemented.

7 SPARE PARTS

The *Contractor* shall supply such spare parts for the operation of the Plant for a minimum period of] or as the *Employer's Agent* shall direct, where specified elsewhere in the Contract document.

All spare parts shall be new, unused and strictly interchangeable with the parts for which they are intended to be replacements and shall be treated and packed for long storage under the climatic conditions prevailing at the Site.

Each spare part shall be clearly marked or labelled on the outside of its packing with its description and purpose, and when more than one spare is packed in a single case or other container, a general description of its contents shall be shown on the outside of such case or container in a waterproof transparent envelope and a detailed list enclosed.

All cases, containers and other packages shall be marked and numbered in an approved manner for purposes of identification.

All spare parts shall be inspected by the *Employer's Agent* prior to packing.

8 TOOLS AND TESTING EQUIPMENT

The *Contractor* shall supply all special tools and test equipment for the *Employer's Agent*'s approval to enable any erection, dismantling, reassembly or testing to be carried out on all parts of the Plant, whether of an electrical, mechanical or other nature during the life of the *Works*. Payment shall be at the rates entered in the Schedule of Quantities.

The tools and test equipment shall not be used for erection and except that the *Employer's Agent* may call upon the *Contractor* to demonstrate their use and effectiveness, they must be handed over to the *Employer's Agent* in a completely new and unused condition. Should the *Contractor* require any such tools and test equipment at the Site during erection, he shall provide his own.

The tools for each different type of equipment shall be contained in suitable boxes clearly marked or labelled with their description. Each tool shall be identified and a list of tools stamped on a stainless steel plate shall be affixed to the inside of the box lid. Boxing shall be deemed to be included in the rates entered for the tools. Each set of tools shall be supplied with the equipment with which it is associated.

The test equipment shall include only special purpose items essential for the testing or repair.

9 PACKAGING, TRANSPORTATION AND STORAGE

9.1 Packing and Transportation

a) Before any of the Plant is despatched from a manufacturer's *Works* it shall be properly prepared and packed and the *Contractor* shall give the *Employer's Agent* at least 14 days' notice that these preparations are to commence

b) Prior to despatch all parts shall be adequately protected by painting or by other means for the whole period of transit, storage and erection, against corrosion and incidental damage, including the effects of vermin, sunlight, rain, temperature, wind-blown sand and humid atmospheres. The *Contractor* shall be responsible for the Plant being so packed and/or protected as to ensure that it reaches the Site intact and undamaged. The Plant shall be packed to withstand rough handling in transit and all packages shall be suitable for storage including possible delays in transit.

c) The *Contractor* shall be deemed to have included in the Bill of Quantities for all materials and packing cases necessary for the safe packing and transport of the Plant. All transporting arrangements shall be to the satisfaction of the *Employer's Agent*.

d) No one package or bundle shall contain items intended for incorporation in more than one section of the *Works*. Cases containing small items shall not weigh more than 500 kg gross.

e) Bolts in strong hessian bags and other small components shall be labelled and crated. The bags and crates shall be tagged using metallic tags and shall indicate the following information:

- Contract number;
- Project name;
- Part numbers;
- Description;
- Sizes; and
- Quantities.

f) Each bag or crate shall have the delivery address listed on a separate metallic tag.

g) Every crate or package shall have a general description of its contents shown on a packing list in a waterproof transparent envelope attached to the outside of the crate. A duplicate copy of the packing list shall be sent by post to the *Employer's Agent*.

h) All items shall be clearly marked for identification against the packing list.

i) All crates, packages, steel fabrications and machinery shall be clearly marked with a waterproof material to show the weight, the position to which slings may be attached and shall have an indelible identification mark relating them to the packing lists. In addition, all packages shall be clearly painted with a distinctive site identification colour and sign, so that the final location of each item can be easily identified at the Site in order to avoid delay, double handling or loss. These special identification marks will be in addition to the normal shipping and transport marks.

j) Machined flanges of pipes, valves and fittings shall be protected by wooden discs attached by means of service bolts (which shall not be used on the *Works*) or by other approved means.

k) Coated items shall not be handled within the drying time recommended by the coating manufacturer, relevant to the ambient temperature. Wherever possible lifting of painted items shall be from approved lifting attachments. All coated items shall only be lifted by means of broad band slings that will not damage the coating. Slings shall not be less than 50 mm wide or as approved by the *Employer's Agent*.

l) During transport, non-packaged items shall be held securely in position on sufficient padded blocks as are necessary to give adequate and safe support and, inter-alia, to militate against the possibility of brinelling of bearings en route to site.

m) The use of ropes, wire ropes or chains without suitable padding is expressly forbidden.

n) All the necessary balks of timber or sawdust bags to support the components on soil, concrete or other hard surface and to separate them from each other in transit and at Site, shall be provided by the *Contractor* free of charge.

o) When loading onto vehicles, precautions shall be taken to support and chock the components to prevent movement. Components shall be firmly lashed or chained with padded lashing, supported on sawdust bags. The area of padded surfaces shall be adequate to prevent damage to the coating.

p) Items may be inspected on arrival at the *Contractor*'s end delivery point and any repairs necessary shall be to the cost of the *Contractor*. Any damage that occurs during the handling and storage of Plant and components at the Manufacturer/*Contractor*'s *Works*, including transportation to site, shall be repaired by the Manufacturer/*Contractor* at his own cost, in accordance with the Specification and to the approval of the *Employer's Agent*.

9.2 Off-Loading at Site

a) The *Employer's Agent* shall be notified of the delivery date and of any requirements regarding off-loading and storage at site.

b) The supplier shall be responsible for the transportation and supervision during off-loading of the equipment and other small components at the delivery site.

c) Under no circumstances shall coated equipment be allowed to rest directly on the ground.

d) The final delivery inspection and acceptance of equipment supplied shall be undertaken on site after off-loading has been completed.

e) The *Employer's Agent* has the right to reject any damaged equipment, components and materials which have been delivered and off-loaded at site.

9.3 Stacking and Storage

a) The *Contractor* shall provide all the necessary balks of timber and sawdust bags used to support the equipment and components on soil, concrete or other hard surface and to separate them from each other, both at his *Works* and on site.

b) Grass or other vegetation shall not be allowed to grow in the storage area within three metres of the Plant and components.

9.4 Attachments for Transport and Erection

a) The *Contractor* shall submit for the *Employer's Agent*'s approval proposals for such properly designed supports, lifting attachments or handling points as the *Contractor* considers necessary or desirable for assistance in handling fabricated sections for cleaning, applying protection, assembly transportation storage, erection, and subsequent maintenance. All such lifting attachments or handling points shall be such as to avoid overstressing or deforming the steel members of fabrications. Lifting attachments shall be designed for not less than the applicable mass reaction plus 50 % allowance for impact.

b) Temporary supports, lifting attachments or handling points shall be removed or filled in as required, and by approved methods to the satisfaction of the *Employer's Agent*, and the surfaces of the permanent steelwork in these localities shall be dressed, cleaned and painted as specified elsewhere. Where tapped holes are provided for lifting devices (such as eyebolts) the tapped holes shall be plugged with stainless steel socket head screws (the thread of which shall be covered with anti-seize compound).

c) Supports, lifting attachments or handling points may be left, if so approved by the *Employer's Agent*, provided that in his opinion:

- There is no deleterious long term effect on the structural integrity or operational use of the completed fabrication;
- The steelwork protective system is continuous over or around the lifting attachments or handling points and there is no undue risk of breaks or cracks occurring in the protection at such areas; and
- There is no significant effect on the visual appearance of the fabrication.

d) Attachments to the steel fabrication to assist in the future inspection and maintenance of the steelwork and associated equipment may be required. Such attachments (e.g. supports for ladders, scaffolding cradles and ropes) may be combined with the *Contractor*'s temporary handling and lifting requirements during fabrication and erection and agreement on additional attachments shall be subject to the approval of the *Employer's Agent* before fabrication of the steelwork is commenced.

10 MATERIALS AND WORKMANSHIP – GENERAL

10.1 Introduction

This part of the Specification sets out the general standards of materials to be supplied by the *Contractor* and mention of any specific material or Plant does not necessarily imply that such material or Plant is to be included in the *Works*.

All component parts of the Plant shall, unless otherwise specified, comply with the provisions of this part and be subject to the approval of the *Employer's Agent*.

The names of the manufacturers of materials and equipment proposed for incorporation in the *Works*, together with performance reports, capacities, certified test reports and other significant information pertaining to such manufacturers, shall be furnished when requested by the

Employer's Agent, who shall have power to reject any parts which, in his opinion, are unsatisfactory or not in compliance with the Specification and such parts shall be replaced by the *Contractor* without additional payment.

10.2 Compliance with Standards

The materials, design and workmanship shall be in accordance with the appropriate Specification current at the time of manufacture unless otherwise specified. Providing the *Contractor* has stated in his Tender that any part of the Plant offered conforms to some other equal or better Standard and the *Employer's Agent* has accepted such offer, such other Standard shall prevail.

Should the *Contractor* desire for any reason to deviate from the Standards specified or the aforesaid equal or better Standard, he shall submit for the *Employer's Agent's* approval a statement of the exact nature of the deviation, fully supported by copies of the equivalent Standard (in English) and complete Specification of the alternative materials proposed. It shall be the responsibility of the *Contractor* to demonstrate that any alternative Standards proposed are equal or superior to those specified.

10.3 Materials

a) All material and Plant, where not specified, shall comply with the relevant Standard Specifications.

b) All materials incorporated in the *works* shall be the most suitable for the duty concerned and shall be new and of first class commercial quality, free from imperfection and selected for long life and minimum maintenance.

c) All parts subject to submergence or subject to relative movement, shall be of corrosion-resistant metals or other materials as appropriate. All parts in direct contact with various chemicals shall be completely resistant to corrosion and abrasion by those chemicals. All parts shall maintain their properties with minimum deterioration due to passage of time, exposure of light or any other cause. Parts bearing on each other shall have their relative hardness considered such that the part more easily replaced in the event of wear is of an appropriate lesser hardness.

d) Particular attention shall be paid to the prevention of corrosion due to the close proximity of dissimilar metals. Where it is necessary to use dissimilar metals in contact, these shall be selected so that the bimetallic corrosion potential is minimised or preferably eliminated by the use of standard isolating procedures, including appropriate coatings.

e) Except where otherwise accepted by the *Employer's Agent*, all materials, supplies or articles used in the Plant shall be new products of recognised reputable manufacturers with established dealerships and/or agencies in the Republic of South Africa, and subject to the acceptance of the *Employer's Agent*. Products will be accepted only when the *Employer's Agent* shall have been notified and have satisfied himself as to their strength, reliability, durability and suitability for the application intended.

f) To assist the *Employer's Agent* in this matter the *Contractor* shall furnish performance data, references to completed works and any other relevant information together with samples of materials for acceptance. Materials, equipment and other articles incorporated in the *works* without the acceptance of the *Employer's Agent* may be subsequently rejected by the *Employer's Agent*.

g) All items shall be permanently and indelibly marked to identify each individual item as specified by the *Employer's Agent*.

10.4 Workmanship

a) Workmanship and general finish shall be of first class commercial quality and in accordance with best workshop practice and the specified or accepted Standards.

b) The fabrication, machining and finish (incl. corrosion protection finishes) of all parts shall be such that when the work is assembled both in the shop and at the Site, the appropriate tolerances and clearances shall be obtained. The clearances used shall be sufficiently small to avoid vibration but all moving parts shall operate freely and shall be such that the risk of undue wear or jamming under load or on account of debris, temperature effects, encrustation or other causes is minimised. Finished faces shall be free of any wind or twist.

c) All similar items of Plant and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same type of materials as the originals and shall fit all similar items of Plant. Machinery fits on renewable parts shall be accurate and to specified tolerances so that replacements made to manufacturer's Drawings may be readily installed.

d) All equipment shall operate without harmful vibration and with minimum of noise. All revolving parts shall be statically and dynamically balanced so that when running at all operating speeds and any load up to a maximum, there shall be no vibration due to lack of balance.

e) All parts which can be worn or damaged by dust shall be totally enclosed in a dust-proof housing.

f) Manufacturers of stainless steel items shall comply with the “Stainless Steel Good Housekeeping Rules” as issued by SASSDA from time to time.

11 STEELWORK

11.1 Minimum Thickness and Corrosion Allowance

Stainless steel (except for that which is used for cladding) subject to a river water environment, an outdoor environment or an indoor environment shall have a minimum thickness of 8 mm, 6 mm and 3 mm respectively, unless otherwise specified in the drawings or schedule of quantities.

All other steel, with the exception of machinery house claddings, gear covers, etc., subject to an outdoor environment and subject to corrosion (even though painted on both faces or one face only), shall have minimum thickness of 12 mm, 10 mm and 6 mm respectively.

Steelwork (unless of stainless steel) shall be thicker, by not less than 0.8 mm for each exposed face, than that required when calculated in accordance with this Specification to resist the applied loads, to allow for corrosion.

11.2 Steel for Fabricated Construction

Mild steel for welded, riveted and bolted construction shall comply with SANS 1431: Weldable Structural Steels. Mild steel for load-bearing components shall not be inferior to Grade 300WA.

Stainless steels used in construction shall comply with EN 10088 and that used for pressure linings shall comply with EN 10028-7.

The *Contractor* shall provide the *Employer’s Agent* with copies of mill rolling sheets for all sections incorporated in the *works*, together with test certificates certifying that the steel has been tested and found to comply with the appropriate Standards. The *Employer’s Agent* reserves the right to test samples of steel independently and the results of these tests shall take precedence over the

tests carried out by the rolling mill. Marking by the steel maker and the mills shall comply with BS EN 10025.

11.3 Stainless Steel

Unless otherwise specified, stainless steel shall have resistance to atmospheric corrosion not less than that provided by BS 970, Grade 304L.

Particular attention shall be paid to the prevention of seizure by fretting where two corrosion resistant metals are in contact, by the selection of materials of suitable relative hardness and surface finish and the application of lubricants.

Stainless steel shall be pickled and passivated after fabrication and welding; re-passivation may be ordered, post-installation, at no additional cost, should there be evidence of ferrous re-contamination. Refer also in this regard to the specification on Painting and Corrosion Protection.

Fabrication shall take place in dedicated areas separated from carbon steel. All equipment used in the forming and manipulation of stainless steel items during fabrication shall be clean and free of materials that may contaminate the metal with carbon steel. Iron contamination shall be removed by pickling and passivation, by the dipping process, after degreasing. All surfaces shall be tested for free iron contamination by the water or the ferroxyl test method. Organic contamination shall be removed by degreasing.

The manufacture of items from corrosion resistant steels shall be in accordance with the SASSDA's Information Series and the guidelines of the material supplier. Discoloration caused by welding or cutting shall be mechanically cleaned by buffing followed by pickling and passivation in accordance with the SASSDA's Information Series and the guidelines of the material supplier.

11.4 3CR12

This is the titanium stabilised, 12 % chrome steel as produced by Columbus Stainless, South Africa. 3CR12 shall always be supplied with an annealed and pickled finish. 3CR12, in cases where it is to be coated, shall be suitably abrasive blasted to ensure adherence of the prime coat.

11.5 Lamellar Tearing

The *Contractor* shall design, detail and fabricate all junctions in steelwork in such a way as to prevent failure by lamellar tearing.

11.6 Structural Steelwork Fabrication

a) Fabrication of structural steelwork shall be generally in accordance with BS 5400 unless otherwise specified.

b) The *Contractor* shall ensure that all surfaces requiring corrosion protection are either:

- Accessible, to the satisfaction of the Employer's Agent, for maintenance of the protection by reasonable methods when in position in the works; and
- Enclosed in hermetically sealed voids, where it is structurally safe to seal such voids, and as agreed in writing by the Employer's Agent, which shall be proved to be sealed by air pressure testing if required by the Employer's Agent.

c) All surfaces shall be accessible by blast and spray equipment. Practical requirements for providing accessibility for surface preparation and coating shall be taken into consideration. Features which would prevent access to blast material and coating application shall be removed.

d) All permanently exposed edges and corners of members of fabricated steelwork shall be formed or dressed to a rounded profile with a minimum radius of approximately 3 mm to ensure an even coating of the protection to such parts of the fabrication.

e) All cutting, chamfering and other shaping of metals necessary for site connections shall be done in the shop. Adequate provision for temporary bolted site connections or clamps shall be provided to hold assemblies rigid and in proper alignment during site welding. After welding, all temporary connections and clamps shall be removed and all bolt holes shall be plugged, welded over and ground down flush with the adjacent metal on both faces, all to the satisfaction of the *Employer's Agent.*

f) Bending and pressing of plates may be by either the hot or cold process. In no case shall the internal radius of bends in cold-bent plates be less than twice the thickness of the metal. The procedures used, including temperature control in the case of hot-forming, shall be to the acceptance of the *Employer's Agent*. Where necessary, allowance shall be made in the design for possible modification of material properties.

g) Edges of all plates and members shall be square, clean, free from burrs and true to dimensions. If flame cutting is employed, edges shall be dressed smooth and true and the work shall be stress relieved, particularly for stainless steel.

h) All bolts and nuts shall be in accordance with SANS 1700.

i) All bolt holes shall be drilled, not punched. Templates shall be used where applicable.

j) Large washers of at least twice the thickness of a standard washer shall be used on all fasteners going through slotted holes.

k) Where required, lugs shall be fitted by the manufacturer to the requirements of the Corrosion specialist and the acceptance of the *Employer's Agent*. After removal the damaged coating area shall be repaired in accordance with the Specification. Lugs not intended to be removed shall be manufactured of equal or more noble grade than the base material in accordance with the Specification.

l) The Manufacturer shall be responsible for all the pre-preparation of equipment prior to surface preparation. Pre-preparation shall be carried out to the acceptance of the *Employer's Agent* and the Corrosion Protection specialist. Pre-preparation shall be carried out by competent personnel. All oil, grease or other surface contaminants shall be removed with a water soluble solvent degreaser followed by rinsing with clean soft water before the items are despatched to the Corrosion Protection specialist.

m) Stress raises are to be avoided.

11.7 Surface Defects in Fabricated Steelwork

a) All fabricated steelwork shall be free of surface defects in the steel, burrs, sharp or rough edges, crevices, cracks or discontinuities in welded joints and depressions, hollows or moisture retaining features in locations where rain, spray or condensed moisture left in contact with the structure may promote corrosion of the steel. The dressing of the steel to remove burrs and rough edges from holes or cut lines shall be carried out as soon as possible after their presence has been detected consistent with the need to clean and give initial protection to exposed steel elsewhere on the plate, section or fabrication concerned.

b) Surface defects shall be ground out. The extent and depth of laminations shall be determined before any rectification is carried out. Provided the size and extent of any surface defect or lamination is not such as to warrant rejection of the steel plate or member on structural or other grounds, the area affected by the remedial work shall be cleaned and protected to the same condition as the rest of the plate or member.

c) Where necessary (e.g. to meet dimensional tolerances) the steel surface at such defective areas may be built up by welding including any preheating that might be required and ground flush with the surrounding steel surface before being cleaned and protected. This welding is to be stress-relieved by an accepted post-weld heat treatment as accepted by the *Employer's Agent*. Appropriate Non Destructive Examination (NDE) and testing, per BS 5400 and as accepted by the *Employer's Agent*, shall to be applied 48hrs after the repair

d) All extrusions, rolled steel and castings shall be clean and free of score marks, pits, protrusions, blisters, porosity, blowholes, cracks or any other flaws which may be detrimental. Laminations, scabs or occluded scale shall be ground out. If such grinding penetrates deeper than 7% of the metal thickness, the area shall be repaired by welding or the metal shall be rejected at the discretion of the *Employer's Agent*. Repairs to be per BS 5400.

11.8 Welding

a) Standards

Standards complying with good modern practice, and acceptable to the Employer's Agent, shall be adopted. These include the following:

BS EN 1011	Arc welding carbon and carbon manganese steelwork.
BS 4677	Arc welding austenitic stainless steel pipework.
BS 2633	Class 1 Arc welding of steel pipework.
BS 2971	Class II Arc welding of steel pipework.
BS 806	Design and construction of ferrous piping in connection with land boilers (used for arc welding specification of all pipe flanges).

Welders shall be experienced artisans approved in accordance with BS 4872 or equivalent.

b) All welds shall be continuous and shall have a smooth contour. All welding shall comply with the general requirements of BS 5400 (except as amended by the Merrison Interim Design Rules should the *Contractor* wish to submit designs of gates or other parts of the *works* involving box girder construction). Double U or J welds shall be adopted where control of distortion is important.

c) All welding whether in the shop or at Site shall be accepted metal-arc processes and shall be in accordance with BS 5135 subject to the provisions of this Clause. Full details of welding procedure and detail Drawings of welds and weld preparations shall be submitted to the *Employer's Agent* for his acceptance and the *Contractor* shall carry out, without additional payment, such welding procedure tests as the *Employer's Agent* may order to prove the sufficiency of his proposed procedures. All stainless welding to be TIG welding.

d) Radiographic inspection shall be done for minimum 10% of all welds, with a weld design joint factor of 0.8 employed. Alternatively, where 100% of the welds are radiographically a joint factor of 1.0 may be used. All in-situ (field) welds shall be 100 % radiographically or ultrasonically inspected. All inspections shall be recorded.

e) No welding shall commence until all welding procedures have been accepted by the *Employer's Agent* in writing and no alteration shall be made to any previously accepted procedure without prior acceptance of the *Employer's Agent*.

f) All welders shall be qualified in accordance with BS 5400 or in accordance with such appropriate sections of BS 4871 or BS 4872 as the *Employer's Agent* may approve to.

The *Employer's Agent* shall have the authority to order that any welder whose work he deems to be questionable shall be re-tested in his presence. No separate payment shall be made for such tests. Welders will be required to be re-qualified for the welding procedures in respect of which they have accepted qualifications should they have failed to be employed on work involving these procedures for a period of six months or longer.

g) All welds shall be identified and recorded to enable each weld to be traced to the welder by whom it was made. The form and location of all identification marks shall be proposed by the *Contractor* and shall be subject to the acceptance of the *Employer's Agent.*

h) The preparation of joint faces shall be by machining except as otherwise accepted by the *Employer's Agent*. Where errors in joint preparation lead to larger gaps between fusion faces than permissible, these shall not be bridged over but the faces shall be made up with weld metal and re-machined as necessary to the correct profile before welding proper commences.

i) Where deviation from true profile of fusion faces occurs due to mill tolerances in rolled sections, fitting up and welding shall be in accordance with a procedure to be agreed between the *Contractor* and the *Employer's Agent*. To this end the *Contractor*'s statement of welding procedures, including stress relieving processes, shall contain proposals for dealing with such deviations.

j) Pre-heating shall be carried out as recommended in BS 5135 or other appropriate British Standard. Welding processes used shall limit heat input to a minimum to restrict the heat affected zone.

k) The full throat thickness shall be ensured at the ends of butt welds by the use of extension pieces or by other accepted means. If extension pieces are used they shall be clamped to the work and not welded. To ensure full penetration in butt welds, the use of backing material shall not be permitted except as accepted by the *Employer's Agent*.

l) All welds shall be continuous and even, with no contact gaps, and crevices left between members or unfilled re-entrant corners which would harbour moisture or dirt and prevent the satisfactory application and retention of the corrosion protective system. Weld undercuts and cavities as well as pits in metal surfaces are not permitted. All undercuts, cavities and pits shall be ground out, re-welded and ground to a smooth contour.

m) Weld beads with a surface irregularity exceeding 3 mm or with sharp crests having a radius under 2 mm shall be ground.

n) Staggered welds, where specified, shall only be permitted with prior acceptance of the *Employer's Agent* on submission of appropriate remedial corrosion protection procedures.

o) Removal of slag from welds which will be subject to tensile stresses shall be carried out by grinding or blast cleaning. Peening shall be carried out only where accepted by the *Supervisor*. With stainless steel use appropriate grinding disk or wire brush.

p) The finish of the welded joint shall be free from irregularities, grooves and depressions. Undercutting at the welded joint shall not be permitted. Where welds are ground smooth, grinding shall where possible be in the direction of the principle stress.

q) The *Employer's Agent* shall be notified of all defects before any repair work is commenced and the repair technique shall be subject to the acceptance of the *Employer's Agent.* Where ordered by the *Employer's Agent,* repairs shall be subject to radiographic and/or ultrasonic testing and an appropriate stress relieving process.

r) All welds between plates 25 mm or greater in thickness whether carried out in the shop or at the Site shall be stress-relieved by an accepted post-weld heat treatment unless otherwise agreed in writing by the *Employer's Agent*.

s) All fabrications which are subsequently to be machined in any way shall be stress relieved prior to machining.

t) Shop and Field Fabrication Method Statements / QCP's shall be provided detailing welding distortion mitigation or elimination strategies before manufacture commences. The *Employer's Agent* reserves the right to halt any work should this issue not receive the necessary attention.

u) Use of temper beads for heat treatment will only be allowed if accepted by the *Employer's Agent.*

11.9 Welding Of Stainless Steel and 3CR12 – Additional Requirements

Fabrication of austenitic stainless steels and 3CR12 shall comply with the recommendations in "The Stainless Steel User Manual", "The 3CR12 Fabrication Guide" and the general welding requirements in "Pocket Guide – Stainless Steels" issued by Columbus Stainless. Compliance with publications from equivalent authorities will be acceptable.

Stainless steels to be welded shall be of the low carbon grade; e.g. 1.4306 rather than 1.4301 and 1.4404 rather than 1.4401.

The welding rods used shall be the most suitable for the metal and purpose. Only welders experienced with welding stainless materials shall be used. Welds which are accessible from only one side shall be executed in a manner to prevent heat tint or shall be post-weld treated in order to remove all traces of heat tint.

Type 309 stainless steel welding rods shall be used for welding 3CR12 unless otherwise approved in writing. 3CR12 shall be welded as recommended in "The 3CR12 Fabrication Guide" issued by Columbus Stainless.

All possible steps shall be taken to ensure maximum corrosion resistance and strength of the welds and welded material. Special care shall be taken to avoid prolonged heating. Welds shall be passivated. Discolouration and steel contamination must be removed by pickling or electro cleaning as approved by the Employer's Agent but should rather be avoided by taking the appropriate measures.

12 MISCHELLANEOUS MATERIALS

12.1 Castings – General

a) Castings with defects exceeding the restrictions given in the table below shall be rejected.

b) In the case of blowholes occurring opposite each other, the combined depth shall be taken into account.

c) Blowholes and cavities not exceeding 2 mm depth shall be smoothed out by grinding.

d) Acceptance criteria for the repair of blowholes and cavities is shown in the table below:

Table 2: Blowholes

SURFACE	DEPTH OF BLOWHOLES	DIAMETER OF BLOWHOLES	REPAIR
Internal	Maximum 22% of material thickness	40% maximum of material thickness	Welding only
External	Maximum 10% of	22% maximum of	Solvent free Epoxy or welding

	material thickness	material thickness	
External	10 to 22% maximum of material thickness	40% maximum of material thickness	Welding only

e) Castings shall, after inspection by the Employer's Agent, be ground smooth.

f) Small and repaired blowholes shall be ground level and smooth.

g) All pressure retaining castings shall be hydrostatically tested to not less than 1,5 times the maximum working pressure after machining and shall be drop tight.

h) The Contractor shall provide a test certificate for each casting or batch of castings, except for those made of grey cast iron, giving details of the material analysis, the heat treatment and any mechanical tests carried out.

12.2 Cast Iron

a) Cast iron shall be of the nodular or spheroidal graphite type to BS EN 1563 grade EN-GJS-400-15 or to such other grade as is accepted by the *Employer's Agent*.

b) Cast iron shall not be used for components subject to impact stresses unless otherwise accepted by the *Employer's Agent*.

c) Before proceeding with foundry work for any castings which will be subject to hydraulic pressure and for all other important components, the *Contractor* shall submit to the *Employer's Agent* for his acceptance Drawings of such castings, showing the proposed locations for taking specimens for tensile, impact, fatigue, bending and any other appropriate tests. Castings shall be clearly marked by the manufacturer.

d) The *Contractor* shall give the *Employer's Agent* not less than 14 days' notice in writing of the date when such castings will be cleaned to enable the *Employer's Agent* to inspect the castings immediately after they have been cleaned. Whether or not the *Employer's Agent* attends such inspection, no repair work shall be undertaken without the *Employer's Agent*'s prior acceptance.

e) Castings shall be true to the Drawings and any castings in which any dimension is so much reduced as to impair the strength of the casting by more than 10 % or to increase the stresses above specified limits may be rejected by the *Employer's Agent*.

f) The structure of the castings shall be homogeneous and free from excessive non-metallic inclusions and other injurious defects. Excessive segregation of impurities or alloys at critical points in a casting will be sufficient cause for its rejection.

g) The *Contractor* shall perform all tests listed in BS EN 1563 together with the following additional tests on specimens from each batch:

- Each tensile test shall include determination of the 0.2 % proof stress value; and
- Three impact tests shall be performed on samples from each batch of castings at normal ambient temperatures and 3 further tests at an ambient temperature of -30˚C. The average impact value of each set of tests shall be such as will be suitable for the operational temperatures of each item made from the batch, as agreed with the *Employer's Agent*.

h) The *Contractor* shall non-destructively test all castings using radiographic, magnetic particle, penetrant and ultrasonic flaw detection methods as appropriate, similar to those specified in BS 4080 and as agreed with the *Employer's Agent*.

i) Subject to the acceptance of the *Employer's Agent*, minor defects shall be chipped or grooved out by a carbon arc air process to sound clear metal and repaired by welding. Castings with defects which do not otherwise affect the performance of the castings

but which necessitate the removal of metal resulting in a reduction in the stress-bearing cross-section of a component by more than 22 % may be rejected by the *Employer's Agent.*

j) Welding shall only be carried out by properly qualified welders and all such repairs shall, unless otherwise agreed by the *Employer's Agent*, be subject to stress relief.

k) Before carrying out any repairs the *Contractor* shall submit to the *Employer's Agent* for his acceptance a complete statement of procedure for such repairs together with, where appropriate, stress calculations and no repair work shall commence until the *Employer's Agents* written acceptance of such statement and calculations has been received.

l) In addition to tests carried out under sub-clause ( ), and if so instructed by the *Employer's Agent* radiographic and/or ultrasonic testing and/or other accepted non-destructive testing shall be carried out on the areas around all defects in any casting after removal of metal to ensure that each defect has been properly removed.

m) Certified copies of the results of any test required shall be furnished to the *Employer's Agent*.

12.3 Steel Castings

a) The steel used for castings shall be of the quality appropriate to each particular item as accepted by the *Employer's Agent* and shall comply with the relevant British Standards included in BS 3100. Castings shall be heat treated as agreed in writing by the *Employer's Agent*.

b) The *Contractor* shall perform all the tests listed in BS 3100, together with the following additional tests on specimens from each batch:

- Brinell hardness tests together with copies of test certificates; and
- Impact tests

12.4 Forgings

a) Steel for forging shall be of the quality appropriate to each particular item, shall comply with BS 29 or BS 970, as appropriate and shall be subject to the acceptance of the *Employer's Agent*.

b) All forging shall be heat-treated for the relief of residual stresses before the start of machining and the *Contractor* shall submit details of his proposed method to the *Employer's Agent* for his acceptance in writing before starting the treatment. The forging shall be inspected by the *Contractor* using radiographic methods similar to those set out in BS 4080 for steel castings and also using the ultrasonic, magnetic particle and penetrant flaw detection testing techniques set out in BS 4124.

c) The *Employer's Agent* shall be informed in writing of all flaws found by the inspection and the *Contractor* shall not use in the *works* any forging containing flaws unless remedial action is agreed with the *Employer's Agent* and carried out by the *Contractor* to the satisfaction of the *Employer's Agent*.

12.5 Fabrics and Wood

a) Fabrics, cork, paper and similar materials which are not subsequently to be protected by impregnation, shall be treated with an accepted fungicide. Sleeving and fabrics treated with linseed oil varnish shall not be used.

b) The use of organic materials shall be avoided as far as possible but where these have to be used they shall be treated to make them fire resistant and non-flame propagating.

c) The use of wood shall be avoided as far as possible. If used, woodwork shall be thoroughly seasoned teak or other accepted hardwood which is resistant to fungal decay and free from shakes and warp, sap and wane, knots, faults and other blemishes. All woodwork shall be treated to protect it against damage by fire, moisture, fungus, bacteria or chemical attack, unless it is naturally resistant to those causes of deterioration. All joints in woodwork shall be dovetailed or tongued and pinned. Metal fittings shall be of non-ferrous material. Adhesives shall be specially selected to ensure the use of types which are impervious to moisture. Synthetic resin cement only shall be used for joining wood. Casein cement shall not be used.

12.6 Bronze

Where bronze is specified or used it shall be zinc free.

12.7 Bright Parts

Bright parts and bearing surfaces shall be thoroughly polished and protected from corrosion by the application of rust preventive lacquer or high melting-point grease, as accepted by the *Employer's Agent*, before the parts are packed. A sufficient quantity of the correct solvent for removal of the protective compounds shall be supplied and packed with each particular part.

12.8 Aluminium and Aluminium Alloys

Aluminium and aluminium alloys used in mechanical parts shall be for the acceptance of the *Employer's Agent.*

12.9 Adhesives

All adhesives shall be specially selected to ensure use of types which are impervious to moisture and are resistant to mould growth and other forms of attack or deterioration.

12.10 Asbestos

Asbestos and materials containing asbestos shall not be used.

12.11 Plastics

Thermoplastics and fibre reinforced polymers shall be UV resistant, have adequate tensile strength, and high impact strength and generally suitable for the application.

PVC is generally regarded as too brittle and shall not be used unless specified elsewhere or approved by the Employer's Agent.

12.12 Rubber Seals

Rubber, neoprene or EDPM seals shall be provided for all gates in accordance with either ASTM or DIN Standards as follows:

- ASTM D297: Test Methods for Rubber Products -Chemical Analysis
- ASTM D395: Test Methods for Rubber Properties - Compression Set
- ASTM D412: Test Methods for Rubber Properties in Tension
- ASTM D413: Test Methods for Rubber Properties - Adhesion to Flexible Substrate
- ASTM D471: Test Methods for Rubber Properties - Effect of Liquids
- ASTM D572: Test Method for Rubber Deterioration by Heat/Oxygen

- ASTM D573: Test Method for Rubber Deterioration in Air Oven
- ASTM D1149: Test Method for Rubber Deterioration by Surface Ozone Cracking
- ASTM D2240: Test Methods for Rubber Property-Durometer Hardness
- DIN 53504: Determination of tensile stress/strain properties of rubber
- DIN 53505: Shore A and D hardness testing of rubber and elastics
- DIN 53509-1: Determination of the resistance of rubber to ozone cracking under static load
- DIN 53516: Determination of abrasion of rubber
- DIN 53517: Testing of compression set of rubber at constant strain

13 CORROSION PROTECTION

13.1 Design Precautions

a) All Plant shall be designed to suppress corrosion in an exposed environment.

b) Easy access for protection and maintenance shall be provided. The use of back to back angles, partially open box sections or inaccessible stiffeners shall be avoided. Corrosion protection of areas that are unavoidably inaccessible shall be specified by the *Employer's Agent*.

c) Pockets, recesses and crevices in which water and dirt may collect shall be avoided. Water retention areas shall be properly drained by holes as large as possible i.e. 150 mm diameter – minimum 50 mm diameter.

d) Surfaces of corrodible metals, such as the insides of tanks or hollow sections that cannot be protected by any method (e.g. painting or dipping), shall be avoided, or where not possible, be fully sealed against ingress of air and moisture.

e) The parts of all permanent installations embedded in concrete (built-in parts) that are exposed to water (e.g. seal faces and roller tracks) shall be manufactured from stainless steel as specified in the relevant section above. Where such items are connected to carbon steel parts embedded in the concrete, suitable measures as specified or as proposed by the *Contractor* and accepted by the *Engingeer* shall be employed.

13.2 Corrosion Prevention

a) The *Contractor* is referred to the Particular Specification GIBB-007 *Painting and Corrosion Protection* for corrosion prevention requirements.

b) The *Contractor* shall ensure that the following steps are taken to minimise corrosion. Where dissimilar metals are used, coat all surfaces of the whole assembly including the more noble member of the galvanic series.

c) If the noble member of the assembly cannot be entirely covered:

d) Keep the anode/cathode ratio as large as possible in the particular component.

e) Use electrical insulators between two metals. Insulation must be complete; a bolt requires a sleeve as well as washers of an insulating material.

f) Joints and crevices between metals shall be sealed.

g) Where fastening is unavoidable, the fasteners shall be more noble (cathodic) than the base material. Fasteners shall be coated where possible and/or adequately electrically insulated between fasteners and the base material.

13.3 Hot-Dip Galvanized Items

a) The *Contractor* is referred to the Particular Specification GIBB-007 *Painting and Corrosion Protection* for hot dip galvanized items.

14 BEARINGS

14.1 Operation

Bearing designs shall ensure safe shut down without damage following electrical supply failure.

Bearing designs for variable speed drive applications shall be suitable for the full expected speed range.

Rotational bearings shall be designed to rotate in either direction unless the design prevents reverse rotation.

14.2 Design Life for Rolling Element Bearings

Ball and roller bearings shall generally be selected for a design life of 100 000 – 200 000 hours; i.e. the bearing manufacturer's category for machines required to work with a high degree of reliability 24 hours per day.

For shaft sizes above 50 mm, the L-10 bearing life shall be at least 100 000 hours. This may be reduced if the equipment is expected to operate for less than 3 000 hours in a normal year.

14.3 Plain Bearings

Plain bearings; i.e. bearings also referred to as "slide bearings", "oil-film bearings" or "sleeve bearings"; which are oil lubricated shall have lubrication by oil ring, by rotating dish or by pumped feed.

Run down, including run down after a power failure, shall be managed without damage to the bearing.

14.4 Bearing Choice

Bearings shall be chosen primarily to suit the equipment manufacturer's requirements and the plant's design conditions but the following guidelines shall be considered:

a) Greased lubricated bearings are generally acceptable for units with power ratings up to 100 kW.
b) Units with power ratings between 100 kW and 1 000 kW shall preferably be provided with rolling element bearings.
c) Units with high speed shafts, with power ratings above 1 000 kW and with high temperature applications shall preferably be provided with plain bearings (oil film type).

14.5 Thermal Alarms

Thermal alarms on bearing systems shall be set in accordance with the equipment manufacturer's instructions. Alarm settings done on Site shall be set after at least 24 hours of operation have occurred.

If high temperature protection is specified for a bearing, the Contractor shall note the equilibrium temperature reached after 30 minutes of normal operation and shall also note the ambient temperature. The high level trip temperature shall then be calculated as follows:

Ttrip = Tequilibrium + (40ºC -Tambient) + 10ºC. This assumes that the bearing is operating correctly.

15 GEARBOXES

15.1 Motor Driven Gearboxes

a) Gearboxes shall be supplied with environmental protection to IP 55 or higher.

b) Gearboxes shall have an efficiency of not less than 96 % on two stage reduction and 95 % on three stage reduction.

c) The Contractor shall drain and replace oil in all gearboxes during the Defects Notification Period.

d) The **service factor** to be used for the design of gearboxes in uniform load duty shall be at least 1,25 for electric motor driven applications. A minimum service factor of 1,5 shall be used for moderate shock applications and a minimum service factor of 2 shall be used for heavy shock applications.

e) The service factor to be used for engine driven gearboxes shall not be less than 2.

f) Gears shall be case hardened, profile ground and lapped, helical and spiral bevel gears.

g) The gearbox housing shall be of rigid cast construction preferably split in the horizontal plane.

h) Unless close coupled, each gearbox shall be mounted on machined sole plates fitted with jacking screws to assist with alignment.

i) Bearings shall be designed for an L-10 life in excess of 100 000 hours.

j) Oil-bath gearboxes shall have suitable oil level indicators or dipsticks which indicate the allowable levels. Inaccessible oil drain points shall be provided with extensions so that the oil can be easily drained. The drain line shall be of EN Grade 1.4401 (316) stainless steel and shall be fitted with a ball valve and square head plug.

k) Grease lubrication points shall be easily accessible. Grease nipples shall be of stainless steel. A breather designed to prevent moisture from entering shall be fitted.

15.2 Manual Gearboxes

a) An over-torque limiting device shall be incorporated.

b) Grease lubrication points shall be easily accessible. Grease nipples shall be of stainless steel.

c) A breather designed to prevent moisture from entering shall be fitted.

16 LUBRICATION

Grease lubrication is preferred and all greasing points must be easily accessible. Equipment with multiple greasing points shall be provided with grease lines which are piped, separately, to a single easily accessible position.

In cases in which motorised lubrication is provided to more than one destination, a distributor shall be provided. The distributor shall be a positive displacement device which ensures equal, successive lubrication to all destinations.

Pipework for grease distribution shall be of stainless steel or non-ferrous metal.

Oil level indicators shall be fitted for visual checking. Drain cocks, including Grade 316 stainless steel fittings where necessary to permit convenient draining, and plugged at the end, shall be provided for oil reservoirs exceeding 1.5 litre capacity.

All lubrication systems shall be designed so as to exclude dirt and moisture. Air vents on oil reservoirs shall contain an air filter.

17 GAUGES

a) Gauges shall be of industrial construction and shall be glycerine filled for damping. The case and bezel shall be of stainless steel unless this material is unsuitable for the application.

b) Pressure, vacuum or compound gauges shall comply with SANS 1062 and shall bear the Standards mark. Gauges shall be of Accuracy class 1.6 and Durability grade A unless otherwise specified.

c) The scale shall be chosen so that the expected pressure is not less than half full scale reading but the full scale reading for a gauge on the discharge leg of a centrifugal pump shall be higher than the pump shut off head.

d) The gauge reading shall indicate gauge pressure unless absolute pressure measurement has been called for.

e) Gauges shall have a scale diameter of not less than 100 mm. Calibration shall be in kiloPascals with the full scale reading between 1,5 and 2 times maximum actual operating pressure except where otherwise specified. The units of measurement shall be clearly marked on the dial.

f) Wherever applicable, gauges shall be clearly strip marked in green to indicate the normal operating range and in red to indicate the non-permissible range of values.

g) Gauges shall be suitable for continuous operation and shall be liquid filled on all pump applications and where fluctuations in pressure may cause damage. Gauges shall not be mounted directly on equipment subject to vibration. Gauges for pipework larger than DN 250 shall be remotely mounted and isolating valves shall be provided at each end of the connecting pipework.

h) Gauges shall be mounted vertically and in such a position that they can be easily read from floor level. Flanged nozzles for gauge tappings shall be provided on the parent pipework. Nozzles shall comply with the requirements of the clause "Pipework (> DN 100)". Pressure gauges shall be fitted with an isolating and an air bleed valve.

i) A gauge for liquids containing solids shall have its nozzle on the side of the parent pipe and the configuration shall allow easy cleaning of the passageways.

j) Gauges used on wastewater, sludge, chemical, solids conveying or other applications where blockage or corrosion of the gauge is possible shall be fitted with a diaphragm type chemical seal, both being liquid filled. The portion of the seal in contact with the process liquid shall be of a suitable non corroding material.

k) Scale markings shall be radial, plain, straight, black lines on a white background and shall be spaced so that one scale division represents approximately 1,5 % of the maximum scale value in values of 1, 2 or 5 multiplied by any power of 10 to suit the maximum operating rating. On circular gauges the scale shall be concentric and the maximum and minimum scale values shall be near the bottom of the gauge, with the scale symmetrically disposed about the vertical centre line of the gauge. The tip of the pointer shall be of the knife edge type extending across the scale divisions and shall be as close as practical to the dial.

18 BASEPLATES

18.1 General

Equipment and drivers shall not be mounted directly onto a concrete base without the use of either a baseplate or soleplate.

Driven equipment and their drivers shall be mounted on common cast iron or fabricated steel baseplates of rigid construction. Common baseplates shall be provided for direct coupled and for belt driven machines.

In applications where baseplates are not practical, machined soleplates, suitably fixed and grouted into the concrete plinths, shall be provided.

The Contractor shall provide the baseplate, anchor fasteners and chemical anchor for securing the fasteners.

18.2 Design Requirements

Baseplates shall prevent pooling of water and shall be grout filled or shall be provided with drain holes in all side members.

The baseplate shall incorporate machined mounting pads at the support and fixing positions of each item of plant and equipment to be mounted on the baseplate. On fabricated baseplates this machining shall be done after fabrication, stress relieving (if applicable) and hot-dip galvanizing (if applicable) are complete. The thickness of the mounting pads shall be not less than 1.25 times the diameter of the holding down bolts. The pads shall not be provided with threaded holes for machine screws but shall be drilled for inserting through bolts and adequate provision shall made for reaching the nut with a suitable spanner. In the period between machining and installation of the equipment, the machined surface shall be protected against corrosion by a removable coating. After installation, a non-hardening compound, Tectyl or equivalent, shall be applied to exposed machined surfaces and to the crevice formed at the foot of the equipment. The above design may be suitably modified if the Contractor uses a pourable resin based chocking system. Such chocks shall be at least 15 mm thick.

At least two diagonally opposed jacking screws shall be provided for belt tensioning in the case of belt driven units. Direct coupled motors above 10 kW shall be provided with jacking screws for horizontal alignment and direct coupled motors above 150 kW shall be provided with jacking screws for vertical alignment as well. Jacking screws shall be of EN Grade 1.4401 (316), or better. Drilled and tapped flat plate is not acceptable for jacking points. A jacking point shall consist of a suitable hot rolled steel section welded to the baseplate and with a captured machine nut to accept the jacking screw.

18.3 Fabrication

Fabrication shall comply with the clause “Structural Steelwork Fabrication” and welding shall comply with the clause “Welding”.

Baseplates shall be manufactured of either:

- hot rolled steel sections.
- bent plate (with the overall length not more than 200 X plate thickness).

Practical requirements for providing accessibility for surface preparation and coating shall be taken into consideration. Inaccessible pockets shall be avoided. Hollow spaces which cannot be accessed by blast and spray equipment shall be avoided or shall be welded closed. All such hidden surfaces shall not be permitted.

Inspections of carbon steel fabrications will generally be done after fabrication is complete.

18.4 Materials

Baseplates shall be fabricated from Grade 300WA steel or superior.

1.1. Corrosion Protection

Steel baseplates shall be hot dip galvanized.

The requirements of the clause “Corrosion Protection” shall be followed if the item is to be hot-dip galvanised. Designs shall provide proper access for safe and proper entry of the zinc into open spaces so that subsequent drilling at the galvaniser’s yard is avoided

18.5 Corrosion Protection

Anchor fasteners shall be of EN Grade 1.4401 (316), or better. Fasteners shall comply with the clause “Fasteners”.

A minimum of six anchors shall be provided for pumps with an inlet of DN 150 and smaller.

Eight or more anchors shall be provided for pumps with an inlet larger than DN 150.

Pumps with an inlet of DN 100 or smaller shall have anchor bolts of at least 12 mm. Pumps with an inlet larger than DN 100 shall have anchor bolts with a diameter no less than 12 + (Ø-100)/25.

1.2. Installation

Not more than three shims may be used at any point and these must be made of a corrosion resistant material.

Concrete surfaces under baseplates shall be scabbled before the baseplate is placed and shall be blow clean using compressed air immediately before grouting.

Baseplates shall be designed and grouted to eliminate collection points for water or dirt. Except where otherwise approved in writing by the Employer’s Agent, all baseplates on concrete plinths shall be fully grouted in. Grouting holes must be provided on baseplates having a continuous top plate. Tapped holes and fixing setscrew protrusions shall be suitably protected. The material used for grouting shall be a non-shrink, cementitious grout (ABE Duragrout 1000, or equivalent). ABE Epidermix 324, or equivalent, is acceptable if the Contractor’s design requires an epoxy grout to be used. The initial grouting shall be overseen by the grout supplier's technical representative.

Preliminary alignment of equipment mounted on baseplates shall be done at the factory to ensure that the baseplate has been correctly manufactured, but final alignment shall always be done on Site after installation and grouting has been completed. Alignment shall be accurate and to the approval of the Employer’s Agent and a final alignment check witnessed by the Employer’s Agent must be carried out by the Contractor prior to start up.

18.6 Inspection

The Contractor shall arrange for the Employer’s Agent to inspect the fabrication of the baseplate before it is hot dip galvanized.

19 MACHINE GUARDS

Guards shall comply in all respects with the Occupational Health and Safety Act of 1993 as amended and the following points shall also be noted:

Guards are required to cover all moving or revolving components of machinery and shall:

- Be such as to adequately cover all moving protrusions such as couplings, keys, lock nuts, lock washers, sets crews, and the protrusion.
- Be neatly and rigidly constructed and fixed so as to not vibrate or cause noise during operation of the plant.
- Enable adjustments to be made where required such as on belt guards.
- Be fixed with M10 or larger hex head bolts and shall be of EN Grade 1.4401 (316) stainless steel.
- Be easily removable for maintenance purposes.
- Guards shall preferably be fabricated of EN Grade 1.4401 (316) stainless steel (uncoated) but may also be hot dip galvanized, hot metal zinc sprayed or hot metal aluminium sprayed carbon steel, coated to Specification in all these cases.
- Comply with the requirements of BS 1649 or equivalent standard.

Mesh shall not be used for chain guards but, on belt drives, the side of the guard most conveniently sited for inspection, shall be constructed of expanded metal or similar.

Mesh should similarly be used in other situations where inspection or ventilation is required. Where expanded metal or similar mesh is used, the mesh opening shall not permit a circular object 10 mm or larger to penetrate.

20 SHAFT COUPLINGS

Shaft couplings shall be selected to reduce transmission of misalignment forces and of torsional oscillations between the driving and driven machine. Couplings shall, wherever practical, be of the rubber type or rubber compression type, keyed to the shafts.

Elastomeric elements shall be urethane based. Flexible metallic elements shall be of stainless steel. Couplings shall not require lubrication.

Spacer couplings shall be used in all cases where this will assist maintenance.

Coupling guards shall comply with the requirements of the OHS Act and shall be to the approval of the Employer's Agent.

After installation, the alignment of all couplings shall be checked by the Contractor in the presence of the Employer's Agent or a person delegated by him. Alignment shall be accurate and to the approval of the Employer's Agent.

21 GRID FLOORING

21.1 General

The Contractor is responsible for the design of the grid flooring system. The Contractor shall confirm all measurements on Site prior to submitting dimensioned details to the Employer's Agent for approval. These details shall be presented on drawings which comply with the requirements of SANS 10111.

The depth of bearer bars in metal grid flooring shall not be less than 30 mm with a bearer bar pitch of not greater than 40 mm. The bearer bars shall be across the shorter span.

Panels shall be set level and fixed to angle frames to prevent rocking.

Cut outs in grid flooring for pipes, valve spindles, etc. are to be made and fully banded before any corrosion protection is done. The edges of removable grid access covers must also be fully banded.

Unless another material (such as stainless steel) is specified, grid flooring and frames shall be of carbon steel, hot dip galvanized after fabrication. Painted coatings are not acceptable.

Where grid flooring rests on painted surfaces, strips of rubber insertion material shall be secured under the grid to protect the paint.

21.2 Fixing

The fixing clip set (saddle clamp and locking plate) shall be of hot dip galvanised steel or stainless steel. Fasteners shall be of EN Grade 1.4401 (316), or better, unless otherwise specified in the drawings and schedule of quantities.

21.3 GRP Grid Flooring

GRP grid flooring is acceptable only where specified in the drawings and schedule of quantities.

The resin used for all GRP components of grid flooring shall contain a UV stabiliser.

The design shall ensure the prevention of fibre prominence for a period of at least ten years.

External grp components and all internal components subject to direct sunlight shall, in addition to the UV stabiliser in the resin, be provided with a polyurethane based UV protective coating to a thickness of at least 25 micron. A suitably stabilised flow coat will also be acceptable. The coat shall be provided over the full surface.

21.4 Installation

Grid flooring shall be mounted firm and level and shall be of neat and workmanlike appearance, solidly and evenly supported, true to line, level, plumb and in proper working order.

Panels shall be set level and fixed to frames to prevent rocking. No perceptible movement will be acceptable.

The Contractor shall provide all components required for the support and fixing of the flooring.

Adjacent floor pieces shall have vertical edge alignment of within 5 mm of each other.

22 ACCESS LADDERS, PLATFORMS AND HANDRAILS

All access ladders, platforms, handrails, covers, etc., shall be in accordance with the Occupational Health and Safety Act, Act 85 of 1993 and the Drawings.

22.1 Ladders - General:

a) All ladders, platforms, cover plates, kerbings and appurtenant parts located in wet or wet/dry conditions shall be fabricated from 304L stainless steel.

b) All ladders, platforms, cover plates, kerbings and appurtenant parts located at the outside of civil structures shall be manufactured of mild steel and hot dip galvanized.

c) All internal ladders, platforms, cover plates, kerbings and appurtenant parts shall be manufactured of mild steel and hot dip galvanized.

d) Access points to the head of ladders from platforms and walkways shall be protected by self-closing gates or by chains.

e) No part of a ladder may project into a passageway.

f) The clear width between stringers shall be no less than 500 mm.

g) A minimum clear space of 230 mm must be allowed behind the rungs.

h) The diameter of the rungs shall be between 20 mm and 50 mm.

i) Additional rungs shall be provided in the same horizontal plane as the top rung in order to close the gap between the platform and the ladder. Sufficient rungs shall be

provided to ensure a maximum gap of 75 mm. These top rungs shall be at the same level as the floor or platform to which access is being provided.

j) Stringers shall be formed from flat plate or channel sections. The vertical distance between the ladder support brackets shall not exceed 1 800 mm.

k) The stringers shall extend to 1 100 mm above the floor or platform and shall be matched with any hand rail protections at this level. Connections between hot-dip galvanised steel ladders and stainless steel hand railing shall be bolted. Unless laterally supported by the hand rails, these stringers shall be supported by vertical structural sections (not flat bar) whose bases shall comply with this specification for hand rail stanchion bases.

l) All rises in a flight shall be uniform and the surface of the top rung shall be level with the top platform or landing. The height chosen for the rise shall be between 225 mm and 255 mm.

m) Except on chimneys, the height of a ladder should not exceed 6 000 mm. Greater heights shall be provided with intermediate landings between each 6 000 mm ladder sections.

n) If the height between start and end levels is over 4 000 mm, the ladder shall be fitted with a safety cage. The safety cage shall extend at least 1 000 mm above the higher landing. The cage shall be no more than 700 mm away from the plane of the rungs and shall comprise no fewer than seven vertical elements.

o) Anchor bolts shall be of Grade 316 stainless steel and shall be no smaller than M16.

p) Stringers, rungs and anchor brackets shall be of solid structural sections (e.g. flat bar, round bar, square bar, angles, etc.) and no hollow sections will be accepted for any part of the ladder.

22.2 Cat Ladders

Cat Ladders: Where not shown and dimensioned on the Drawings, cat ladders shall be manufactured as follows:

a) The sides of the cat ladders shall consist of flats, the size depending on the length but in any case shall not be less than 70 mm x 12 mm, and the inside width shall not be less than 380 mm. The rungs shall consist of round bars, not less than 22 mm diameter at 250 mm centres holed through the side stringers, welded all around on both sides of the flats and ground flush on the outside. If it is not possible for any reason to adopt the rung centres stated above the pitch adopted must be not less than 230 mm and not more than 255 mm. The length of each ladder shall not exceed 7 m and shall be suitably supported over its whole length.

b) The cat ladders shall be vertical and provided with safety hoops of 700 mm diameter. The bottom safety hoops on each ladder shall be 2.50 m from the floor or landing level. The side stringers of all ladders shall be extended nominally one metre above the first rung to provide a handhold. Entries to the tops of cat ladders shall be suitably guarded by an entry bar.

22.3 Platforms

Platforms shall be provided where applicable. All landing covers shall be of the open grille type. This open grille shall be suitable for a floor loading of not less than 500 kg/m^2 and bar sections shall not be less than 39 mm x 3 mm and the platforms shall be designed accordingly. Kicking plates or angles shall be fixed around all platforms and shall extend 150 mm above the top of the flooring.

22.4 **Handrails**

22.4.1 General

a) Handrailing shall comply with inter alia, SANS 10104 and shall be in accordance with legislated requirements and shall be provided generally in positions where the vertical difference in level is 1 000 mm or greater.

b) Guard railing shall be designed to resist, without any damage and without excessive deflection, the loadings in Category E in Table 7 in Clause 9.4 of SANS 10160 2:2011, Edition 1.1, namely:

- A force of 1 000 Newtons in any direction (concentrated over a length of 100 mm).
- A distributed horizontal force of 1 000 Newtons per metre applied along the top rail.

c) Handrailing shall comply with inter alia, SANS 10104 and shall be in accordance with legislated requirements and shall be provided generally in positions where the vertical difference in level is 1 000 mm or greater.

d) All handrailing shall comprise hand and knee rails not less than 32 mm diameter and stanchions spaced at not more than 1,8 m except where specifically directed otherwise in writing by the Employer's Agent. All components shall be supplied in the pickled and passivated condition which may also be polished. All surfaces must be uncontaminated and unmarked to ensure maximum corrosion resistance.

e) Handrails shall be provided along the exposed edges of all platforms and elsewhere as shown on the Drawings. All handrailing shall be tubular but the standards may be tubular or solid forged. Angle irons shall not be used.

f) The height to the top handrail from the finished platform or floor level shall be 1.10 m and the height to the top of the lower handrail shall be 550 mm. All handrails shall be equivalent in size and stiffness to BS 1775 Grade 13, 33.7 mm O D heavy duty tube or equivalent standard.

g) Stanchions and rails shall be smoothly finished and free from sharp corners, edges and projections which may injure persons or damage clothing. Stanchion bases shall have the corners rounded off.

h) The tubular rails shall be joined using the slip-jointing method with separate and neatly fitting tubular inserts fitted into the railing bore. If stainless steel pins are used they shall have their ends peened over and smoothed or, if taper pins are used, they shall be filed off flush with the rail. The joints shall withstand the required loads when situated in any position including centrally between two stanchions. Joints shall preferably be located inside the stanchion balls.

i) Railings shall be ended off with positively fixed (pinned) closure bends. At corners, short radius bends with stanchions on both ends shall be employed or, alternatively, stanchions specifically designed for such a position shall be employed. No sharp endings will be permitted.

j) Stanchions shall generally be base-mounted but can be side mounted to suit the arrangement requirements and shall be of solid or welded construction. Welding shall be compatible with the material, shall not impair the strength or corrosion resistance of the material, shall be continuous and shall be smoothly finished and then passivated.

k) Stanchions shall be self-draining to suit the mounting arrangement.

l) Holes for the rails to go through the stanchions shall have a diametral clearance not exceeding 1 mm but preferably 0,5 mm. On stairways with stanchions vertically

mounted, the hole shall be angled to suit and shall accurately fit the angled rail with the abovementioned clearances.

m) Stanchion bases which are attached to metallic surfaces shall have minimum dimensions of 150 mm x 60 mm. Two fasteners, of minimum size M16, shall be used to attach the base which must have a material thickness shall be not less than 8 mm.

n) Stanchion bases which are attached to non-metallic surfaces shall have minimum dimensions of 150 mm X 150 mm. In instances where the horizontal surface to which the base is to be fastened is less than 150 mm wide, the base shall be designed to be seated on at least two surfaces. Four fasteners, of minimum size M16, shall be used to attach the base to the concrete. Base material thickness shall be not less than 10 mm. Non-shrink, cementitious grout shall be applied under the foot just prior to final tightening of nuts.

22.4.2 Mild Steel Handrails

a) Fabrication and welding shall comply with the clauses “Structural Steel Fabrication” and “Welding”.

b) The guard rails shall be hot-dip galvanised in accordance with the relevant clauses pertaining to the hot-dip galvanizing of carbon steel.

c) Designs shall provide proper access for safe and proper entry of the zinc into open spaces so that subsequent drilling at the galvaniser’s yard is avoided.

d) If the guard rails are welded or cut after hot-dip galvanising, they shall be returned to the galvaniser for re-galvanising.

22.4.3 Stainless Steel Handrails

Where stainless steel has been specified, all handrailing shall be of EN Grade 1.4301 unless otherwise specified.

22.4.4 Fasteners

a) All anchor fasteners, including nuts and washers shall be of EN Grade 1.4401 (AISI 316) stainless steel.

b) Fastener diameter shall not be less than M12.

22.5 **Cover Plates and Kerbings:**

a) Cover plates, kerbings and appurtenant parts located in wet or wet/dry conditions shall be fabricated from 304L stainless steel.

b) Cover plates, kerbings and appurtenant parts located at the outside of civil structures shall be manufactured of mild steel and hot dip galvanized.

c) Cover plates, kerbings and appurtenant parts shall be manufactured of mild steel and hot dip galvanized.

d) All open grill type covers shall be suitable for a floor loading of not less than 500 kg/m2. All raised tread non-slip type plate covers shall be of "Durbar" pattern and shall also be suitable for a floor loading of not less than 500 kg/m^2 but in any case shall not be less than 8 mm thick on the plain plate and shall be reinforced if and where necessary.

e) The covers and supports shall also be designed to take account of any special loadings that may be imposed during erection or maintenance. All heavy duty covers shall be designed for HB loading.

f) The kerbings shall consist of rolled stainless steel angles suitably anchored and the landings for the covers shall not be less than 40 mm wide. Removable supports shall be provided where necessary.

23 FASTENERS

23.1 Standards

a) Bolts and nuts shall be hexagon head type complying with SANS 1700 with threads of the coarse pitch series.

b) Nuts, bolts, studs and washers for incorporation in the works shall conform to the requirement of the appropriate British or other accepted standard.

c) Bolts shall be of such standard length that a minimum of two to four complete threads shall show through the nut when in the fully tightened condition.

d) Mating surfaces shall be adequately protected against corrosion whilst awaiting assembly of the faces and bolting all to the acceptance of the Employer's Agent.

e) Galvanized nuts and bolts shall be avoided, except for handrails and ladders. Use stainless steel in lieu of galvanized where anticorrosion properties are required, with due regard to galvanic corrosion due to dissimilar metals.

f) All bolting shall comply with the general requirements of BS 5400.

g) Double washers shall be used for all nuts and bolts.

23.2 Materials

a) Fasteners in non-corrosive areas shall, except when specified otherwise, be mild steel construction and hot dip galvanized.

b) Fasteners in corrosive areas shall be of EN Grade 1.4401 (316) or better. Corrosive areas shall be taken to include any moist or wet area such as in and above settling tanks, in or in the vicinity of open channels, where a spray can be expected.

c) M12 fasteners and smaller shall be of EN Grade 1.4401 (316) or better.

d) Fasteners larger than M12 which are in non-corrosive areas shall, except when specified otherwise, be hot dip galvanized.

e) Plated fasteners are not acceptable.

23.3 High Tensile Bolts

Where high tensile bolts are required by the design, they shall be hot dip galvanized and painted. The bolt holes and crevices shall be filled and sealed prior to painting.

23.4 Anchor Fasteners

a) Anchor fasteners shall be of EN Grade 1.4401 (316), or better.

b) Anchor fasteners for water retaining structures and for brickwork shall be of the chemical anchor fastening type. Other anchors may be of the expanding type or chemical anchor type.

c) Where hook bolts are used, these shall be supplied and grouted by the Contractor into pockets which will be provided in the concrete structure in accordance with the information to be supplied by the Contractor. The grouting products shall be used strictly in accordance with the manufacturer's instructions.

d) Where machinery is anchored by studs or bolts which extend through the supporting structure and is therefore fastened down with the use of nuts from both sides, the studs or bolts, together with associated washers and brackets, shall also be of EN Grade 1.4401 (316), or superior.

e) Submerged anchors shall be secured with chemical anchor designed for submersion.

23.5 Material Compatibility

Fastener material shall always be of equal or better corrosion resistance than the items being fastened, e.g. EN Grade 1.4401 (316) bolts must be used to fasten together EN Grade 1.4401 stainless steel flanges and fabrications.

23.6 Washers

a) Flat washers shall be provided under nuts and setscrew heads.
b) Flat washers shall be provided under bolt heads on painted surfaces.
c) Flat washers shall be provided under bolt heads where the bolt is positioned in a slot.
d) Spring washers shall be used on fasteners subject to vibration (other approved locking arrangements will also be acceptable on proprietary equipment).
e) Anchor bolts for machinery shall each be provided with a flat washer and a spring washer (other locking arrangements are not acceptable).
f) Washers shall be of the same material as the fasteners.
g) Flat washers exhibiting visual deformation shall be replaced by thicker washers.
h) Washer material should match that of the bolt and nuts, or as specified elsewhere.
i) Double washers shall be used for all nuts and bolts.

23.7 Anti-Seize Compound

Before assembly, stainless steel threads shall be treated with a nickel-based, anti-seize/corrosion protection compound such as Chesterton 725: Nickel Anti-Seize Compound, or equivalent. Copper based compounds are not acceptable.

A small amount of the compound shall be applied along the full length of the exposed thread before fastening. Excessive compound visible on the thread after the nut has been applied shall be cleaned off.

23.8 Thread Projection

Bolt threads shall project no less than 3 threads and no more than 8 threads from the head of the nuts when fixed. Longer projections will only be allowed if the Contractor can show that bolts of a more suitable length are not manufactured.

23.9 Corrosion Protection

After installation, the exposed surfaces of fasteners not of stainless steel shall be coated as for the items being fastened.

If the use of Allen head or similar fasteners has been approved by the Employer's Agent, the recessed heads shall be filled with a suitable non-hardening sealing compound.

24 SIGNAGE

24.1 General

All signs as specified below shall be installed prior to commissioning.

24.2 Operating Instructions

Operating instructions shall be framed and shall be attached to the wall in the control room using brass screws. The frame shall be of aluminium with a glass front and hardboard backing. They shall include the following:

- Start up, Shut down and Operating instructions shall be comprehensive and shall indicate actions to be taken in the case of all alarm conditions. These shall be written from the point of view of the plant operator.
- A layout drawing of the equipment installation.
- A process flow diagram.
- A P&ID.

24.3 Safety Signage Requirements

Safety signs shall be suitably framed or encapsulated. Symbolic signs shall comply with SANS 1186. The wording of the signs shall be approved by the Employer's Agent prior to final printing. They shall be provided by the Contractor in appropriate places on the walls of the plant room and shall include the following:

- All statutory and special safety warning instructions.
- Course of action during/after electrical shock.
- Any operating restrictions for equipment.
- Operating instructions in cases of plant trip and electrical supply failure.
- Spares list

25 NAMEPLATES, RATING PLATES AND LABELS

a) Where appropriate each item of Plant shall have permanently attached to it in a conspicuous position a nameplate upon which shall be engraved or stamped the manufacturer's name, type and serial number of Plant, Contract No., order no., date of manufacture, mass, material and all necessary information relating to the supply and replacement of parts and details of the loading and duty at which the item of Plant has been designed to operate. A nameplate denoting the Plant or function identification number shall also be attached. Such nameplates shall be of stainless steel.

b) Labels shall be provided for every panel to describe the duty of or otherwise identify every instrument, relay or item of control equipment mounted externally and internally.

c) Externally fitted panel labels shall be of non-plastic, durable, weather resistant material with letters and numbers engraved and filled with black.

d) Internally fitted panel labels shall be finished white and engraved letters and numbers filled with black, laminated material such as "Trifoliate" or rear engraved and filled plastic may be used. Embossed materials and techniques will not be accepted.

e) Labels shall also be provided in conformity with the above requirements or by other accepted means wherever necessary to designate panels or panel sections, to provide warnings or reminders of dangerous or potentially dangerous circumstances and wherever called for elsewhere in this Specification.

f) Danger labels, e.g. "DANGER-380V AC" shall be coloured red with white lettering.

g) Caution labels e.g. "CAUTION-ISOLATE BEFORE REMOVING COVER" shall be white with red lettering.

h) Where withdrawable equipment is provided both fixed and moving portions shall be suitably identified.

i) Labels shall be of uniform design and the display of manufacturers' standard nameplates on panel external surfaces shall be subject to the acceptance of the *Employer's Agent.*

j) Details of proposed inscriptions shall be submitted to the *Employer's Agent* for acceptance before any labels are manufactured.

k) All nameplates and labels shall be fixed using non-corrosive fasteners to the acceptance of the *Employer's Agent*. Adhesive only shall not be acceptable.

26 NOISE CONTROL

26.1 General

Noise emitted by equipment shall be kept to a minimum and shall not exceed the noise levels specified in these documents.

26.2 Noise Levels

The sound power of any equipment shall not exceed 89 dB(A) (referred to 10-12 Watts) unless specifically approved by the Employer's Agent. This is approximately equivalent to a sound pressure level of 81 dB(A) at a radius of one metre from the acoustical centre assuming uniform hemispherical propagation in a free field on a hard floor. In certain instances, a lower noise level may be called for.

Where the Contractor is unable to restrict the noise level of the machines to the maximum specified by the appropriate selection of suitable equipment; e.g. by selecting slow speed or silent type machines, quiet type cooling fans, suitable silencers, etc.; the Contractor shall inform the Employer's Agent so that appropriate steps can be taken to counteract the effects of noise.

26.3 Acoustic Treatment

Standard acoustic enclosures shall be provided where called for.

Acoustic treatment of high noise sources shall be provided where this can be done without greatly interfering with operation or maintenance.

If acoustic lagging of pipework or ducting is specified, this shall consist of pre-formed rockwool encapsulated in stainless steel sheet metal. Alternatively, a 100 mm thick layer of rockwool having a density of 60 kg/m3, suitably fixed in place and reinforced to prevent collapse, and covered with 25 mm thick asbestos free plaster having a density of 1 000 kg/m3 (I.P. Insultex AF720, or equivalent). The outer surface shall be finished off with scrim cloth before being painted.

It is not normally necessary to lag flow meters and cast iron valves on acoustically lagged pipelines.

Components which can move, such as those associated with expansion bellows or mechanical couplings, shall be enclosed by an effective acoustic enclosure designed to prevent sound transmission but able to cope with movement without damage.

27 ERECTION, SETTING OUT AND INSTALLATION OF PLANT AND EQUIPMENT

27.1 General

When installed, the plant and equipment shall be of neat and workmanlike appearance, solidly and evenly supported, true to line, level, plumb, and in proper working order.

The Contractor shall provide all foundation bolts, supports, hangers, brackets, etc. required for the support and fixing of all equipment.

All pumps, pipework, valves and fittings shall be securely fixed and supported so as to impose no undue stress on any pump casing and the prices tendered shall include for the supply and installation of all supports and fixings in this regard.

27.2 Puddle Pipes

Where pipes pass through concrete walls, the Contractor shall install the pipework and shall grout the pipes into the structure using a suitable non-shrink grout approved by the Employer's Agent. The Contractor shall provide a water tight installation and shall be responsible for rectifying any leakage at the puddle pipe.

Where pipes pass through brick walls, the Contractor shall build these in achieving a finish to match the surrounding wall.

27.3 Grouting

27.3.1 General Duties

Concrete for embedding built-in parts shall be supplied, mixed and placed in accordance with specified requirements as approved by the *Employer's Agent*.

Grout for the connection between bed plates and machinery and concrete shall be non-shrink epoxy grout and shall be mixed and placed in accordance with the approved Drawings.

27.3.2 Approval of Grouting Materials and Methodology

The method proposed for anchoring and grouting equipment into concrete structures shall be submitted to the Employer's Agent for approval and shall incorporate the details of the non-shrink grout proposed. The material used for grouting shall be a non-shrink, cementitious grout such as ABE Duragrout 1000, or equivalent. ABE Epidermix 324, or equivalent, is acceptable if an epoxy grout is required

Non-shrink grout shall:-

- Have a compressive strength not less than 4 times the maximum stress to be transmitted;
- Be subject only to compressive stress;
- Be such that air voids are eliminated between bed plates and machinery and concrete;
- Be completely resistant to lubricants, hydraulic fluids and diesel fuel;
- Have a bond strength to concrete exceeding the tensile strength of the concrete; and
- Have a bond strength to steel not less than (v) above.

Cavity and contact grouting behind bellmouth intake linings shall be done, following precise alignment to line, plane and level. When the grouting is complete the *Contractor* shall fill all grout holes in the lining with the screwed and welded steel plugs to give a flush surface on the inside of the lining.

27.3.3 Building in of Pipework

Pipework shall be firmly secured and checked for movement before shuttering is built. The profile of the soffit shall be prepared so that pockets of air and water will not form on the top surface of the grout. At this point, the Employer's Agent shall be called to inspect the pipe, the cleanliness of the wall penetration and the profile of the soffit. The "letter box" spout shall ensure that at least 100 mm of head is applied to the grout once the pour has been completed and shall also allow entry of a poker vibrator during the pour. The pipework shall be checked a second time for movement after the shuttering is built.

The grout mix and pour shall be done in the presence of the Employer's Agent unless otherwise required.

27.4 Alignment of Shafts

Shafts for drives, such as motors, shall be accurately aligned using laser aligning equipment.

Final alignment shall be carried out after installation and an alignment certificate shall be submitted to the Employer's Agent before commissioning. Alignment shall comply with the manufacturer's recommendations and be sufficiently accurate to ensure that there are no adverse effects as a result of the out of alignment tolerances.

27.5 Installation of Pipework

Pipes and fittings shall be selected to suit the application and shall be neatly installed, straight to line and level, and adequately supported and shall operate without vibration. Adequate provision shall be made for expansion and contraction due to variations in temperature or pressure.

All pipework shall fit perfectly and be so arranged and supported that it shall not impart stresses to any other plant or equipment.

Unless otherwise stated in the Project Specification, drawings or schedule of quantities, all pipework to be built into or in contact with concrete structures shall be 6 mm thick Grade 304 stainless steel.

All pipework shall be suitably equipped with the requisite tapped bosses, isolating cocks, supports, fixings and everything necessary for attaching site pressure testing apparatus and controls and for satisfactory operation of the plant.

27.6 Pipe Supports

a) Pipe supports shall be so located that when an item of mechanical equipment is removed, the associated valves and pipework will still be adequately supported.

b) Supports shall be provided under or close to heavy items such as valves.

c) Supports shall be provided close to all heavy items such as valves of size DN 300 and larger.

d) Pipework shall not place any external loads on items of mechanical equipment such as pumps, compressors, etc.

e) Adequate provision shall be made for expansion and contraction due to variations in temperature or pressure.

f) Proposed designs of pipe supports shall be submitted to the Employer's Agent for approval prior to manufacture. The calculations for pipe supports designed to withstand the thrust from reducers, bends and check valves shall also be submitted to the Employer's Agent for approval.

g) Pipe supports which only support the weight of horizontal pipework may be of the sliding type and shall be vertically adjustable.

h) Pipe supports which resist thrust forces shall incorporate doubler plates on the pipe which are contoured to match the pipe. Other reinforcing designs are also available.

i) Low carbon steel supports shall be fabricated from heavy duty hot rolled steel sections. The complete assembly shall be hot-dip galvanised after all fabrication is completed. Welds shall be continuous "all round"; i.e. no crevices.

j) Stainless steel supports shall be fabricated of plate with a minimum thickness of 4,5 mm or shall be fully triangulated, boxed or closed sections. Welds shall be continuous “all round”; i.e. no crevices.

k) At least four anchor fasteners shall be provided for the foot of each pipe support. Anchor fasteners shall be of EN Grade 1.4401 (316) stainless steel.

l) For cantilevered pipe supports, the spacing between anchor fasteners on the foot shall be not less than one quarter of the cantilevered length. Gussets between the column and the foot are normally required and these shall be positioned so as to minimise the distance between the gusset and the bolt hole. This requirement does not apply to supports which only provide vertical support.

m) The maximum spacing between pipe supports for steel (including stainless steel) pipe of diameter, d [mm], shall be calculated as follows: Spacing (mm) = 1 000 + 10d. This applies to pipe only. Valves or other heavy fittings which shall be provided for separately as required. (Pipe support spacing distances for non-metallic pipework shall be half of the above.)

n) The maximum spacing between pipe supports for plastic pipe of diameter, d [mm], shall be calculated as follows: Spacing (mm) = (1 000 + 10d) / 2. This applies to pipe and not to valves or other heavy fittings which shall be provided for separately as required.

o) Where appropriate, 3 mm thick neoprene strips shall be placed between pipes and supports or clamps to protect the paintwork and to limit corrosion.

p) Where roller or sliding supports are used to accommodate movement, suitable wear blocks shall be fixed to the pipe to prevent damage.

q) Floor and wall mounted pipe supports shall be aligned using nuts above and below the foot. A space of at least 20 mm shall be left between the foot and the floor and this space shall be filled using non shrink grout once alignment has been completed. Grouting shall be done in accordance with the manufacturer’s instructions. Alternative designs and installations may be submitted by the Contractor.

r) Concrete surfaces under foot plates shall be scabbled before the support is placed and shall be blown clean using compressed air immediately before grouting.

s) Where the Employer’s Agent approves the use of concrete pipe supports, these will be constructed after installation of the pipework and temporary supports shall be provided by the Contractor in positions which will not interfere with the construction of concrete supports.

t) Fabrication and welding shall comply with the relevant sections of this specification.

u) Corrosion Protection shall comply with the relevant sections of this specification, and the related specification on corrosion protection.

v) Stainless steel shall be correctly pickled and passivated. All stainless steel surfaces shall be completely clear of ferrous stain upon completion.

27.7 Installation of Instruments

All measuring instruments shall be installed in accordance with the recommendations or instructions of the instrument manufacturer, for the particular application. Each mounting position shall be chosen to give correct operation of the equipment, faithful reproduction of the quantity to be measured, ease of operation, reading, maintenance and servicing, and freedom from any condition which could have adverse effects.

28 INSPECTION AND TESTING

Refer to GIBB-019 *Control, Integration and Commissioning* for inspection and testing requirements.

29 COMMISSIONING

Refer to GIBB-019 *Control, Integration and Commissioning* for commissioning responsibilities.

30 MEASUREMENT AND PAYMENT

30.1 General

Unless otherwise specified in the Project Specifications, measurement and payment will be as specified hereafter.

a) For the mechanical equipment the unit of measurement will generally be the number of the specific item to be supplied and installed, unless specified otherwise.

b) Different items will generally be included in the Bill of Quantities for different stages, e.g.:

- Supply and delivery on site.
- Erection, installation, site testing and commissioning.
- Maintenance (sometimes not itemised separately).

c) Measurement will be specified in each section for the specific equipment. Typical examples of payment items are listed hereafter.

30.2 Detail preparation of drawings

Detail preparation of drawings (describe equipment) ……Unit: lump sum (Sum)

The tendered sum shall cover the cost of the detailed preparation of working drawings as required in terms of the CLAUSE 5 ABOVE

30.3 Manufacture, Supply and Delivery on Site at Point of Installation

Manufacture, Supply and Delivery on Site at Point of Installation (describe equipment) ……Unit: lump sum (Sum)

The tendered sum shall cover the cost of manufacture, procurement, supply, loading, off-loading, transport, storage and delivery to site including all costs for labour, plant, equipment, tools, consumables, attendance, overheads, profit and all other costs to execute all the work as specified in this Contract. The rate or price shall also include the design, preparation of drawings and fabrication as necessary and as scheduled.

30.4 Erection, Installation, Site Testing and Commissioning of the Equipment and Materials

Erection, Installation, Site Testing and Commissioning of the Equipment and Materials (describe) ……Unit: lump sum (Sum)

The tendered sum shall cover the cost of loading, off-loading, storage on site, transport on site, hoisting, erection, installation, painting, grouting, site testing, liaison, commissioning, running for a 48 hour continuous test run, training of the Employer's personnel and preparation and production of both the draft and final Operation and Maintenance Manuals as well as maintenance for 12 months if no separate item is scheduled, including all costs for labour, plant,

equipment, tools, consumables, attendance, overheads, profit, additional site visits and all other costs to execute all the work as specified.

Installation and commissioning may be scheduled separately as necessary.

In respect of the amounts tendered against the relevant items of the priced Bill of Quantities, payment will be effected as follows:

Partial payments of the amount tendered against each item in accordance with the progress of the work on a basis of the ratio of the value of the work carried out pro rata to the total value of the work on completion or such other basis as the Employer's Agent may determine up to a maximum of 80 percent of the amount tendered against each item on completion of site testing, commissioning. The final 20 percent will only be paid upon completion of the 48 hour continuous test run and the final copies of the Operating and Maintenance Manuals have been submitted and approved.

30.5 Essential Tools

Essential tools ……Unit: lump sum (Sum)

Supply to site one complete set of all specialised tools required for the operation and maintenance of the equipment supplied as part of this contract.

30.6 Grouting and Machining of Baseplates

Supply, handle, install complete

No separate payment will be made for the grouting and machining of baseplates. The cost of grouting and machining shall be deemed to be included in the scheduled rates for the applicable items.

30.7 Storage

Storage ……Unit: lump sum (Sum)

No separate payment will be made for storage. All costs associated with the need to temporarily store equipment shall be deemed to be included in the scheduled rates.

HARRY GWALA DISTRICT MUNICIPALITY

CONTRACT NO: HGDM748/HGM/2021

CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM: CIVIL, MECHANICAL & ELECTRICAL

PARTICULAR SPECIFICATION

GIBB 003 – GENERAL PUMP

REV 1.1

Table of Contents

Table of Revisions

Revision	Date	Change Detail	Editor
1.0	December 2020	Initial Release	C. Maine / M. Holmes
1.1	March 2021	Changed Pump Witness Testing to SANS 9906 Grade 1E (with efficiency included as a guarantee requirement). and SANS 9906 Grade 2B	M. Holmes

1 SCOPE

This Specification deals with the manufacture, supply, performance guarantees, installation, testing and commissioning of pumps (sizes DN 100 to DN 600 and pressures PN 10 to PN 25) for handling potable and raw water.

The installation shall be as shown on any applicable drawings provided with the tender documents.

The numbers and sizing of equipment to be provided are specified on any applicable drawings provided with the tender documents.

This Specification is to be read in conjunction with the applicable Project Specification.

2 INTERPRETATIONS

2.1 Normative References

The following Particular Specifications are referred to in this Specification:

a) GIBB-002: General Mechanical Specification
b) GIBB-004: Project Specific Pump Specification
c) GIBB-007: Painting and Corrosion Protection
d) GIBB-011: General Electrical Specification
e) GIBB-014: Detailed Electrical Specification
f) GIBB-019: Control, Integration and Commissioning Specification

The following Standards and Codes of Practice are referred to in this Specification:

American National Standards Institute

ANSI B4.1	Preferred limits and fits for cylindrical parts

American Society of Mechanical Engineers

ASME Section VIII	Boiler and Pressure Vessel Code, Division 1 for Unfired Pressure Vessels

British Standards Institution

BS 916	Black bolts, screws and nuts
BS 970	Wrought steels in the form of blooms, billets, bars and forgings
BS 1452	Specification for grey iron castings
BS 2789	Specification for spheroidal graphite or nodular graphite cast iron
BS 3100	Specification for steel castings for general engineering purposes
BS 3468	Austenitic cast iron
BS 4080	Methods for non-destructive testing of steel castings
BS 4504	Flanges and bolting for pipes, valves and fittings
BS 5316	Specification for acceptance tests for centrifugal, mixed flow and axial pumps
BS EN 1092	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges

South African Bureau of Standards

SANS 1109	ISO pipe threads for pipes and fittings where pressure-tight joints are made on the threads

SANS 0140 Identification colour marking (Part II)

SANS 10108 The classification of hazardous locations and the selection of equipment for use in such locations

SANS 1123 Pipe flanges

SANS 9906 Rotodynamic pumps - Hydraulic performance acceptance tests – Grade 1, 2 and 3

International Standards Organisation

ISO 9001 Quality assurance

ISO 9002 Quality systems. Model for quality assurance in production, installation and service

ISO 9906 Rotodynamic pumps - Hydraulic performance acceptance tests - Grades 1, 2 and 3

When reference is made to a code, specification or standard, the reference shall be taken to mean the latest edition of the code, specification or standard; including addenda, supplements and modifications and revisions thereto, unless otherwise specified.

2.2 Definitions

For the purpose of this document:

a) "Flow rate" means the volume of liquid passing through the pump per unit of time;

b) "Materials" includes both the basic materials used in the manufacture and fabrication of the pump-sets themselves as finished products that are to be installed and commissioned;

c) "Nominal diameter (DN)" means a numerical designation of size that is common to all components in the piping system other than components designated by outside diameters. It is a convenient round number for reference purposes and is only loosely related to the manufacturing dimensions in millimetres.

d) Nominal size is designated by DN followed by the size in millimetres.

e) All equipment of the same size (DN) designated by the same PN number shall have compatible mating dimensions.

f) "Nominal pressure (PN)" means a numerical designation which is a convenient round number for reference purposes.

g) The maximum allowable working pressure depends upon the materials design and working temperature and shall be selected from the pressure/temperature rating table in the appropriate standards. It is the internal pressure corresponding to the maximum allowable working pressure.

h) "Static head" means the difference between the free water surface levels (or equivalent pressure heads) on the suction and delivery sides of the pump when the pump is not in operation.

i) "External friction head" means the head required to overcome the friction external to the works provided under this contract.

j) "Plant losses" means the friction losses in all pipe-work, specials and valves within the limits of this contract.

k) "Velocity head" means the head given by $(v^2/2g)$ at the point of pressure measurement.

l) "Total manometric head" (TMH) is the sum of h), i), j), and k).

m) "NPSH Available (NPSHA)" defines the total pressure at the suction nozzle for a given liquid at a certain flow rate and is independent of the pump itself.

n) "NPSH Required (NPSHR)" is a pressure characteristic of the particular pump and is given by the manufacturer. The head in metres of water required above the reference plane, according to BS 5316 (impeller centre line for horizontally mounted centrifugal pumps) to ensure that cavitation does not occur.

o) "Duty point(s)" means that point (or series of points) on the pump Q-H characteristic curve(s) for the required performance of the pump as stated in terms of total manometric head(s) in metres and minimum required flow rate(s) in m^3/s or l/s or m^3/hr.

p) "Motor power input" means the power absorbed by the motor that is driving the pump.

q) "Coupling" means any process of jointing (except welding) the pump shaft to the motor shaft.

r) "Special" means any pipe other than a straight pipe. Under this definition are included all sizes of specials of shapes such as bends, tees, crosses, angle branches, reducers, and tapers.

s) "Pumpset" means one pump unit together with associated motor, coupling, baseplate and auxiliaries to deliver the specified quantity at the specified head, and all ancillary equipment.

t) "BEP" means best efficiency point which is the point on the pump curve at which the efficiency of the pump is the highest.

2.3 Abbreviations and Material Symbols

For the purpose of this Document, the following abbreviations shall have the meanings given:

AC	:	Alternating current
BEP	:	Best Efficiency Point
CI	:	Cast Iron
DI	:	Ductile Iron
DC	:	Direct current
DFT	:	Dry film thickness
DN	:	Nominal diameter
D/S	:	Downstream
H	:	Total manometric head
IP	:	A symbol which, followed by two characteristic numerals, signifies the degree of mechanical protection to ingress of foreign bodies and water as defined in SANS 1222.
LCD	:	Liquid crystal display
LV	:	Low Voltage (typically V < 1000)
MV	:	Medium Voltage (typically, in this context, 1000 < V ≤ 11000)
MFD	:	Mechanical Flow Diagram
P&ID	:	Process and Instrumentation Diagram
PN	:	Nominal pressure
Q	:	Flow rate
SG	:	Spheroidal Graphite
TP	:	Test pressure
U/S	:	Upstream
VSD	:	Variable Speed Drive
NPSHA:	:	Net Positive Suction Head Available
NPSHR:	:	Net Positive Suction Head Required
Q-H	:	Flow- Head relationship

rms : root mean square

3 DESIGN & GENERAL REQUIREMENTS

3.1 General

Pumps and ancillaries shall comply with all of the following requirements and shall be capable of withstanding the applicable test pressure specified in this document.

The materials used, the design and the protection provided shall comply with the relevant requirements set out in this document. The Contractor shall justify the type of pump selected by taking into consideration specific speed calculations, efficiency and reliability.

The manufacturer shall operate a quality assurance system approved to ISO 9001 (and ISO 9002) (latest edition) for the manufacture of pumps and pumping systems in addition to the manufacturer's project management activities.

Hydraulic performance criteria are as outlined in the applicable Project Specification.

3.2 Tender Submission

The Tenderer shall submit with this Tender for each pump offered the following characteristic curves:

With respect to flow:

- total head;
- power demand;
- efficiency;
- net positive suction head (NPSH) requirements, critical and 3% "head loss"

With respect to speed:

- torque requirements rated in absolute units.

Where variable speed pumps are required, the pump characteristic curves submitted for approval shall include a range of curves (at least 6) for different speeds and which indicate the maximum and minimum speeds possible.

Alternatively, NPSH requirements related to 3% drop in head may be given, if preferred, as long as the method of presentation is clearly stated.

These characteristic curves are to be submitted with water flows covering the full possible pump operating range, including transitions between set points where the pump speed is adjusted.

The Contractor may be called upon to provide further curves at the request of the Engineer, especially for starting and stopping analysis, in connection with surge analysis in the rising mains.

3.3 Type & Arrangement of Pumps

In general the Pump type is specified in the Project Specification if not, equipment and designs which have not previously been in common use in South Africa, shall not be acceptable unless the Engineer agrees in writing.

Arrangements incorporating multiple pump units coupled in series to achieve the duties specified in the particular specifications will not considered unless otherwise specified.

Variable speed functionality, if required, shall be specified in the Project Specific Pump Specification GIBB-004.

The arrangement of impellers shall be such as to reduce the residual axial thrust to a minimum.

Designs incorporating a double suction to balance thrust will be preferred.

Pumps incorporating balance discs and/or balance drums are not preferred for raw water.

The orientation and arrangement of the suction and delivery pipes and pumpsets shall be generally in accordance with the Tender drawings. The layout shall be designed to facilitate maintenance whilst being designed for minimum losses and no air traps.

Particular attention in the selection of all pumps, and the respective systems they are working in, under the range of working conditions required, taking all vane pass induced pulsations and the fundamental frequency of various parts of the system into account, and ensure that the system(s) have adequate natural damping.

3.4 Pump Characteristics & Performance

3.4.1 Duty Point(s)

The required pump duty point(s) are as set out in the Project Specific Pump Specification (GIBB-004).

Unless specified to the contrary, the proposed pumps shall be able to operate without perceptible signs of cavitation in the full range of heads specified, pumpsets running singly or in parallel.

The specified operating points (whether there will be one operating point or multiple operating points or a range of operating points) shall be within the pump manufacturer's recommended operating range for the pump as tendered and adequate information shall be provided in the tender to confirm this.

3.4.2 Best Efficiency Point & Impeller Characteristics

The pump operating point shall be generally to the right of the pump's best efficiency point for the chosen impeller size and speed unless there is another overriding factor which affects the choice of pump.

Pump impellers shall have the characteristic of generally decreasing head with increasing capacity from shut-off to maximum capacity.

3.4.3 Efficiency

The efficiency curve shall be flat over a wide range in order to provide efficient working with various pump operating conditions. Where specified, it shall conform to the requirements of the Project Specification.

3.4.4 NPSHR

NPSHR curves for both 0% and 3% cavitation shall be included with the pump characteristic curves.

Should the pump manufacturer not have made such tests, the Engineer will make the following assumptions to obtain an approximate 0% head drop curve to ensure that cavitation does not occur because of insufficient suction pressure when the NPSHA calculations are made:

a) On the left hand side of the 3% curve, 150% will be added to the value shown;

b) At the BEP of the 3% curve, 40% will be added to the value shown;

c) On the right hand side of the 3% curve, 50% will be added to the value shown; and

d) Atmospheric pressures shall be measured at sea level less 1 m, to allow for low atmospheric pressure conditions.

3.4.5 Pumped Liquid

The pumps shall be able to handle the designated pumping medium without corrosion, erosion or abrasion throughout its designated life cycle.

3.4.6 Specific Intake Velocity

Specific intake velocity, also referred to as *suction specific speed*, S, (defined hereunder) shall under no circumstances exceed the value of 185 per impeller inlet, unless detailed and acceptable justification is given.

$S = nQ^{0.5} / (Nsh)^{0.75}$

Q = capacity in m3/s (if double entry impeller, equals half pump capacity)

Nsh = absolute suction head in metres (Nsh = Ha - Hs - Po)

Ha = atmospheric pressure at the elevation of the pump in metres of water

n = rotational speed in revolutions per minute

Hs = difference in level of the highest point of the impeller entry above the water level on suction side, increased by the head losses in the suction line in metres of water.

Po = vapour pressure in metres of water.

3.4.7 Impeller

The pumps shall have stable, non-overloading characteristics.

No pump, with a constant speed driver, which requires a maximum or minimum diameter impeller to meet the rated pumping conditions will be acceptable.

The impeller diameter shall be such that at least a 5% increase in head at the rated capacity can be obtained by installing a larger diameter impeller of the same pattern. Minimum allowable diameter shall be at least 105% of the pump supplier's minimum catalogue diameter.

3.4.8 Operating Speed

Pump shaft rotational speed shall not exceed 1 500 r.p.m unless explicitly stated in the Project Specifications.

3.4.9 Operating Temperature

Each pump and electric motor shall be capable of operating satisfactorily at an assumed maximum shade temperature of 45°C. The temperature of the pumped liquid will not exceed 25°C.

3.4.10 Vibration Standards

A machine will not be acceptable if vibration is not within the prescribed limits below. Maximum vibration amplitudes are specified on bearing housings measured in the horizontal, vertical and axial planes. Machined surfaces (50 mm x 50 mm) shall be provided for these measurements on the housings.

Pumpsets shall be accurately balanced statically, dynamically and hydraulically in accordance with ISO 1940 Grade G6.3 or approved internationally recognised Standard.

4 MATERIALS

4.1 Pump

Generally:

- Pump bodies shall be cast and shall be coated internally.
- Materials highly resistant (such as high chrome iron) to corrosion/erosion/abrasion shall be used to make the impellers, wear plates, wear rings and liners (as applicable).

Pump materials shall comply with the following or at least be equivalent and as amended in the Project Specifications.

For large pumps (Larger than 50kW):

Table 1: Minimum material requirements for large pumps

PUMP COMPONENT	MINIMUM MATERIAL	MINIMUM GRADE
Impeller	Bronze	
Casing wear rings & impeller wear rings	Stainless steel or non-ferrous material	
Volute casing	Ductile iron	EN-GJS-400-18

PUMP COMPONENT	MINIMUM MATERIAL	MINIMUM GRADE
Shaft	Chrome steel or stainless steel	431
Shaft sleeves	Phosphor-bronze (PB1)	
All fasteners, mechanical seals and all auxiliary steel components	Stainless steel	316

For small pumps (smaller than 50 kW):

Table 2: Minimum material requirements for small pumps

PUMP COMPONENT	MINIMUM MATERIAL	MINIMUM GRADE
Impeller	Gray cast iron	DIN GG-25
Casing wear rings & impeller wear rings	Stainless steel or non-ferrous material	
Volute casing	Cast iron	BS 1452 Gr 260
Shaft	Medium carbon steel	DIN C45 N
Shaft sleeves	Phosphor-bronze (PB1)	
All fasteners, mechanical seals and all auxiliary steel components	Stainless Steel	316

Other approved international standards may be considered. Alternative materials may be considered by the Engineer.

4.2 Care in Handling

The Contractor shall provide temporary end covers that adequately, in the opinion of the Engineer, protect flanges and threads, and prevent damage to internal lining during transportation and during handling on Site.

The pumps shall be so transported, stored, and handled that they are not overstressed at any time and are not damaged in any way. Pumps damaged or cracked in any way shall be removed from the Site.

4.3 Dimensions and Assembly

All parts shall be of ample dimensions and strength and of the best and most suitable material, corrosion-resistant, free from flaws, accurately machined, properly assembled and fitted so as to avoid initial stresses and to ensure free running. All fittings such as packing glands, shaft assemblies, thrust bearings and plummer blocks shall be of adequate size and sound design.

Each pump shall be provided with a cast-in or permanently attached metal plate with direction-of-rotation arrow.

4.4 Flanges & Accessories

All pumps and ancillaries shall be supplied complete with couplings and jointing material. Each flange and fitting shall be supplied complete with one insertion piece of the appropriate diameter and made of a material that is suitable for the maximum working pressure, such as rubber for small diameter low pressure pipelines or compressed fibre cement or other approved material for medium to large diameter and medium to high (2.5 MPa and over) pressure pipelines, and one set of bolts and nuts. The drilling of steel and CI flanges shall conform to the requirements of SANS 1123 or BS EN 1092 or BS 4504 : Part 1, as applicable, appropriate to the class of pipe specified, except that in the case of flanges, where M27 and M33 bolts are specified in BS 4504 : Part 1, M24 and M30 bolts, respectively, shall be used as specified in SANS 1123. The minimum pressure rating of flanges shall be 1.0 MPa.

4.5 Compatibility of Materials

The responsibility for selecting materials, which are compatible with the liquids or surroundings with which the equipment comes into contact, to prevent corrosion and/or abrasion rests with the Contractor. The materials used shall be at least equal and approved to those specified in this

Specification and the Project Specification. Materials selected for manufacturing of the pumps shall conform to the applicable material specifications which are described in above and Appendix B hereof.

4.6 Corrosion Protection

All components shall be suitably designed for corrosion resistance.

Corrosion Protection shall comply generally with the following unless mentioned specifically in the Particular Specification GIBB-007 *Painting and Corrosion Protection*.

Grey cast iron and ductile cast iron wetted parts shall be provided with corrosion resistant coatings over their full wetted surfaces. The coating shall be applied directly to the correctly prepared metal surface. The system's dry film thickness shall be about 500 microns and shall not be less than 450 microns. The system used shall be specifically suitable for pump internals such as a solids bearing vinyl ester acrylic copolymer such as Corrocoat Polyglass VEF or a ceramic coating such as Belzona 1321 or equivalent.

Where abrasion resistance is required, a suitable coating shall be provided over the pump's full wetted surface. The coating shall be specifically suitable for pump internals. The system's DFT shall be about 1 500 microns and shall not be less than 1 200 microns. The coating shall be specifically suitable for pump internals such as a solids bearing vinyl ester copolymer of about 1 500 microns such as Corrocoat Armagel, or a ceramic carbide such as Belzona 1811/1812 or equivalent.

The coatings shall be applied in accordance with the coating supplier's method statement.

Decorative colours shall be in accordance with the Code numbers shown in BS 381C and SABS 1091, SANS 1200 HC as applicable, or otherwise specified in the Project Specifications or as directed by the Engineer.

5 DESIGN & CONSTRUCTION

5.1 Horizontally Split Casing Centrifugal Pumps

The casing shall be of the volute type, split on the rotating element centre line. Both branches shall be cast in the lower portion making it possible to inspect the pump interior and remove the rotating parts without breaking pipe joints or interfering with the alignment.

Volute casings shall be fitted with renewable phosphor bronze or other approved material casing eye rings at the points of running clearance.

The multi-channel, shrouded impellers shall be of the double entry type with, with optimum vane geometry to provide high efficiency, low NPSHR and minimised pulsations in the discharge. Impellers shall be hydraulically, statically and dynamically balanced for two stage pumps, and of the single entry type for single-stage pumps. For multi-stage pumps the impellers shall be mounted back to back to ensure balanced thrust.

All horizontal pumps with two or more stages and all horizontal double suction pumps shall have the impellers mounted between bearings.

Design requirements for split casing pumps:

a) All parts shall be of ample dimensions and strength and made of the best and most suitable materials, corrosion resistant, free of flaws, accurately machined, properly assembled and fitted so as to avoid initial stresses and ensure free running. Where end thrust is unavoidable, adequate long wearing thrust bearings shall be fitted.

b) The horizontal axially split casing shall have the suction and delivery branches in the lower half of the volute casing.

c) The shaft shall be designed for arduous service conditions.

d) Shaft sleeves, which are replaceable, shall be fitted throughout the waterways. The sleeves shall be screwed or either locked to the shaft by means of lock nuts.

e) Bearing housings shall be axially split to allow easy removal of the complete rotating element. The housing shall contain an oil bath and labyrinth seals to secure oil retention and a bearing oil feeder.

f) Replaceable-wearing rings shall be fitted to the impeller and volute casing.

g) The pump shall run quietly over a wide operating range.

h) Requirements for bearings are detailed below:

i) Split Casing pumps shall be able to operate in the vertical or horizontal position, as specified or shown on Drawings.

j) Vertically installed pumps and motor shall include approved support pedestals and a Hardy Spacer, flexible drive shaft or equal approved by the Engineer.

k) Horizontally installed, pumpsets shall be direct coupled by means of an approved flexible coupling and mounted on a substantial base-plate.

l) The shaft bearing support shall also be unaffected by removal of the upper casing; i.e. the bearing housings shall be supported separately from the upper casing.

m) Base plates shall be of rigid design. Fabricated steel base plates shall be stress relieved before any machining is done, and accurately aligned on site.

n) Safety guards shall protect shafts and couplings. The guards shall be removable and of an approved design.

5.2 Other Pumps

Requirements for other pump types required for this contract are detailed in the Project Specific Pump Specification GIBB-004.

5.3 Pump Casing

5.3.1 General

All the pressure casings shall be of such thickness as will be suitable for the maximum discharge pressure (plus surge pressure) at pumping temperature and hydrostatic test pressure at ambient temperature, with a 3 mm minimum corrosion allowance. Casings shall have stiffening ribs at all points of high stress. Particular care shall be exercised in designing a pump casing, which will resist the tendency to crack through the cutwater or guide passage walls during the pressure tests, and the Tenderer is to indicate clearly in his tender the design features incorporated in his pump to ensure that this requirement is satisfied.

The design stress used for any given materials shall not be in excess of the values given in ASME Section VIII, Division 1 for "Unfired Pressure Vessels" for the same material. For cast materials, the factor specified in the ASME Boiler and Pressure Vessel Code shall be applied. Pressure casings furnished of forged steel, rolled and welded plate, or seamless pipe with welded cover shall comply with the applicable standards of ASME Section VIII, Division Cl.

Pumps shall be furnished with suction and discharge flanges integrally cast with the casing and complying with Cl 4.4 above. Where the pump supplier's standard pattern offers a flange thickness and diameter greater than that specified, the heavier flange may be furnished, but it shall be drilled as specified. All cast iron casings with flanges or other bolted mating surfaces shall have a full width gasket surface.

Pumps shall be provided with a vent connection unless the pump is made self-venting. All horizontal drive pumps shall be provided with a drain connection.

The backs of all flanges shall be machined full-face or spot-face and bolt holes shall straddle the horizontal and vertical centrelines. All vent, lantern ring, case drain, or seal recirculation connections on pumps shall be threaded according to SANS 1109.

Preference will be given to a design and arrangement of the pump casing which ensures that it is unnecessary to disconnect the delivery pipework in order to remove or replace the complete rotating element.

Where the pump type allows, provision shall be made on each pump for removing the pump casing cover and the shaft assembly without disturbing the motor drive.

All slings, shackles, spread bars, cradles and other equipment necessary for the lifting of components of the pumpset for installation or maintenance shall be provided by the Contractor and handed over to the Employer's Agent on completion of the Contract.

5.3.2 Castings

Castings shall be sound, free from shrink or blow holes, scale blisters and other similar defects. The surfaces shall be cleaned by the supplier's standard methods. All casting burrs shall be filed or ground flush with the surface of the casting.

No welding, burning, filling or plugging of defective castings shall be permitted without the Engineer's permission in writing, following an inspection of the defects. The repair of leaks and defects in pressure castings shall be allowed only after the approval of the Employer's Agent has been obtained. It shall then be done strictly in accordance with rules of Section VIII of the ASME Code.

5.3.3 Casing eye rings

Renewable phosphor-bronze (PB1) eye rings or similar approved shall be provided on all pumps.

5.4 Impellers

Pinning of the impeller is not acceptable. All impellers shall be statically as well as dynamically balanced, the latter at not less than half the rated speed.

All water passages shall be polished to a smooth finish; water passages which cannot be machined shall be hand ground and filed to a template. The castings shall be free of blow-holes and other defects. No welding, burning, filling or plugging of defective castings shall be permitted without prior approval being obtained from the Employer's Agent in writing, following an inspection of the defects.

Entrance to the vanes at the eye of the impeller shall be smooth and leading edges of the vanes shall be ground to the optimum profile consistent with best efficiency and cavitation-free operation.

Lines showing the designed width of the water passage at the outlet shall be scribed on the impeller periphery when the impeller is being machined. The internal surfaces of the impeller shall be finished off to these machined lines smoothly and symmetrically; bevelling the metal to conform to the scribed lines will not be accepted.

Impeller shrouds shall be of adequate thickness after they have been machined, the thickness depending on the impeller diameter. Impellers for similar pumps shall have the same outside diameter and shall be interchangeable.

Where impeller eye-rings are not fitted, the design of the impeller eye shall be such that sufficient thickness is left so that material can be machined away at a later stage and either impeller eyerings, or undersize casing eyerings fitted. Replaceable wearing rings shall be made of the same material as the impeller. These rings, which shall be "L" cross-section, shall be secured to the impeller with non-corroding screws and mechanically locked.

The rotating assembly shall be designed to have its first critical speed at least 25% above the maximum operating speed.

5.5 Diffusers

Where fitted, diffusers shall be cast in an approved zinc-free bronze or stainless steel and shall be finished smooth all over.

5.6 Pump Shaft and Sleeves

5.6.1 Shafts

The Contractor shall ensure that both the critical speed and torsional oscillation characteristics of the combined pump and motor rotating elements are satisfactory for all possible conditions of operation.

Shafts shall be of sufficient dimensions to transmit the power to which they will be subjected, without undue torsional or bending stresses and deflection. They shall be designed to be resistant to pitting corrosion and fatigue failure.

The shafts shall be stress relieved after initial machining, and ground to final size. The manufacturer shall take special care to avoid sharp radii. Shaft failures due to corrosion are common and the manufacturer shall indicate which steps he has taken to prevent the occurrence of pitting corrosion in pump shafts.

The shafts shall be suitably designed for the reception of the impeller which shall be adequately secured to the shaft in such a manner as to be readily removable without damage to either the shaft or the impeller. They shall be held axially and radially by roller or deep grooved ball bearing. The impeller shall be driven by a sunken shaft key.

Provision shall be made on each pump shaft or coupling for checking speed by means of a hand tachometer of the reflective digital read-out type.

5.6.2 Shaft Sleeves

The shafts shall be adequately protected with replaceable sleeves of an approved bronze or other similar approved non-corrodible material at all areas where wear and/or corrosion could possibly be expected. These sleeves shall be readily removable without causing damage to either the shaft or the sleeves.

Replaceable shaft sleeves shall be made of phosphor-bronze or other approved material. Sleeves shall be ground with a polished finish on the wearing surface. They shall be fitted to all pumps where the shaft passes through the stuffing box. The sleeve shall extend a minimum of 3 mm beyond the gland plate.

Where the pumped fluid is incompatible with the shaft material, suitable sleeves which afford full protection to the shaft shall be fitted.

5.7 Shaft Seals

Unless otherwise stated in the Project Specifications, mechanical seals are the preferred means of shaft sealing.

5.7.1 Glands and Stuffing Boxes

Soft-packed stuffing boxes of ample depth shall be provided where gland packing is specified. Easily removable lantern rings shall be used in all pumps with a liquid or grease seal, and these lantern rings shall be provided with inlet and outlet connections.

Stuffing boxes shall have not less than four rings of packing plus the lantern ring and renewable-type non-ferrous throat bushings. The make and type of packing shall be to the Engineer's approval.

Stuffing box glands shall be easily removable and must permit replacement of packing without removal or dis-assembly of any other part of the pump.

Glands shall be made with completely enclosed bolt holes. Slotted holes open at one side are acceptable only if studs are provided for securing glands. Gland bolts and nuts shall be of grade 304 stainless steel or other material as approved. Gland leakage from the pumps shall be led through suitable tubing to a point immediately outside the pump house or the nearest point inside the pump house provided for this purpose.

If the quality of the water necessitates filtration, the Contractor shall provide the appropriate equipment. Filters shall (as a minimum), be of the “twin-barrel” (quick change-over) type and must default automatically to “bypass” in the event of blockage. The flow of water to or from the glands shall be clearly visible.

In the case of multi stage pumps, the gland pressure shall not exceed the maximum suction supply pressure without the written approval of the Engineer.

5.7.2 Mechanical Seals

The Contractor shall be responsible for obtaining a full guarantee from the seal manufacturer for the seals provided. Seals shall comply with a) or b) below.

The design of the seal gland plate shall have a throttle bushing to restrict the flow to atmosphere in the event of a seal failure.

The mechanical seals shall be capable of resisting without leakage both the suction and discharge pressure as specified.

If cooling water is required for the mechanical seal, full details shall be submitted by the Contractor at tender stage.

The design of the seal shall be such that the static head on the pump discharge induces a closing action on the seal to ensure that no leakage occurs during pump shut-down.

a) Potable water

A single self-aligning balanced mechanical seal manufactured in specified material (Cl 4) and fitted with at least matched solid tungsten carbide (or other approved) rotating and stationary faces shall be supplied.

An external flush shall be provided to ensure heat dissipation through circulation. Unless otherwise specified, seals requiring an independent source (i.e. not the pumped medium) of cooling water are not favoured. See Cl 5.7.3 below for further requirements of water to the seals.

b) Abrasive liquids

A double self-aligning mechanical seal manufactured in specified material (Cl 4) and fitted with at least either carbon on ceramic (for water lubrication) or carbon on solid tungsten carbide (for oil lubrication) shall be fitted on the end of the seal not in contact with the liquid being pumped. At least solid tungsten carbide on solid tungsten carbide shall be fitted on the end in contact with the pumped liquid. If specified, or should the Contractor consider it to be necessary, seals of greater technical sophistication (than tungsten carbide) shall be fitted.

If required, an independent (i.e. not the pumped medium) fresh water (or oil) flush shall be provided. Care shall be taken to ensure that the pressure of the flushing fluid is at least 100 kPa greater than the pressure of the liquid on the inboard side of the seal. See below for further requirements of water to the seals.

Built-in or integral type seals are unacceptable.

5.7.3 Water to the Seals

Where filtration is required, flow and pressure sensors shall be provided in the pipework between the filter (or cyclone) and each shaft seal and these shall be incorporated into a protection loop to prevent dry running. Stainless steel ball isolation valves shall be provided in suitable positions to enable the filter (or cyclone) and the flow indicator to be serviced without having to shut the pump’s isolation valves. Valves shall be lockable in the open position. If a cyclone is used, its discharge shall be piped to return to the suction pipework. Pipework shall be of stainless steel, rigidly supported.

Stainless steel piping or tubing shall be used for the flushing fluids to mechanical seals. Tubing fittings and ferrules shall be stainless steel. Copper tubing and brass fittings are unacceptable.

Auxiliary piping connections shall be plugged with solid plugs. Carbon steel plugs shall be used with cast iron casings; otherwise the plugs shall be of the same metals as the casing material. Plugs shall have a shank to permit the use of a pipe wrench.

5.8 Pump Bearings and Lubrication

5.8.1 Bearings

Bearings shall generally comply with the requirements of the relevant Particular Specification.

If the type of bearing required for the pump is not specified, then the bearings shall be of the type recommended by the pump manufacturer. The particular type and system offered by the Tenderer shall be fully specified. The bearings in the pump casing together with the lubricating system shall be suitable for the particular circumstances described in the Specification.

A minimum bearing life of 100 000 hours is required.

All bearings shall be suitable for shaft rotation in both directions.

The pump rotating element shall be positively located in the axial direction. Where necessary a thrust bearing shall be provided to accommodate the end thrust of the impeller(s), and the mass of the rotating element. Thrust bearings for vertical pumps may be located in the drivers.

Slide/journal bearings shall preferably be configured for air cooling and oil-ring lubrication but more complex methods of cooling and lubrication are acceptable if recommended by the pump manufacturer.

The journal bearings of large, slow revving and multi-stage horizontal pumps shall generally be white-metal lined bronze sleeves, split on the horizontal centre line, and/or "Glacier" bearings as specified by the pump manufacturer.

To facilitate replacement, the bearing numbers for all bearings shall be given together with other data to be provided by the Contractor.

When the pumps are controlled by VSD the bearings shall be insulated from the frame to prevent damage by any shaft stray currents which may be produced.

Grease-lubricated bearings shall be sealed or re-greasable. Ball or roller bearings shall be loaded conservatively in order that the grease may be renewed at intervals of not less than one year and they shall not be equipped with grease nipples or cups. If these are supplied, they shall be replaced with threaded plugs. For purposes of maintenance, end-shield bearings are preferred.

Preferably the same type of bearing will be chosen for motor and pump; if not, the necessary allowance shall be made when aligning pump and motor.

5.8.2 Bearing Housing

Bearing housing closures of the labyrinth type ‘slinger’ are required on horizontal pumps at each point where the shaft projects through the bearing housing, except that mechanical oil seals shall be accessible at the coupling end of the bearing housing.

A non-labyrinth type slinger is acceptable on the stuffing box end seal. Bearing housings of vertical pumps shall have equally adequate protection.

5.8.3 Safety Instrumentation

Bearing temperature and vibration sensors shall be provided as stipulated in Cl 11 herein and as modified by the Project Specification.

5.8.4 Cooling of Lubricating Oil (if applicable)

All bearings shall be designed to run continuously in ambient temperatures of the order of 40^{o}C.

The cooling of the oil may be natural or by forced air circulation or by water circulation through coolers. Natural or forced air circulation is preferred.

If water cooling is necessary, stainless steel oil/water coolers shall be incorporated in the bearing oil reservoirs. Where water cooling is employed, the system shall make use of water of the same quality as the water being pumped. All cooling water pipework, valves and fittings shall be of compatible material. The water side of the cooler tube assembly shall be hydraulically tested after installation has been completed, to 3 times the maximum working pressure. Test pressures shall be maintained for 30 minutes and witnessed by the Engineer. The oil cooler shall be easy to clean out.

5.8.5 Lubrication

All internal surfaces in continuous contact with the lubricating oil such as oil reservoirs, piping, etc, shall be thoroughly cleaned either chemically or by shot blasting and protected by a method to be approved by the Engineer until such time as the system is charged with oil. No site welding of oil circulating pipes will be permitted.

Circulation oil lubrication systems incorporating pumps, when required, shall include:

- Two 100% duty motor driven oil pumps;
- Two 100% rated full-flow oil filters;
- Duplicate pressure relief valves;
- Oil pressure relays;
- Enclosed oil reservoir with level indicator and oil filter and drier breather;
- All necessary piping, valves, gauges, relay switches, alarms etc.

The entire lubricating system shall be fail safe with alarms set to indicate automatic change-over to the stand-by unit.

Selection of duty pump shall be made by a manual selection switch.

5.9 Couplings

The pumps and motors shall be direct coupled with an approved type of flexible coupling which will take up minor misalignment or off-setting of the motor and pump shaft satisfactorily. Flexible tyre-type couplings are acceptable for pumps coupled to motors up to 100 kW. Where motors are rated above 100 kW, all metal (curved tooth or similar) couplings shall be used in all horizontal drive units. Where applicable, provision for adequate lubrication shall be made.

The coupling shall be designed in such a manner that no axial or radial loads will be imposed on the motor and pump bearings in excess of the loads approved by the motor and pump manufacturers respectively for the installation offered. Spacer couplings shall be provided with pumps of the back pull out type, where mechanical seals are fitted or where frequent maintenance is likely to be required.

The couplings shall be robust, shall be readily dismantled and reassembled, and shall have a service factor of at least 2

Couplings shall be balanced as specified in 3.4.10.

For coupling alignment, see Section 8.

5.10 Electric Motors

Refer to Standard Specifications for LV and MV Motors, and to the applicable Project Specifications.

Unless otherwise specified, pump motors shall be selected so that the motor power rating is at least 15 % above the shaft power required by the pump for the application. In variable speed applications, this requirement applies to the pump operating point, which has the highest shaft power demand or the maximum shaft power at full rotational speed whichever is the greatest.

6 SUNDRIES

6.1 Plinth and Baseplate

The Tender drawings show indicative plinth sizes; the Contractor shall finalise the concrete dimensions (to suit the selected pumpset dimensions, configuration and weight), the steel reinforcing and the anchor details for the pumpset plinth and shall submit the design to the Engineer for approval prior to construction. The calculations shall confirm that the pumpset's enforcing vibration will cause no damaging resonant condition and that it is suitable for the ground conditions.

Pumps and motors shall be mounted on baseplates of rigid design, manufactured in either cast iron or fabricated steel, equipped with anchor bolt holes, anchor bolts, drain connections and unobstructed grout holes.

Cast iron base plates shall be fully machined to receive the pump or motor. Fabricated steel baseplates shall be substantially ribbed and stress relieved before any machining is done. Baseplates shall be machined at the points of contact with the pump and motor supports so that the set may be mounted on the baseplate in correct alignment without the use of shims. In addition, at least four levelling pads (all machined to the same height relative to the other machined surfaces) shall be provided so that the baseplate can be accurately levelled up on Site. Machining is not required for units of 15 kW and under. Permanent dowelling pins shall be fitted after each item of plant has been in normal operation for at least 72 h and after the final alignment has been approved by the Engineer in writing.

Baseplates and pump supports shall be so constructed and the pump so mounted as to minimise misalignment caused by deflections arising from normal piping strains, internal differential thermal expansion, hydraulic piping thrust and similar causes.

At least two 100 mm diameter openings for grouting up without the removal of the pump or motor shall be cut into the baseplate. Levelling bolts with set screws and nuts shall be fitted to the base plates of all units 100 kW and above. (Refer Appendix A or similar approved by the Engineer).

Baseplates for pumpsets up to 1 000 kW shall have both pump and motor mounted on a single baseplate. Separate baseplates or sole plates may be used for pumpsets above 1 000 kW.

Baseplates shall be given corrosion protection at least equivalent to that specified elsewhere.

6.2 Fabrication

Fabricated items, including the baseplate, shall comply with the requirements of the relevant Particular Specification.

6.3 Anchor Bolts

Anchor bolts shall not be less than M20 and shall be made of stainless steel, to a minimum Grade of 316. Anchor bolts of an approved design shall be used as anchors.

Unless otherwise specified, one of the following methods to fix the anchor bolts shall be used:

a) The Contractor shall drill holes of an appropriate diameter and depth into the concrete base, and grout the anchor bolts in, using an approved prepacked two-part epoxy mortar.

b) Pockets at least 100 mm square and at least 12 bolt diameters in depth, shall be left in the foundation blocks.

The Contractor shall be responsible for providing an accurately constructed rigid template to fit on top of the foundation formwork and to which the anchor bolts can be bolted. The details of the template shall be such that it does not obstruct the concreting of the foundation block.

6.4 Fasteners

Fasteners shall comply with the requirements of the relevant Particular Specification.

Anchor fasteners shall have a minimum diameter of M16.

6.5 Pump Vent & Drain Cocks

Pump vents and drain cocks shall be manufactured from 316 stainless steel.

Adequate size air valves to enable the entrapped air to be released freely shall be provided on the high point of each pump casing and at any high points on the suction and delivery mains within the limits of this Contract.

Drain cocks shall be provided on the pumps, and also on drains from the pump seals. Drain pipework shall be fitted with T sections at every bend to enable rodding in the event of a blockage occurring.

All water and drain cocks shall discharge visibly into funnel shaped receivers discharging to waste.

6.6 Auxiliary Pipe Systems

Recirculating piping systems for gland oil, lubrication oil and accessories such as gauges and valves, shall be furnished by the Contractor, fully assembled to facilitate easy maintenance. Material used for all auxiliary piping and valves shall be suitable for the designed duty of the pumps and all items shall be properly cleaned before assembly. Auxiliary piping shall be installed in a manner which prevents damage to the instruments and gauges due to the vibration of the pump.

6.7 Pressure Gauges

An approved pressure gauge together with all piping shall be fitted on the suction and delivery sides of all pumps. The pressure gauges shall be calibrated to a common datum corresponding to the pump centre line level. The datum level and the difference in level between the datum level and the mounting height of the pressure gauges shall be indelibly marked on the dials of the respective pressure gauges.

One suction pressure transducer, and one delivery pressure transducer, per pumpset shall be supplied suitable for an input range corresponding to that of the respective pressure gauges. The transducers shall have an output of 4 - 20 mA over the scale range specified for the associated gauge and shall operate over a two wire system. A suitable DC power supply for each pumpset shall be supplied to power the transducer.

After erection, and before completion, each pressure gauge, each pressure transducer and each pressure switch shall be calibrated on Site. Calibration certificates shall be submitted to the Engineer for each gauge, transducer and pressure switch after the Site calibration.

Suitable approved brackets shall be supplied and installed to support the pressure gauges, transducers and switches. Each gauge and transducer shall be provided with an isolating cock and an additional high quality test cock shall be provided at each pressure measuring point, for the connection of test instruments. It shall be possible to check and isolate the pressure instruments without disturbing piping or connections.

The Contractor shall supply and connect all piping and fittings to the instruments.

The DC power supplies shall be supplied as loose items and shall be installed and wired by the Contractor.

6.8 Designation & Information Plates

Each pump set shall be provided with an approved number designation plate (baked enamel coated steel plate, stainless steel, or similar) indicating No. 1, No. 2, etc. The letters shall be at least 100 mm in height and the plate shall be mounted close to the pump set in a position which is readily visible from the control area. The pump number order shall be confirmed by the Engineer.

A corrosion-resistant nameplate shall be permanently attached to each pump and contain the following information:

- Manufacturer's name;
- Year of manufacture;

- Serial number of pump;
- Size and type of pump;
- Size of impeller;
- Rated capacity in cubic metres per hour (m3/h), litres per second (ℓ/s) or cubic metres per second (m3/s);
- Pump head at rated duty in metres (m);
- Pump speed (rpm);
- Maximum allowable casing working pressure in kilopascals (kPa);
- Mass of upper casing in kg, (for horizontal split casing pumps,)
- Mass of lower casing in kg, (for horizontal split casing pumps,)
- Mass of complete rotating element in kg; and
- Mass of completely assembled pumps in kg.

Letters and figures shall be engraved, or embossed, NOT STAMPED.

6.9 Instrumentation

Notwithstanding the requirements for instrumentation set out in the Project Specification, at least the following shall be fitted to the pumpset:

a) All motors shall have embedded in their stator windings, two RTD per phase which shall automatically shut off the motor in the event of overheating of the stator windings.

b) All pump-motor-sets rated 55 kW and over shall be fitted with RTD, thermal sensors in the drive-end and non-drive-end bearings to give a warning and automatically shut off the motor in the event the bearing temperature exceeds 80°C, or as recommended by the manufacturer.

c) All pump-motor-sets rated 110 kW and over, shall be fitted with vibration detectors on the bearings and automatically shut off the motor in the event the amplitude exceeds the manufacturer recommended limit. Vibration sensors in horizontal multistage pumps shall be provided in the ‘x’ and ‘y’ directions. Axial vibration sensors shall not be provided on horizontal multistage pumps.

6.10 Lifting

Suitable lifting points shall be incorporated in the design of all equipment.

6.11 Safety

Each pumpset shall be provided with an emergency stop station in an appropriate position.

Removable or hinged galvanized wire, expanded steel mesh or sheet metal cages shall protect all shafting and couplings. Guards shall be sufficiently heavy and rigid in design to avoid contact with the coupling or shaft as a result of accidental body contact. In the single shaft system, the bottom couplings only shall be guarded and in the two shaft system the complete shaft shall be protected with a cage from top to bottom, with hinged inspection openings for inspection and lubrication of the joints. All motor stool openings shall similarly be protected with removable guards.

Equipment or a combination of equipment shall not exceed the maximum noise limit of 85 dBA. (Refer to the latest version of BS EN 60034-9). The noise level shall be measured during workshop testing as well as on site.

7 PLANT

7.1 General

The Contractor shall provide all plant that is necessary to install, test and commission all items covered in this specification.

7.2 Handling and Rigging

The plant and rigging equipment used by the Contractor for the handling and placing of pumps, motors, valves and pipes shall be such that no installed equipment is over-stressed during any operation.

7.3 Setting Out

The Contractor may use any acceptable device to control the installation and alignment of the pumpsets, etc.

7.4 Testing

7.4.1 Hydraulic pressure test for leakage

The equipment provided by the Contractor for testing shall include the pump, pressure gauges, meters and the necessary tools and fittings required for the performance of the tests given in Cl 10.

7.4.2 Performance test

a) Works test

The equipment provided by the Contractor to verify the guaranteed pump performance, shall consist of the complete pump test rig including instrumentation to test the pumps in accordance with SANS 9906 Grade 1E (with Efficiency as a Guarantee requirement) including an NPSH test.

b) Site test

The equipment provided by the Contractor on Site to test the performance of the equipment shall include all the instrumentation not included in the permanent installation, (e.g. Watt meter, suitable pressure gauges, water meter of sufficient accuracy to ensure testing to SANS 9906 Grade 1E), and all tools and suitably trained staff necessary.

8 DELIVERY/INSTALLATION/SITE WORKS

Installation work shall generally comply with the requirements of the relevant Particular Specification.

8.1 Transport

When assembled pumps are transported, care shall be taken to prevent damage to bearing elements. Either the shaft shall be secured against relative movement or the pump base shall be mounted on suitable anti-vibration mounts during transport.

8.2 Placing on Foundation Blocks

After the casting foundation blocks is complete, with holding down bolt pockets, for pumps, motors, valves and pipework, the installation of pumps, motors, valves and pipework on those foundations shall take place.

Before positioning the pumps on their foundations the Contractor shall roughen the concrete surface, and ensure that all surfaces are free of all foreign materials, grease, oil, etc. The pumps shall be aligned as specified below before grouting commences.

The pumps shall be placed such that grouting clearances are maintained between the machine base, foundations and formwork.

NOTE: The concrete foundation blocks shall be to suit the dimensions and positions of the equipment supplied by the contractor.

8.3 Alignment

The Contractor shall align and level accurately the pump unit, using metal blocks and shims under the base at the anchor studs and, in the case of heavy equipment, midway between studs. The anchor nuts shall then be drawn tight against the base. The pump and motor shall then be checked for alignment.

If alignment needs improvement, metal shims or wedges shall be added at the appropriate places under the base. The Contractor shall align the units using laser beam alignment, and shall ensure that the measured deviations nowhere exceed the smallest values recommended by the manufacturers of the motors, pumps and flexible couplings respectively. The readings shall be recorded and made available to the Engineer upon request.

The Contractor shall be responsible for filling the voids inside and under the baseplate with an approved non-shrink grout.

The Contractor shall satisfy himself that the baseplate is fully supported over its whole length and that no voids have been left on the underside of any parts of the baseplate.

After the pumps have been in operation about one week, the foundation bolts shall be finally tested for tightness, the alignment checked (using clock gauges) and dowel pins fitted in the pump and motor feet in the approved manner.

When the grout has thoroughly dried (about 14 days after grouting), the exposed edges shall be painted by the Contractor using an approved oil paint of the same colour as the pump baseplate.

8.4 Defects

Each pump set and each piece of ancillary equipment shall be thoroughly cleaned and carefully examined for damage and defects immediately before installation. Should any damaged or defective pump set or ancillary piece of equipment be installed, it shall be removed and replaced at the Contractor's expense and to the satisfaction of the Engineer.

8.5 Keeping Pump Sets Clean

Every reasonable precaution shall be taken during installation to prevent the entry of foreign matter and water into the pump(s).

8.6 Mounting

In addition to supplying and installing the pump sets, the Contractor shall supply and install all appurtenant pipework and valves and he shall connect the pump sets to the pipework using, inter alia, acceptable forms of restrained flexible connections.

8.7 Electrical Inspection

The Contractor shall check all items of electrical plant for direction of rotation, correct phasing, motor and terminal voltage, and insulation resistance.

Before energising any of the motors for the purpose of commissioning, the Contractor shall measure the insulation resistance of each motor between phases and to the casing.

8.8 Stuffing Boxes and Mechanical Seals

Gland bolts shall be left completely loose and the final gland packing and tightening of gland bolts shall only be done after the motors have been tested for direction of rotation and once the plant is ready for commissioning.

Where mechanical seals are fitted and the pump design allows it, the motor couplings shall be disconnected during the initial dry run tests of the motors to ensure that the seals are not damaged.

8.9 Priming of Pumps

Where a positive head is available on the suction side of the pumps, no special priming equipment is required.

8.10 Finishing and Painting

Finishing and painting and cleaning up the Site are regarded as inherent parts of the installation. On completion of erection, all pipework, control gear and indicating gear within the pump house shall be thoroughly cleaned. Steelwork not treated in accordance with Cl 4.6 shall be primed with an alkyd

resin based primer and painted two coats gloss alkyd enamel. Other pipework, control gear and indicating gear shall receive two coats of enamel or other approved paint to the colour(s) selected by the Engineer, in accordance with SABS 0140 Part II, or as specified elsewhere. The whole of the work shall be left in a clean and properly finished condition. All paints, and materials used in their preparation, shall be of the best quality of their respective kinds. The paints and their colour shall be approved. All paint work shall be executed by tradesmen skilled in this class of work, and in strict accordance with the paint manufacturer's recommendations as approved.

9 TOLERANCES

9.1 General

The standards laid down in this Specification shall be adhered to in all cases unless the standards used by the Contractor are more stringent. In all cases where the Contractor deviates from the above standards, the Engineer shall be informed in writing and only after acceptance by the Engineer can the alternative standards be used.

9.2 Shafts

The surface of the shaft (or sleeve) through the stuffing box shall not exceed a roughness of 32 rms (root mean square) and the pump shaft (or sleeve) shall be straight and any runout, as measured by a dial indicator, shall not exceed 0.050 mm total indicator reading.

Dynamic shaft deflection measured under the worst conditions of load shall not exceed 0.050 mm maximum at the face of the stuffing box.

The balancing of all rotating equipment shall comply with the requirements of ISO 1940/1 (Balance Quality Requirements of Rigid Bodies) using balance grade G1 or Balance Tolerance grade API. Complete test certificates shall be submitted for evaluation before assembly of the units.

The alignment of shafts shall comply with the requirements of BS 3170. The shafts should be aligned in such a manner that both parallel and angular misalignment is eliminated. The acceptable alignment tolerance for parallel misalignment is 0.07 mm and for angular misalignment 0.07 mm / 100 mm.

9.3 Performance

Permissible variations from the required performance are as for SANS 9906 Grade 1E (with Efficiency as a Guarantee requirement) including an NPSH test, or SANS 9906 SANS 9906 Grade 1E (Site Works).

9.4 Vibration

Should vibration testing be specified (see Cl 10), the following shall apply.

9.4.1 Pumps

Vibration shall be measured and tolerances shall be in accordance with ISO 10816-7, Category I pumps.

9.4.2 Electrical motors

Test data taken on electrical motors running solo:

- Motor to have a ½ key installed.
- Motor to be placed on rubber mat at least 6mm thick or free-hanging.
- Where possible motor to be tested at full service speed.
- Measurement must be taken in the horizontal, vertical and axial direction on each bearing (HVA).
- Maximum amplitude of any peak in each frequency range to be recorded.
- Maximum line amplitude is the amplitude value of the highest discrete frequency component within the stated frequency range in any direction (HVA).
- Factory test certificates from the motor manufacturer must be included with delivery.

TABLE 3

VIBRATION ACCEPTANCE CRITERIA FOR MOTORS > 370 kW:

FREQUENCY RANGE		AMPLITUDE In Any Direction (mm/sec, peak)
Frequency	**Related to RPM**	
Overall vibration	Overall	2.5
Sub-harmonic	< 1 x RPM	0.6
Harmonic	1 x RPM	2.4
Lower multiples	(2 to 9) x RPM	0.9
Higher frequencies	(10 to 50) x RPM	0.3
OVERALL ACCELERATION	0 to 20 kHz	0.5 g at peak

10 TESTING/COMMISSIONING

10.1 General

All pump casings shall be hydraulically tested at the factory to at least 1.5 times the maximum possible working pressure of the pumps before any corrosion protection is applied. Through bolting, for the purpose of blanking the casing at the gland housing for pressure test purposes, will not be permitted.

Pumps and pipework shall be hydraulically pressure tested in situ by the Contractor to 1.5 times the working pressure for the pumps at their "duty point", or 1.3 times the pump shut-off pressure, whichever is the greater, by means of test equipment supplied by the Contractor.

Each test shall be carried out and certified by the manufacturer in the presence of the Engineer or his representative. The Contractor shall be responsible for all expenses incurred in carrying out all tests. When carrying out the hydraulic test (see 10.2), the Contractor shall ensure that all valves, tees and bends are properly secured and shored to prevent movement of pipes and fittings. Should any movement occur, the Contractor shall, at his own expense, reposition and, if necessary, repair the pipes and fittings and the securing means.

Until the pumps, pipework, valves, specials and joints have shown zero leakage when subjected to the pressure test, the plant will not be accepted. The test shall be repeated until the Engineer is satisfied that there is no leakage.

Pumps manufactured in cast steel shall have their casting and test bars inspected and tested at the factory (the Contractor’s works) in accordance with latest BS EN 10293 when the power absorbed by the pumps exceeds 250 kW and/or where the working pressure exceeds 1.6 MPa.

10.2 Standard Hydraulic Tests

The specified test pressure for medium pressure pipework, valves, etc., shall be applied by means of a test pump. All pipes, specials, joints and fittings shall be carefully inspected for leaks. All visible leaks shall be made good and any pipe, special or fitting found to be defective shall be removed and replaced at the expense of the Contractor. Such replacement material shall, after installation, be tested at the expense of the Contractor.

The above tests shall be complete and the test results submitted to the Engineer in writing before any running tests are undertaken on Site.

10.3 Pumpset Testing

10.3.1 General

a) Where witnessed works or Site tests are required, the Contractor shall conduct trial test runs, and satisfy himself that the test results are in accordance with the requirements specified, before notifying the Engineer. The Contractor shall be liable for the cost incurred by the Employer in the event of an abortive test requiring a retest.

b) Any pump that requires segmental hydrotest shall have the method of hydrotesting fully described in the proposal.

c) If hydrostatic tests are performed with the shaft in position, the mechanical seals shall be removed and tests conducted with other types of seals or sealing methods.

d) In carrying out the tests, the quantity of water pumped shall be measured volumetrically if facilities are available, but, if not, by a meter made in strict accordance with SANS 9906. The readings of discharge given by the meter shall be taken to be correct and accepted as such by the Contractor.

e) Apparatus shall be provided to calibrate the testing equipment before and after the tests and to measure accurately the electrical power consumed.

The Contractor shall carry out the tests specified below and such additional tests in the Manufacturer's works, on the Site or elsewhere as in the opinion of the Engineer are necessary to determine that the Works comply with this Specification. Where mechanical seals are specified or form an integral part of the pumps installed under this Contract, all performance tests shall be conducted with the seals installed, except as specified in Cl 10.3.1 c) above.

If the Engineer so requires, all instruments forming part of or used in the Works shall be calibrated at the expense of the Contractor by an approved independent authority.

Except as provided for in a) and b) below, all labour, materials, fuel, stores, apparatus and instruments for the tests shall be supplied at no extra cost by the Contractor.

a) The cost of such tests and/or analyses as are required by the Engineer to be effected by independent authorities will be refunded to the Contractor by the Employer if the results of such tests and/or analyses prove satisfactory.

b) The Employer will provide free of charge, as and when available, the electrical load or supply and the necessary water required to run the plant for the Contractor's preliminary runs and for the final acceptance tests.

If relevant to the contract, the Contractor shall carry out the tests on Site so as not to interfere with the operation of the Works or the execution of other contracts.

Three copies of the Contractor's records of all tests shall be furnished to the Engineer, as specified in Cl 10.4 d). The vibration testing shall be done by an approved agency when requested by the Engineer. Payment will be as specified in a) above.

In the event of the pump plus pipework's failure to meet the specified values, the Contractor shall be responsible for the cost of the tests, rectification and subsequent re-testing until the specification is met.

10.3.2 Pump Tests - Manufacturer's Works

All test bed testing shall be carried out under the supervision of competent and experienced staff, fully conversant with the test bed. Test measurements shall generally be carried out in accordance with SANS 9906 Grade 1E (with Efficiency as a Guarantee requirement) including an NPSH test..

Non-conforming pumps shall be modified or replaced by other pumps in order to achieve the guaranteed efficiency at the duty point.

A test manual, fully describing the test procedure, etc., as well as details of the calibration procedures and calibration interval of all instruments, shall be available at all times while the pumps are under

test. The test manual shall include simplified explanations of all key points necessary on measurements, datum corrections, calculations and all points to be considered in assessing mechanical integrity. The manual shall be sufficiently comprehensive to make it the only document required by test personnel.

If required performance and/or vibration testing shall be carried out by the pump/motor manufacturer at an approved test facility and witnessed by the Engineer or his representative.

Certified test results, whether from the manufacturer's works or elsewhere, shall be provided to the Engineer before delivery.

The pump shall be inspected at the factory. The impeller shall be available for inspection.

If the equipment is manufactured and assembled in South Africa, the Contractor shall make all arrangements and carry all costs for the Engineer to inspect equipment and fabrications in the workshop prior to dispatch to Site. Fabrications shall be inspected prior to corrosion protection.

If the equipment is manufactured and assembled outside South Africa, the Contractor shall make all arrangements and carry all costs for an Engineer approved inspection authority to inspect the equipment in the workshop prior to dispatch. The inspection shall include a full report on compliance of the equipment with this specification and this report shall be submitted to the Engineer prior to dispatch of the unit from the workshop.

The Contractor shall make all arrangements for the Engineer to witness the following for pumps with motor ratings of 100 kW and above:

- the casing being pressure tested to 1,5 times design pressure for a period of 30 minutes.
- the performance testing for flow, head and efficiency at the specified duty point. The test shall be performed in accordance with SANS 9906 Grade 1E (including Efficiency as a Guarantee requirement) including an NPSH test; preferably at the manufacturer’s works.

The Contractor shall arrange that a test report for the following shall be submitted to the Engineer for pumps with motor sizes smaller than 100 kW:

- the casing being pressure tested to 1,5 times design pressure for a period of 30 minutes.
- the performance testing for flow, head and efficiency at the specified duty point. The test shall be performed in accordance with SANS 9906 Grade 2B.

10.3.3 Pump Unit Tests - Site of Works

The correct operation of the equipment and achievement of the specified performance requirements shall be demonstrated to the Engineer prior to the commissioning of the Works.

During witness testing in accordance with the specified SANS 9906 grade of test, the pump shall perform within the standard’s acceptable tolerances for differential pressure across the pump, volume flow and energy efficiency.

Vibration testing shall be carried out in accordance with BS ISO 10816-7, Category I pumps.

During witness testing of the pump casing, the pump shall exhibit no leakage.

Two separate series of tests called the Preliminary Acceptance Test and Final Acceptance Test shall be carried out by the Contractor on all pumping units after installation. Test measurements shall generally be carried out in accordance with SANS 9906.

10.3.3.1 Final Acceptance Test

The Final Acceptance Test shall be carried out after he has run the plant for a period of 48hours. The Contractor shall provide all necessary instruments, staff and labour for the tests and a representative of the Engineer will be present at all tests and shall be provided with full details and the calculated results, all recorded as shown in Appendix D.

If in the Final Acceptance Test, the characteristics fall short of those specified by the SANS 9906 grade of test, the Contractor shall immediately remedy the defects to ensure that the installation complies with these requirements, at his own expense and within such time as may be laid down by the Engineer. When the Contractor has made good the defects, and is satisfied that the pumping unit is ready to be taken over by the Employer, a second Acceptance Test shall be carried out, by the Contractor.

If, in the second Acceptance Test, the performance of any of the pump units falls short of requirements, using the criteria in the preceding paragraph, the equipment or part thereof may be rejected, in which case the Contractor shall take immediate steps to replace the rejected equipment with equipment complying with the specifications.

Such replaced equipment shall be subjected to a Final Acceptance Test and the provisions of the two preceding paragraphs shall apply thereto.

10.4 Guarantees of Performance

a) The Contractor shall guarantee the output and efficiency of all machines, which guarantees shall be binding under the Contract.

b) The fulfilment of these guarantees shall be demonstrated at the Contractor's factory premises or a suitable off-site test facility approved by the Engineer in accordance with SANS 9906 Class 1 and shall be verified on Site in accordance with SANS 9906 Class 2.

c) All measuring instruments used in the tests shall have previously been certified by an independent testing authority, not more than one month prior to the test and to the Engineer's satisfaction. The pump power output shall be based on the total head as defined in the Project Specification.

d) Where guaranteed performance is specified, certified test curves shall be drawn from the test data obtained from the purchased pumps and shall include; head (m), quantity pumped (m3/h or ℓ/s), efficiency (%), power consumption (kW), speed in rpm and speed/torque (rpm/kNm). The probable performance with maximum and minimum impellers shall also be indicated, as well as tested (or probable) NPSH available.

e) Each pump shall be checked for acceptable vibration limits and noise limits if required during testing.

10.5 Failure to Achieve Guarantees

a) The Contractor shall ensure that the pumps deliver the "Required minimum discharge", by fitting new impellers or taking whatever action is necessary should there be any shortfall in the quantity of water measured when the pumps are delivering at the total head associated with the "duty point" in fulfilment of the Guaranteed Performance criteria.

b) Payment by the Contractor in lieu of under-performance of the pumpsets relative to the Guaranteed Performance will not be acceptable.

11 MONITORING OF PUMPS AND MOTORS

11.1 Monitoring Devices

11.1.1 General

The indicating or monitoring equipment shall not be affected by surges in the supply system or by portable radio transmitting equipment.

All sensors shall be compatible with the associated monitoring equipment.

Monitoring equipment shall be suitable for flush panel mounting at any angle between the vertical and horizontal planes.

Full details of the sensing equipment and of the associated control and monitoring or indicating equipment shall be submitted with the tender offer. Evidence shall also be submitted that adequate spares and services are readily available in this country.

11.1.2 Temperature monitoring devices

It shall be the full responsibility of the Contractor to ensure that all temperature sensing devices for either motor or pump and their respective monitoring equipment are compatible with the local network and other systems installed in the pump station.

Refer to clauses elsewhere for temperature monitoring of pump and motor bearings.

a) Temperature sensors

Either thermocouples or resistance temperature detectors (RTD's) shall be installed, depending on which is more suitable to the duty and application. Unless otherwise specified, pumps with motors smaller than 50 kW shall have thermocouples installed. Pumps with larger motors shall have RTD's installed. At least two RTD's shall be installed per phase (a minimum of 6 RTD's in total for a 3 phase motor)

b) Location of temperature probes

Separate temperature probes shall be installed at the sleeve and/or rolling bearings of each pump and motor and at the gland housings (where applicable) of the pump to monitor the temperatures at these points. If suitable, probes shall also be installed in the slots of the motor stator windings together with the coils, one per phase, to monitor motor winding temperatures as required in the Project Specific Pump Specification.

Each pump casing (for split casing pumps) shall be fitted with a RTD to safeguard the pump in the event of inadvertent sustained operation against a closed discharge valve. The RTD's shall be calibrated to close when the temperature of the water in the pump casing exceeds 40°C. The RTD shall be settable over a range of 20 to 60 degrees and shall provide a digital output to the pumpline PLC.

The probes shall be installed in direct contact with the motor stator windings and/or shall be spring loaded to ensure positive contact with the bearing shells or gland stuffing boxes.

Each probe shall be complete (where required) with an integral and continuous compensating lead of sufficient length to permit a neat installation between the probe and the terminal point. The compensating lead shall be adequately protected against the risk of mechanical damage.

Each probe shall be clearly identified by means of an engraved marking on the sheath and shall be individually calibrated. Test certificates covering the calibration results of all temperature probes shall be submitted to the Engineer.

Temperature probe terminals shall be clearly marked in order to prevent inadvertent reversed readings.

c) Temperature monitoring equipment

Temperature monitoring equipment shall feed analogue (4-20 mA or similar) signals to the pumpline PLC and display of the temperature shall be on the HMI panel as well as remotely.

11.1.3 Pressure Devices

a) Pressure gauges

Each pumpset shall be equipped with two 160 mm diameter dial flush mounting stainless steel pressure gauges. The gauges shall be calibrated in Kilo-Pascals (Kpa) and the range shall suit the particular application. The gauge shall be filled with glycerine, and the bubble shall be out of the range of usual reading. The gauges shall be of a type that can be recalibrated (dead-weight method) and reset on Site. Where there are more than one pump in a pumpline operating in series, the pressure between pumplines shall also be indicated on a pressure gauge.

Pump discharge pressure gauges shall be capable of reading pump closed valve pressures. The gauge indicating the pump suction pressure shall a combination gauge capable of indicating the maximum possible suction pressure as well as full vacuum conditions.

All pressure gauges shall be supplied and installed complete with isolating and drain cocks, piping, etc., and fitted with a pulsation snubber.

Pressure gauges, if located on the control console, shall be mounted in a compartment totally separated from the electrical equipment. The compartment shall be equipped with a drain.

b) Suction Pressure Switch

If required in the Project Specific Pump Specification, a pressure switch shall be fitted to the suction pipe of each pump downstream of the inlet isolating valve, and interlocked with the pump control circuit.

c) Pump suction and delivery pressure transducers

Where required in the Project Specific Pump Specification Project Specification, suction and delivery pressures shall be registered by suitable pressure transducers and the signals of these instruments shall feed into the pump PLC. Analogue signals shall be generated by these devices.

d) Pump station suction and delivery pressures

A signal derived from a suitable source on the suction manifold or pump station forebay and an appropriate tapping on the venturi flow element (if installed) or other suitable source on the delivery manifold shall be utilised to indicate the station suction and delivery pressures in the position specified.

e) Hydraulic snubbers

Hydraulic pulsation snubbers complete with throttle/isolating/bleed devices shall be fitted in series with all pressure sensing devises.

11.1.4 Pumpset Vibration Sensors

Suitable vibration sensors shall be mounted on each pumpset to stop it on detection of excessive vibration. At least two detectors shall be provided on each pumpset, i.e. one on the motor bearing (drive end) and one on the pump bearing (drive end), situated as close as possible to those bearings where the highest vibration levels are encountered.

Monitoring equipment similar to that described in clauses above for the temperature sensors shall be installed for monitoring the vibration sensors. The indicating instruments shall be suitably calibrated. They shall be of a type such that it is possible to set different tripping levels corresponding to different RMS velocities.

The monitoring of vibration shall be made via a suitable timing device in order to avoid tripping when starting the pumpset or during other transitory conditions.

11.1.5 Flow and Power indicators, Hour meters

a) Flow measurement for the complete Pump Station

Indication on the appropriate HMI screen and recording of total Pump Station output measured in the rising main shall be provided if required in the Project Specification. Two sets of figures shall be recorded, one resettable and the other not.

b) Flow Sensing for each pumpset (where required)

If required, indication of flow from each pumpset shall be as specified in the Project Specific Pump Specification. The presence of flow from each pumpset shall be registered on the appropriate HMI screen.

c) Power (where not addressed elsewhere)

Where required in the Project Specification, the power absorbed by each main pumpset motor shall be displayed on a power meter, calibrated to indicate the rated motor power, of the industrial grade complying with BS 89, wired to appropriate sources of current and potential, and mounted on each local control panel.

d) Hour meter (where not addressed elsewhere)

The total number of hours for each machine shall be displayed on the appropriate HMI screen. Two figures shall be recorded, one resettable and the other not.

11.1.6 Additional sundry sensing devices

a) All valves in the main pumpline (except for when a reflux valve is called for) shall be provided with both "fully open" and "fully closed" limit switches. A pump control valve may require additional switches to facilitate its design function.
b) Valve actuators shall be provided with torque limit switches.
c) A flow sensor shall be provided in the motor cooling-water circuit (if applicable).
d) A temperature sensor will be provided in the inlet and outlet of each cooling water circuit (if applicable).
e) A pressure sensor will be provided in the inlet of each cooling water circuit (if applicable)
f) Any additional sensing devices as more fully described in the Project Specific Pump Specification.

11.2 Pump Control Panels

This clause shall generally only apply to smaller pumps.

The requirements for larger pumps are dealt with in the relevant Particular and Project Specifications.

11.2.1 General

Unless otherwise stated in the Project Specification, a small desk-type console, shall be provided for each pumpset and mounted in close vicinity of the pump on the pumpwell floor. The console shall be fully enclosed and fitted with removable front panel to facilitate mounting of monitoring equipment, instruments and associated wiring. All displays, and control equipment as specified, shall be flush mounted on the consoles. Engraved labels indicating the designation of each instrument, indicator lamp or control, shall be fixed below each item.

If two pumps operate in series, each pumpset shall be provided with all the monitoring equipment specified, mounted on one common control console. As far as control is concerned, the pump line shall be treated as a whole with only one start/stop switch.

The layout of the control console and the equipment contained therein shall be as more fully described in the Project Specification and to the approval of the Engineer.

11.2.2 Rated voltage

The voltage available for the Local Control Panel (LCP) will be 48V DC. If any of the equipment inside the panel requires a different voltage, the Contractor shall make provision for this voltage from the 48 V DC.

Equipment located in the console shall be suitable for operation at any voltage within the range plus 10%, minus 20%.

11.2.3 Labelling

Labels shall be in English and shall be of Traffulyte or rear engraved Perspex. Lettering shall be in black on white background. Punched tape is not acceptable.

Each panel shall be fitted with a general information plate at least 150 mm wide made of either chrome-plated steel or stainless steel on which the following information is clearly engraved (as applicable).

- The pumpset number at least 100 mm tall.
- Pump : as per Cl 6.8
- Motor : manufacturer, type or designation, power kW, cooling media
- Inlet valve : manufacturer, design, type or designation, nominal bore
- Control valve (if required): manufacturer, design, type or designation, nominal bore.
- Check valve : manufacturer, design, type or designation, nominal bore.
- Delivery valve : manufacturer, design, type or designation, nominal bore.

11.2.4 Control Panel Cabinet

Refer to GIBB-011 General Electrical Specification, and the Umgeni Water particular specifications.

11.3 Mounting of Equipment

All indicating or monitoring equipment as well as control equipment providing indication and setting facilities, are to be flush-mounted on the consoles and all other components are to be mounted internally. At least 10% of free space shall be provided inside the console.

All components shall be inter-connected and fully wired and all connections shall be clearly identified by means of suitable numbered ferrules. All outgoing circuits shall be wired to terminal blocks comprising suitable screw connectors and situated near the base above the gland plate. All terminals shall be labelled and at least 10% free terminals shall be provided as spare. Cables will enter the consoles from below through slots in the floor.

12 MEASUREMENT & PAYMENT

The tendered rates or sums shall cover the cost of anything not specially mentioned, but which an experienced contractor can reasonably foresee as being required to enable the apparatus and equipment to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of equipment or part thereof is not specifically mentioned in the Schedule of Quantities.

Measurement and payment of pumpsets shall comprise payment in two stages:

- Design, supply, and delivery
- Installation, testing, and commissioning.

The term ‘pumpset’ refers to the complete set of pump, motor, shaft, couplings, baseplates, fasteners, holding down bolts and all accessories necessary for a complete functional unit.

12.1 Design, supply, and delivery of pumpset, Instrumentation and accessories

Design, supply and delivery of pumpset, Instrumentation and accessories: [description of pumps. Describe additional requirements where applicable]	……Unit: No. or Sum

This shall include the set of all equipment, instrumentation, couplings, cabling, and ancillary items considered to form a complete pumpset, including the motor and accessories thereof.

Design: The rate tendered shall include full compensation for the design of the complete installation including full design calculations; detail working Drawings for all items; Specifications; schematic diagrams; electrical Drawings and wiring diagrams; layout Drawings, quality control plans, and provision of the above to the Employer's Agent for approval in accordance with the requirements of the Scope of Work.

Supply: The tendered sum shall cover the cost of the supply of the goods, testing as specified, provision of test certificates certifying compliance of the goods with the applicable standards, quality control, corrosion protection, if not scheduled separately, and supply of all special tools and keys required for maintenance and installation. Payment for supply of the relevant equipment will not be effected until the draft copies of the related sections of the Operation and Maintenance Manuals have been submitted.

Delivery: The tendered rate or sum shall cover the cost of preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. Where a rate or sum has been tendered for delivery of goods, which are then, stored, the Engineer at his sole discretion may certify an amount for partial or full payment of the relevant item, if in the Engineer's opinion such a payment is justified by reason of the transportation of such goods to their place of storage.

12.2 Installation, Testing and Commissioning of complete pumpset, instrumentation and accessories

Installation, testing and commissioning of complete pumpsets, instrumentation and accessories [description of pumpsets. Describe additional requirements where applicable]	……Unit: No. or Sum

The scope shall include the pump, pump ancillary items, motor, motor ancillary items, and instrumentation specific to each pump-line, and all other components, accessories, equipment and civil works necessary for a complete functional installation.

Installation: The tendered rate or sum shall cover the cost of all necessary site oriented activities such as handling at the Site, storing, sorting, erecting, all painting, including all costs of transport of personnel and their erection gear to Site, and the cost of all materials, labour and consumables. Where items of equipment are to be grouted in (such as for anchors and pumpset base plates), the installation sum shall include for such work.

Testing and commissioning: The tendered rate or sum shall cover the cost of pre-commissioning tests, as well as commissioning tests, including putting the Works into operation. All costs of transport to and from Site, and Site accommodation of personnel and their gear shall be included in the tendered rates.

12.3 Spare Parts

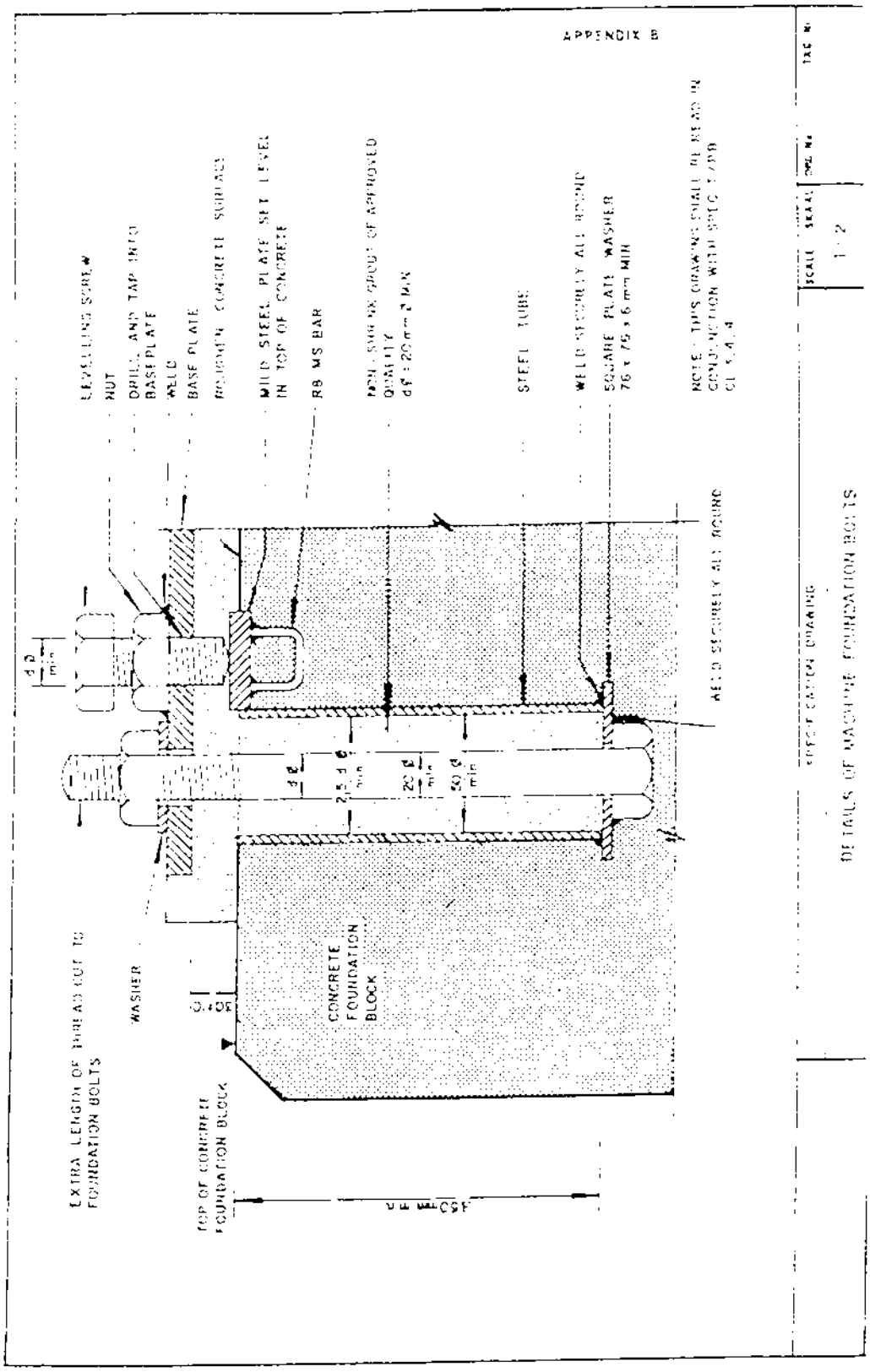
Design, Manufacture Supply and delivery to site of complete set of spare parts as described below:	……Unit: Lump sum (Sum)

*(example list of required spares provided below)

- Spare impeller, spare shaft sleeves, all mounted on a spare shaft with all keys in position. (1 set)
- Casing wear ring. (1 No)
- Impeller wear ring. (1 No)
- Drive end seal. (1no.)
- Non-drive end seal. (1 No)
- Drive end bearing, including all washers, seals, sleeves, etc. (1 Sets)
- Non-drive end bearing, including all washers, seals, sleeves, etc. (1 Sets)
- Complete set of gaskets, O rings, V rings, etc., for a single pump (1 Sets)

Where applicable spares shall be mentioned in the payment item description.

APPENDIX A: DETAILS OF MACHINE FOUNDATION BOLTS



APPENDIX B : RECOMMENDED CAST MATERIALS

Description	Preferred alloys			Specific application alloys		
	British Standard Specification	Near equivalent specifications		British Standard Specification	Near equivalent specification	
		American	German		American	German
Grey cast iron	BS 1452 Grade 190	ASTM A48 Class 25	DIN 1691 GG-20	BS 1452 Grade 270	ASTM A48 Class 40	DIN 1691 GG-25
	BS 1452 Grade 220	ASTM A48 Class 30	DIN 1691 GG-20	BS 1452 Grade 315	ASTM A48 Class 45	DIN 1691 GG-30
Spheroidal or nodular graphite cast iron	BS 2789 Grade 420/12	ASTM A536 Grade 60-40-18	DIN 1693 GGG-40	BS 2789 Grade 600/3	ASTM A536 Grade 80-55-06	DIN 1693 GGG-60
Flake graphite austenitic cast iron	BS 3468 AUS 101 Grade A	ASTM A436 Type 1	DIN 1694 GGL-NiCuCr 1562	BS 3468 AUS 102 Grade B	ASTM A436 Type 2b	DIN 1694 GGL-NiCr 203
Spheroidal graphite austenitic cast iron	BS 3468 AUS 202 Grade A	ASTM A439 Type D2	DIN 1694 GGG-NiCr 202	BS 3468 AUS 202 Grade B	ASTM A439 Type D2B	DIN 1694 GGG-NiCr 203
Carbon steel	BS 1504-161 Grade A or BS 592 Grade A	ASTM A216 Grade WCA or ASTM A352 Grade LCB	DIN 1681 GS-45	BS 1504-161 Grade B or BS 592 Grade B	ASTM A216 Grade WCB	DIN 1681 GS-52
Austenitic corrosion resisting steel	BS 1504-821 Grade Nb or BS 1631 Grade B	ASTM A296 Grade CF-8C	DIN 17006 G-X7 CrNiNb 189	NONE	-	-
	BS 1504-845 Grade B or BS 1632 Grade B	ASTM A296 Grade CF-8M	DIN 17006 G-X5 CrNiMo 1810	BS 1504-845 Grade Nb or BS 1632 Grade C	ASTM A296 Grade CF-8M	DIN 17445 G-X7 CrNiMoNb 1810
Martensitic corrosion resisting steel	NONE	-	-	BS 1504-713 or BS 1630 Grade B	ASTM A296 Grade CA-15	DIN 17445 G-X20 Cr 14
Leaded gunmetal	BS 1400 LG2	ASTM B145-No. 836 SAE No. CA 836	DIN 1705 G-CuSn5ZnPb	NONE	-	-
	BS 1400 LG4	-	DIN 1705 G-CuSn6ZnNi	NONE	-	-
Copper-tin alloy	NONE	-	-	BS 1400 CTI	SAE No. CA 905	DIN 1705 G-CuSn10
Aluminium bronze	NONE	-	-	BS 1400 AB2	ASTM B148 No. 955	DIN 1714 G-CuAl10Ni
Phosphor bronze	BS 1400 PB1	SAE No. CA 907	-	NONE	-	-
Leaded bronze	BS 1400 LB2	ASTM B22 No. 937	DIN 1716 G-CuPb10Sn	NONE	-	-
Leaded phosphor bronze	NONE	-	-	BS 1400 LPB1	-	-
Aluminium alloy	BS 1490 LM6	ASTM B85 Alloy S12A	DIN 1725 Sheet 2 G-AlSi12			
	BS 1490 LM9	ASTM B85 Alloy SG100A	DIN 1725 Sheet 2 G-AlSi10Mg	BS 1490 LM 24	ASTM B85 Alloy SC84A	DIN 1723 Sheet 2 G-AlSi8Cu3
	BS 1490 LM 25	ASTM B26 Aloy SG70A ASTM B108 Alloy No. 356.0	DIN 1725 Sheet 2 G-AlSi7Mg wa			

APPENDIX C : MEASUREMENT ACCURACIES

The accuracy of the measurement of pump performance is dependent on the test loop design and the instrumentation used.

The Contractor shall provide testing in accordance with SANS 9906 as applicable to the pumps. Test loops shall have:

- An axially symmetrical velocity distribution;
- A uniform static pressure distribution; and
- Freedom from swirl induced by the installation.

With test loops designed to conform with these standards, the limits of error shall be within those shown in Table 10 of SANS 9906. The quoted figures are maximum values, but greater accuracies can be obtained if the available instruments operate near to their full scale value.

APPENDIX D : PUMP TEST SHEET

Client: ..... Client's Order No.: ..... Test Date: ..... S.A. Job No: .....

Size of Pump: ..... Nameplate No: ..... Flow: ..... N.G.H. ..... rpm .....

Size of Motor: ..... Nameplate No: ..... Volts: ..... Amperes: ..... Power: ..... rpm .....

Test No Time	R P M	Volts K =	Amps K =	Watts K =	Flow Meter %	Flow	Actual Delivery Gauge Reading	Corrected Delivery Gauge Reading	Actual Suction Gauge Reading	Corrected Suction Gauge Reading	Velocity Head Correction	Total Head inc. diff in level of Gauge of =	Motor Power Input	Motor Effcy %	Pump Power Input	Pump Power Output	Pump Effcy. %	Remarks

Impeller Dia:		Shroud Width:	Tip Width:		Imp. Drg. No:
Voltmeter No:	Barometric Press	Time Started Up:	Orifices Used:		Tested by:
Ammeter No:	Balance Water:	Time Shut Down:	Constant: K =		Witnessed by:
Wattmeter No:	Pressure Gauge No./Range		Suction Gauge No./Range		Passed O.K. Mechanically by:
					Passed O.K. Hydraulically by:

HARRY GWALA DISTRICT MUNICIPALITY

CONTRACT NO: HGDM748/HGM/2021

CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM: CIVIL, MECHANICAL & ELECTRICAL

PARTICULAR SPECIFICATION

GIBB 006 – HYDRO-MECHANICAL EQUIPMENT

REV 1.4

Table of Contents

Table of Revisions

Revision	Date	Change Detail	Editor
1.11	December 2020	Initial Release	M. Funnell
1.2	April 2021	Revised payment clause 11 • removed *and GIBB 005 . Sluice Gate Specification* • *Added* "as listed or described in the relevant payment items"	M. Holmes
1.3	April 2021	Revised closing times for hydro mechanical equipment, and defined number of concurrent equipment operations (sections 4.1.1 and 4.3.1)	M. Holmes
1.4	June 2021	Revised Sluice Gate Payment Item Description	M Holmes

1 SCOPE AND DEFINITIONS

This specification deals with the design, supply, installation and commissioning of radial gates, sluice gates, stop logs, and screens. (collectively called hydro-mechanical equipment/works). The Contractor shall provide and install all items specified, including the following:

a) Radial Gates, including seals, bearings, skin plates, hydraulic actuators etc.
b) Sluice gate, including the frame, gate, seals, spindle, headstock with thrust nut and handwheel, yoke design, actuation type, nuts and bolts
c) Stop logs
d) Screens, including frame, screen, seals, lifting equipment which is discussed and measured elsewhere, nuts and bolts etc
e) Installation, including grouting,
f) Testing
g) Line shafting (if specified)
h) Actuators (if specified)
i) Electrical equipment (if specified)
j) Hydraulic equipment (if specified)

The equipment provided under this specification shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, Engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by the Employer's Agent.

All hydro-mechanical equipment and operators shall be supplied with all the necessary parts and accessories indicated on the drawings, specified or otherwise required for a complete and properly operating installation, and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated hydro-mechanical equipment and appurtenances.

2 INTERPRETATIONS

2.1 Supporting specifications

Where this specification is required for a project, the following specifications shall, inter alia, form part of the contract document:

- GIBB 002: General Mechanical
- GIBB 008: Cranes, Gantries, Hoists and Winches (if applicable)
- GIBB 010: Electric Actuation (if applicable)
- GIBB 007: Painting and Corrosion Protection
- GIBB 011: General Electrical

2.2 Definitions

For the purpose of this document and in additional to the definitions given in the above specifications the following definitions shall apply:

- Hydro-mechanical equipment/works collective term used for radial gates, sluice gates, stop logs, screens etc.
- Design. means the original design of all gates and hoists specified herein and includes any model testing, determination of loading, calculations of skinplates (if necessary), structural members, construction and assemblies required to resist the imposed loads, preparation of all general arrangement, detailed and shop drawings and detailing as required to completely show the entire extent of the work to the *Employer's Agent* and the fabrication and assembly

shops, preparation of all shop and field test and inspection plans and Quality Control and Quality Assurance plans, and submission of all design documentation, Operation and Maintenance Manuals and record drawings, for acceptance by the *Employer's Agent*, all in accordance with the specifications.

- Supply. Includes, as applicable, the purchase of all materials or goods, manufacture and fabrication, supply and application of corrosion protection measures and coatings, all off-site shop inspections and testing, preparation of Bill of Materials and packing lists, packing and handling for shipment, shipment to site and storage at site.
- Installation. Includes handling and transport of all equipment from storage, placement, alignment and adjustment of all anchors, built-in parts and stationary parts exposed to water in the primary and secondary concrete (as required by the design), placement of all secondary concrete, insertion of the gates in their correct positions, connection of gates to hoists, and all other erection and setting to work.
- Tests on Completion. includes all specified or necessary *'dry' and 'wet'* commissioning tests (during and after installation) on the equipment specified and supplied herein (and in related sections) that are required to demonstrate to the *Contractor*, the *Employer's Agent* and the *Employer's Agent* that the equipment supplied operates together safely and reliably and in accordance with the specifications, and will so operate over the service life of the equipment. In addition to this any and all statutory requirements and testing applicable to the supplied equipment shall be included.
- Gate. Is a device used to close off entirely a waterway passage and may be wheeled or sliding.
- Stop log. Is a sliding device used to close off a waterway passage or path.
- Hoists**. I**s a collective term referring to all hydraulic, electrical and mechanical equipment and Plant specified for raising and lowering the gate or stop log between their fully inserted (closed) positions and their fully raised (stored) positions and any intermediate position.
- Hydraulic actuator is a collective term referring to all parts of the actuation mechanism and shall include the Hydraulic Cylinder, Drive and Control unit.
- HPP is an acronym for Hydraulic Power Packs

2.3 Tender Drawings

Refer to the Scope of Works for the list of drawings that will outline the general requirements of the mechanical equipment listed below. The *Contractor* shall develop the detailed design in each case, within the space and layout constraints indicated by the Drawings and in accordance with the overall requirements of the Specification.

2.4 Scope of Work

This is a General Specification intended to include design, supply, installation and Tests on Completion of the hydro-mechanical equipment in accordance with the Specifications. The Contract shall include the design, supply of all materials, manufacture, shop assembly and testing, corrosion protection, delivery to site, storage, installation and erection at site, site painting, tests on completion and commissioning, and maintenance until take over, of all mechanical equipment in the Works. Further to this the following specific works are also to be included in the works:

- The Hydro-mechanical equipment shall be supplied with all necessary items to provide complete working installations including all built-in parts and anchors, rail tracks, covers and frames, operating gear, controls and safety devices and hydraulic or electrical control panels from and including the main isolating switch on the incoming supply.
- All Civil Engineering work in forming and preparing box-outs, chases etc., to receive the built-in parts and in placing concrete around them or grouting-in base plates and holding down bolts and the like shall be carried out by the Contractor.

- The general requirements of the hydro mechanical equipment shall be as shown on the drawings. The Contractor shall develop the detailed design in each case, within the space and layout constraints indicated by the Drawings and in accordance with the overall requirements of the Specification.
- The Contractor shall be deemed to have taken into account, inter alia, all of the operating and maintenance requirements and physical conditions in preparing his Tender in addition to the operating and climatic conditions prevailing at the Site.
- The Contractor shall be responsible for all operations necessary for the adjustment and testing of the hydro-mechanical equipment until it has been taken over. During the entire testing (and pre-testing) period, the Contractor shall be wholly responsible for the preservation, care and remedying of any defective parts of the hydro-mechanical equipment. The Contractor shall provide all labour, supervision, guarding, apparatus, materials, stores, instruments etc., necessary for the effective discharge of these obligations.
- The Contractor shall permit and facilitate the Employer's Agent's observation of the erection, installation and testing of all hydro-mechanical equipment. The Contractor shall ensure that specialist personnel from Subcontractors are on hand over the entire planned duration of the tests, and have made contingency plans to remain present in the event that the tests over-run their expected duration.
- The Contractor shall take into account the load capacity and the clear dimensions of the Access road for installation and maintenance in the design and manufacture of the Hydro-Mechanical Equipment. If necessary, the equipment will be designed in components to ensure it can be easily maintained by the Employer after installation.

All plant and equipment shall be identified by a P&ID coding system, either through client preference or GIBB standards. The *Contractor* shall use this system of identification on all drawings and documents.

2.5 Conflicting Specifications

From the list of specifications listed above, should there be any conflicting materials, methods of installation, testing, and general design criteria, the hydro-mechanical specification will take precedence. However, this must be approved by the Employer's Agent should there be any queries by the tenderer or Contractor.

3 GENERAL DESIGN AND MANUFACTURING REQUIREMENTS

Equipment, materials and operational methods shall comply with the latest edition of the relevant national and/or international standard.

As required in terms of the General Conditions, the Contractor shall provide the details of all civil requirements to the Employer's Agent for incorporation into the civil structure, shall measure civil and building work on Site and shall provide, in the design, to accommodate for a normal civil tolerance of + 40 mm unless a tighter tolerance is called for by the Contractor and agreed to by the Employer's Agent.

3.1 Submissions

Submissions shall be in accordance with the Scope of Works and as specified herein. Submittals shall include as a minimum:

1. Shop Drawings
2. Manufacturer's operation and maintenance manuals and information.
3. Manufacturer's installation certificate.
4. Manufacturer's equipment warranty.
5. Manufacturer's performance affidavit .
6. Design calculations demonstrating lift loads and deflection in conformance to the application requirements.

7. Design calculations shall be approved by a licensed Professional and shall be available upon request.

3.2 General Design Criteria

Some of the following design criteria incorporated in the hydro-mechanical specifications will only be applicable should the Scope of Works, Control Philosophy and tender drawings, indicate the availability of certain mechanical equipment.

For example: if the Works does not include use of servomotors or the radial gates do not contain wheels - all directly relevant design criteria pertaining to those specific sections can be ignored.

3.2.1 Service Life

All hydro mechanical equipment materials, design safety factors, steel thicknesses, weld designs, connections, painting, coatings, etc. shall be selected for minimum 50 year service life and minimum 20 years before significant refurbishment.

3.2.2 Tender Designs

The radial gate and stoplog designs shown in the Drawings are provided for the purpose of identifying the types of structures expected, approximate gate dimensions for the specified clear openings, the locations of the seal faces, reservations (boxouts) in the primary concrete on either side of the waterways (boulder/gravel/sand traps) for installation of built-in parts and anchors, the estimated depths of the gates and stoplogs, beams and gate and stoplog slots for the imposed design heads, sill elevations, dimensions and elevations of gate and stoplog and hoist supporting structures and platforms, etc. The *Contractor* is not required to conform identically to the designs shown on the Drawings in order to provide designs that meet the specifications. It is expected that the *Contractor* will employ experienced and qualified designers of gates and hoists who will apply their expertise to provide economical designs that meet the specifications and the intended purpose and requirements of the gates and stoplogs, satisfactorily resist all imposed loads within the specified design criteria, and minimize the loads imposed on adjacent structures.

3.2.3 Concrete Dimensions

The basic dimensions and weights of all proposed gates and stoplogs and estimated hoist capacities shall be submitted by the *Contractor* including confirmation that the reservations provided in the Preliminary Design for anchors and secondary concrete will be sufficient for the proposed installation. **90 days prior to the casting of the first foundation**, the dimensions, and magnitudes and locations of loads upon, all primary and secondary concrete outlines, secondary concrete structures, reservations, boxouts/blockouts, recesses above the radial gate lintel, and structures required by the *Contractor* to accommodate and facilitate correct operation of the gates and associated equipment specified herein or proposed by the *Contractor* shall be clearly shown in drawings submitted by the *Contractor*.

3.2.4 Design Standards

Design loads and load cases, design and permissible stresses, friction factors, analysis of structures, machinery and machine components, design for fatigue, detailing and fabrication of steel structures, design principals for machinery, design and selection of electrical equipment, and manufacture of radial gates, stop logs, screens, electric wire/chain rope hoists, and hydraulic hoist systems (servomotors and hydraulic power systems) shall be in accordance with DIN 19704-1 (Hydraulic Steel Structures, Part 1, Design Analysis, latest version), DIN 19704-2 (Hydraulic Steel Structures, Part 2, Detailing and Fabrication, latest version) and DIN 19704-3 (Hydraulic Steel Structures, Part 3, Electric Equipment, latest version), except where otherwise specified herein. In addition, all Normative references and Standards listed in Section 2 of each of the above named Standards shall be considered to be part of this specification, to the extent that they are applicable to the design and manufacture of the Plant specified, unless otherwise

specified herein, and except where an applicable and equivalent SANS (South African National Standard) Standard exists that shall be used instead.

3.2.5 Design Stresses

Allowable stresses and safety factors for steel and structural steel design shall be determined according to SANS 10162: "The Structural Use of Steel" (all parts, latest versions), taking into account also the specifications of DIN 19704-1. Allowable stresses in welded connections shall be 90% of those permitted in SANS 10162, except where furnace stress relieved and 100% radiographed, in which case 100% of the allowable stresses is permitted. Welded field connections are not permitted on the gate structures, but are permitted on built-in parts.

3.2.6 Further Design References

In addition, the designer of the gates and hoists shall procure, review, and consider, all parts of USACE EM-1110-2-2305 (Design of Hydraulic Steel Structures). However, where the provisions, specifications and recommendations of USACE EM-1110-2-2305 conflict with those of DIN 19704, the latter shall take precedence.

3.2.7 Design loads and load cases:

Design loads and load cases for vertical roller gates, stop logs, and screens shall be those set out in DIN 19704-1 and DIN 19704-2: Hydraulic Steel Structures (Parts 1 and 2, latest versions), except that:

Safety factors for load cases shall be the more stringent of those in DIN 19704-1 and DIN 19704-2 or the following shown in Table 23/2, applied against the guaranteed yield strength of the material:

Table 1:Load Factors

STRESS TYPE	NORMAL LOADS UNDER STATIC WATER LOADS, INCLUDING FRICTION AND THERMAL EFFECTS, HYDRODYNAMIC ACTION, SHIPPING AND ERECTION	NORMAL LOADS PLUS ADDITIONAL LOADS FOR EMERGENCY FLOW SHUTOFF, HYDRAULIC TRANSIENTS, & OPERATION AT EXTREME OPERATING LEVEL IN RESERVOIR	NORMAL LOADS PLUS ADDITIONAL LOADS PLUS SEISMIC LOADS
Compression and compression due to bending when stability considerations are applied	1.7	1.5	1.3
Tension and tension due to bending	1.5	1.3	1.15
Combined bending and shear stresses	1.3	1.22	1.1
Shear with ultimate shear at $1/\sqrt{3}$ shear stress	1.5	1.28	1.15

Friction coefficients for forces and loads due to friction during gate loading and operating conditions shall be per DIN 19704-1.

3.2.8 Structural Steel

Except where otherwise specified, all structural steel parts of gates and hoists shall be manufactured from steel conforming to SANS 1431, Grade 300W, or equivalent standard. The grade classification shall be decided on the basis of notch ductility and corrosion requirements. For gate bottom, side and top beams that support seals and where excessive bending could cause seal leakage, higher strength weldable steels may be proposed to reduce deflections.

3.2.9 Design Heads

All gates shall be designed using the design criteria and safety factors given in the references and standards specified in this section for the hydraulic heads represented by the difference between the Max head level and Sill elevations. Refer to table 1.3. The gates shall be designed for the hydraulic heads provided.

3.2.10 Concrete loads

The Plant shall be designed such that no part of the *works* under any loading condition shall impose any stress greater than those set out below on or in any concrete work:

For compressive bearing stress: 7.0 MPa;
For shearing stress: 1.7 MPa; and

No tensile stress shall be allowed in concrete.

3.2.11 Closure against flow

Stop logs will not be required to close or open against water flow or unbalanced hydraulic pressures. They will only be inserted or raised in static (still) water under balanced head conditions. Each gate shall be designed for full closure from their respective "ready" positions (with the gate lip approximately 150 mm above the gate seal face lintel point) against maximum differential heads represented by the difference between the Max head level and Sill elevations.

Gate lips shall be designed to prevent erosion or cavitation while closing against their emergency closure flows, with seals located on the downstream side. Where skin plate lip extensions are used, as specified, seals are located on the downstream side of the lip extension.

For gates requiring closure against flow, design shall consider the hydrodynamic effects of hydraulic downpull, uplift, cavitation and vibration, and consideration will be given to permitting concrete ballasting if additional closure weight is required and where advantageous to reduce shipping and handling weights.

3.3 General Construction, Materials, Fittings and Accessories

3.3.1 Water Quality

A water quality report is included in the specifications and the design will be required to demonstrate compatibility of all designs, materials and coatings with the water constituents.

3.3.2 Construction materials

Gate, screens, stoplog structures, structural steel members, weldments, etc. shall be of welded construction, fabricated from carbon steel plates and rolled carbon steel shapes, except where specified to be of stainless steel. All welds shall be continuous and allow no crevices to be formed. The gates shall be designed to avoid water retention areas. Generously sized drainage holes (minimum 50 mm diameter) shall be provided in horizontal beams where water or air may be trapped between flanges. The design shall avoid areas and profiles that are difficult to paint. Where this is unavoidable the areas shall be boxed and seal welded. Parts that are difficult to reach after installation or that require disassembly for maintenance shall be stainless steel.

3.3.3 Gate sections

Each gate shall be divided into a minimum of two sections. The sections shall be stacked on the next lower section with seals provided between the sections to complete a watertight joint. Seals between the sections may be either of the compression or deflection type and may be mounted on the top of the lower section or the bottom of the upper section (or both), but if they are on the bottom of the upper section, measures shall be taken to prevent crushing of the seal when the section is resting vertically on dogging beams or on concrete floors.

3.3.4 Gate structure

Gate sections shall consist of a supporting framework of horizontal and vertical structural steel supporting girders ribs and stiffeners sized and spaced according to their individual capacity to meet the design criteria and water pressure. All connections shall be welded, except where required to connect gate sections where bolted connections may be used.

All steel gate structures shall be heat-treated and stress relieved after welding and construction, with corrosion protection and epoxy coating according to the specified or accepted coating plan, unless otherwise described in the GIBB 007 – Painting and Corrosion Protection Specification. Vertical side girders shall be provided to support the gate frame loads and transmit them to the bearing bars or wheels on either side of the gate to transmit all loads, without warping, bucking or undue deflection, to the bearing or wheel tracks embedded in the sides of the gate slots and hence to the built-in anchors and concrete.

3.3.5 Guide rails

This section relates to all hydro-mechanical equipment that requires guide rails for sealing and seating of the permanent Works.

Where necessary, hydro-mechanical equipment shall be supplied with channel steel side/vertical/radial guide on the gates and guide rails fixed to the concrete guide structures to reduce friction and maintain the alignment of the gate within its slots, and the seals on their faceplates, such that the gates do not skew, jam, or drift laterally during travel up or down during normal or emergency closure, normal sealing or lifting, or while cracked in the filling position.

Guide rails shall be of EN Grade 1.4404 SS 316L to SANS standards, or as specified in GIBB 007 – Painting and Corrosion Protection Specification. Vertical guide rails shall be continuous from the gate sill up to the respective top operating deck or hoist deck. The guide system shall be designed to ensure that, during insertion of the sluice gates, stop logs and screens from the upper deck level, the side surfaces will easily mate with their associated channel guides fixed to the concrete without jamming or requiring precision control of the gate position. Guide rails for radial gates shall follow the outline of the manufactured radial gate within tolerances of 5mm.

The guide system design shall also ensure that the hydro-mech equipment seals shall be easily and precisely guided onto their fixed seal faces while the hydro-mech equipment is lowered or dropped from its ready position to the sill. As far as possible and practical and where otherwise specified, guide rails and their mountings and fasteners shall be of common sizes and types for all necessary hydro-mech equipment at the Works.

3.3.6 Seals

Under the maximum head for each element, the maximum permitted gate leakage rates shall be 0.15 litres/second per meter of seal perimeter for the radial gates.

There shall be zero leakage for all other sluice gates and stop logs at full design heads across the seals.

3.3.7 Distributor

All seals shall be fully replaceable and shall be procured from a reputable South African manufacturer or a manufacturer that has a South African distributor that has been in business for a minimum 5 years and can readily supply spare seal parts and materials identical to those provided in the gate supply. All seals for all gates and stop logs shall be of a common type from a single manufacturer.

3.3.8 Materials

Seals shall be solid neoprene or Ethylene Propylene Diene Modified (EPDM) and shall meet all ASTM or DIN standards as listed in GIBB 002 – General Mechanical Specifications. Minimum properties shall be:

- Specific Gravity: 1.23±0.03
- Tensile Strength: 9 MPa
- Elongation at break: 350%
- Shore hardness: 55 – °80 (side and top seals 55, bottom 80).

Seals may also be of synthetic elastomer or of non-ferrous alloy materials (eg. aluminum alloys, magnesium alloys, titanium alloys, zinc alloys, nickel alloys) where specifically stated.

a) Dimensional tolerance of the seals shall comply with ISO 3302, unsupported extrusion class E2

b) Normal dimensions:

i) 10 to 16 mm: ± 1 mm
ii) 16 to 40 mm: ± 1.3 mm
iii) 63 to 100 mm: ± 2 mm

3.3.9 Side Seals

Seal materials, types and arrangements shall be designed to create a watertight gate perimeter under load and to minimize friction. Hollow and/or fabric impregnated seals are not permitted. Side seals for all gates shall be solid “J” bulb (“music note”) types with single stems and with arrangements relying on stem deflection under hydrostatic pressure on the flat (non-bulb) side, not on deformation or compression of bulb.

3.3.10 Lintel seals

Seal materials, types and arrangements shall be designed to create a watertight gate perimeter under load and to minimize friction. Hollow and/or fabric impregnated seals are not permitted. Side seals for all gates shall be solid “J” bulb (“music note”) types with single stems and with arrangements relying on stem deflection under hydrostatic pressure on the flat (non-bulb) side, not on deformation or compression of bulb.

Where the seal bears against the lintel during gate closure (typically on roller gates), the lintel seals shall be solid double-stemmed centre bulb seals both clad in fluorocarbon or Teflon, per the seal specifications in the hydro-mechanical specification. These shall be of the type that rely on water pressure by completely encasing the stems in steel brackets and admitting water pressure to the back of the seal through ports drilled in the skinplate to admit water pressure to press the seal bulb against the seal face. The gate wheels shall be mounted such that they prevent crushing of the seals, but permit a minimum 5 mm deflection of the “J”-bulb side seals and lintel.

3.3.11 Bottom seals

The Sill (bottom or lip) seal shall be Neoprene “J” type for a standard invert or for where grit type applications a Neoprene “rectangular compression” type bottom seal will be used with a minimum depth of 25 mm mounted on the gate lip that can easily be flushed and will not be damaged during flushing proceedings. Bottom seals shall have a minimum Shore "A" durometer hardness of 71 to 80 degrees and a pre-compression of 1.75 N/cm when the gate is in the closed position. Bottom seals shall be designed to withstand the high water velocities due to crack-opening for filling (priming) the waterways and emergency closure.

3.3.12 Seal joints

Seal corners shall be pre-moulded with no joints at or within 200 mm of a corner. Shop joints shall be vulcanised and shall avoid feather-edges on the sealing surface. Field joints shall be minimized, accurately machine cut, carefully butted to provide interference fits, joined by a cold curing epoxy, and held with double fasteners on each side of the joint.

3.3.13 Sheathing

For gates subject to differential pressure during closure, fluorocarbon sheathing of the side and top seals shall be provided to protect the seal material and reduce friction, wear, flutter or extrusion. Side and top seals for stop logs that are inserted and removed in static water under balanced pressure shall not have sheathing. Fluorocarbon sheathing shall be vulcanised onto the seal bulb surface in a semi-cylinder and shall be minimum 1.5 mm thick, meet ASTM D413 testing for adhesion and have minimum 13.8 MPa tensile strength and minimum 250% elongation. The sheath shall show no separation from the neoprene when the two are jointly tested by the machine method at 50 mm/min, and by deadweight method, both to 133 N per 25 mm width.

3.3.14 Backing bars (lashing strips)

Seals shall be mounted on the gate with EN Grade 1.4306/7 SS 304L backing bars (lashing strips) fixed continuously with an epoxy cement recommended by the seal manufacturer and at regular intervals by stainless steel Allen-type bolt or screw fasteners, countersunk into the backing bars. Where fitted into carbon steel, stainless steel bolt fasteners shall use a paste-type, anti-corrosion, anti-seize compound and shall be fitted with sleeves or other anti-corrosion devices due to the potential for galvanic corrosion. Backing bars shall not join at the same points as the seals and shall be clearly stamped to indicate their correct position relative to the gate - hole alignment. The bolt holes in the seals shall be drilled in the factory and the seals shall be marked to indicate their correct position - alignment of holes and to permit the same sequence of installation after removal for seal replacement. Rectangular compression bottom seals shall use a stainless steel bracket or retainer system that prevents the seal from being extruded or pushed out of place during compression and loading, but permits deformation of the seal under compression. The lashing strips shall be clearly marked (numbers to be welded on) to indicate their correct position relative to the gate - hole alignment. The bolt holes in the seals shall be drilled in the factory and the seals shall be marked to indicate their correct position - alignment of holes.

3.3.15 Seal frames, guides and faces

a) Sealing frames shall consist of upstream and side guides and side-, sill- and lintel sealing members where appropriate.

b) All sealing-, sliding- and running surfaces shall be of EN Grade 1.4404 SS 316L, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification.

c) The sealing frames and guides shall be of manufactured from plates and sections of material EN Grade 1.4404 SS 316L unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification and shall be fabricated so as to give a rigid structure.

d) Sealing face plates/seats shall be heat-treated where applicable and stress relieved prior to machining for flatness to provide an evenly distributed seal load.

e) The sealing faces shall be minimum 100 mm wide or greater as required to ensure full contact of the sealing faces with the gate seals over the full range of seal movement over the allowable guide and seal clearances, due to gate displacement, tilting or deflection under any load combination during gate travel.

f) The gate seals shall not be in contact with sealing frames during movement of the gate in the guides, only during sealing of the opening.

g) All sections shall be perfectly straight, flat and true to the dimensions provided by the *Contractor*. The straightness tolerance shall be 1 mm in 1 m to prevent unequal pressure or leakage.

h) All guide members of a specific set shall be bolted together in sequence at the Manufacturer's *Works* for inspection and, after approval by the *Employer's Agent*, each

individual guide member shall be marked by hard stamping with corresponding numbers in order for them to be installed in the same sequence.

i) A clearance of 5 ± 1 mm shall be allowed, in the direction of flow, between the inner surfaces of each guide member and the gate / fine screen element running in it. Across the direction of flow, this lateral clearance shall be minimum 6 mm and maximum 10 mm.

j) All sealing and rolling surfaces shall be smooth, with no steps or misalignment at the joints between different guide sections.

k) All parts permanently in contact with the water shall be of EN Grade 1.4404 SS 316L, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification.

l) Special attention shall be given to the provisions made to facilitate erection and alignment.

The following is required if it is Project Specific or scheduled in the Bill of quantities:

a) All second stage anchor bars and adjusting nuts shall be provided for the gate and screen sealing frames and guide sections.

b) These bars shall be a minimum of 16 mm diameter and shall be welded to the anchor plates to enable accurate adjustment and alignment of the frame and guide sections to be made.

c) The anchors shall be arranged to ensure that no movement of the members occurs during the placing of the secondary concrete around them.

d) For any load bearing roller paths, sealing frames shall have thick stainless steel plate of adequate size to transmit the wheel loads to the supporting frame and concrete.

3.3.16 Deflection

Deflections of main coaxial beam members supporting seals shall be limited to maintain even positive seal contact with seal faces at all static or dynamic hydraulic heads. The maximum deflection of the top beam and side beams supporting the seals shall be 1/800 of the gate span between wheel centrelines or one-half the allowable flexure of the seals, whichever is less, but even smaller deflections may be required to achieve the leakage specification.

3.3.17 Hydraulic Effects

Positions, mountings and projections of top and bottom seals shall take account their effects on hydraulic downpull/uplift forces on the gates. To this end, horizontal top and bottom seal projections shall be equalized as far as possible to balance vertical hydrostatic forces on them. In specific cases, the problem of leakage through the gap between the lintel and skin plate while the gate is in its cracked open position (for penstock filling) shall be addressed, as this can affect the hydrostatic and hydrodynamic forces on the seal projection and the top of the gate.

3.3.18 Bolts

Only high tensile bolts in friction connections per SANS 10162 are permitted and allowable stresses at rated load in such bolts shall not exceed 90% of those permitted in SANS 10162. Bolted connections shall use a safety factor of 20% of the yield stress of the material. Principal load carrying bolted connections, including bolted field connections, shall be stainless steel or Monel. All pins and mechanical fasteners, including those for seal backing bars and wheel assemblies shall be stainless steel. Precautions will be taken to prevent dissimilar metal corrosion wherever stainless steel may contact carbon steel. No threaded holes into mild steel shall be allowed. Threaded holes shall be avoided where possible and where unavoidable shall be into EN Grade 1.4401 SS 316, or as specified in GIBB 007 –Painting and Corrosion Protection Specification.

4 PARTICULAR EQUIPMENT REQUIREMENTS

4.1 Radial Gates

The gates shall have all items specified, including the following chief components:

a) Radial gate, including gate, structure and seals.
b) Bearings, bearing housing and mounting.
c) Side seats, bottom seat and top seat.
d) Replaceable front skin for gate.
e) Operating Station.
f) Hydraulic actuation.
g) 2 No. Hydraulic cylinders or trunnions per gate
h) Connection to a centralised Hydraulic power pack (HPP) system, hoses and conduits.
i) Access to each bearing.
j) Access to each hydraulic cylinder.
k) Guard railing and kick plates at access and service platforms.
e) Electrical and control equipment, limit and position switches, I/O junction boxes, control panel electrical wiring and cabling.

The maximum water level difference across the gate for which the gate and bearing mountings must be capable of handling the max design head above the gates' top seals as indicated in the payment item.

The gate shall pose an obstruction to water, boulders and gravel but shall open when required so that the boulders and gravel are washed away by the resultant water flow.

The gate shall open smoothly and easily without snag or slew even though boulders and gravel might have built up against it.

The bottom horizontal seal/seat is only required to seal when the gate is closed but it shall be arranged so that the flushing action of the water and the boulders being flushed do not cause damage to the seal and the seat.

The seal and seat along the top horizontal surface of the gate are only required to seal when the gate is closed. The seal/seat shall be designed to open without damage to itself.

The gates shall be able to operate at any head up to the maximum design head and at any opening between fully open and fully closed. The minimum opening shall be specified by the designer but shall not be more than 150 mm from the sill.

The gate controls shall be designed in such a manner that the gate shall automatically close in the event of a HPP failure. This is shall be from the own weight of the gate.

The gates shall be designed to operate under un-balanced conditions.

4.1.1 Operation

The operation and control is typically discussed in more detail in the control philosophy or Function Design Specification.

The radial gates will need to operate from fully closed to fully open in 6 minutes (within a tolerance limit of +/-2 minutes). The exact time to be determined during installation. It shall be possible to close the gate by gravity against full flow in case of a HPP failure. No more than one radial gate or sluice gate shall be actuated at any one time. The closing speed under gravity may deviate from the above specified normal operation closing speed (gravity closing speed to be agreed on Site; between 5 and 20 minutes would be acceptable).

The seals must be replaceable in-situ.

The gate shall be designed so that it can remain indefinitely in any position between fully closed and fully open. The position shall be indicated on the local control panel.

The equipment shall be protected by designing the system to stop without damage through limit switches for fully open and closed conditions or oil pressure build up sensors.

The gates will have open and close position indicators, which are connected to a PLC for local and remote position indication

In the event of a HPP failure, it shall be possible for the operator to lower the gate into the closed position under gravity.

4.1.2 Design and Construction

Two double acting hydraulic cylinders shall be used per gate and shall be attached at each side of the gate and operate in a vertical movement above the trunnion.

The hydraulic actuator pins shall be connected to either side of the wall and the recessed and steel design shall be conducted by the supplier and discussed with the Employer's Agent.

The stroke of the cylinder shall be such that the gate is fully raised when the piston is fully retracted, and that the gate seats on the sill with enough force to supply seating pressure for the sill seal when in the fully extended position. The clevis shall be adjustable on the rod for this purpose.

The trunnion bearings shall be self-lubricating and self-aligning.

The Contractor shall provide and install the bearings and the bearing mountings and these shall be suitable for the configuration shown on the drawings. Reinforced concrete structural construction will be done by the Civil Contractor in accordance with the Gate supplier's design requirements but the installation of the bearing housing and securing of it to the structure shall be the responsibility of the Contractor.

A seal wetting system shall be supplied to lubricate the seals of the gate during dry operation. This system shall have a manual override on the control panel when required.

The fixed sealing and sliding surfaces (guides) shall be of EN Grade 1.4401 (316) stainless steel, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification.

The channel guides and anchors shall be of EN Grade 1.4401 (316) stainless steel, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification.

Wall thickness of the guides shall not be less than 12 mm.

The channel guides shall have adequate strength and shall be adequately secured to withstand structural damage, which might be caused by the movement of boulders.

The seals shall be replaceable without removing the gate from its bearings.

The gate structure shall be of EN Grade 1.4306/7 (304L) stainless steel, unless otherwise specified in GIBB 007 –Painting and Corrosion Protection Specification.

Should the gates not be constructed from stainless steel, the front face of the gate shall be provided with a skin which is designed to withstand abrasion and possible impact. This skin shall be in addition to the gate itself and shall be replaceable. The skin shall cover the entire from of the gate and will be in accordance to the painting and corrosion specification.

The seal retaining members shall be of EN Grade 1.4401 (316) stainless steel, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification.

The seal retaining members shall be coated with the same system as for the gate itself, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification.

The gate structure shall be provided with lifting eyes, which allow the complete gate to be lifted from above using slings and a hoisting mechanism.

The gate shall also to be opened if required as a result of hydraulic system failure.

Recessed lifting lugs shall be provided on the top of each gate section to lift the gate on slings by the crane hook. Lifting lugs shall also be provided at all four corners on the back of each gate section to permit it to be lifted in a horizontal position from the floor onto a low-bed transport truck.

The lifting links, hydraulic cylinder and all ancillaries shall be prepared and coated according to GIBB 007 – Painting and Corrosion Protection Specification.

The vertical side plates of the gate shall be of EN Grade 1.4401 (316) stainless steel, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification.

Radial gate position equipment is discussed in more detail in Section 8.

The hydraulic diagram and operating instructions shall be engraved on a stainless steel plate(s) with all engravings filled with black paint. The plate(s) shall be permanently fixed to a wall near the gate controls. The diagram shall be A2 size and must be approved by the *Employer's Agent* before manufacture.

The entire radial gate and/or skin plate shall be manufactured such that they are detached from the truss beams and hydraulic cylinders in the event of damage or failure. This will allow them to be lifted from position with the specified (or if not specified suitable) lifting equipment. Any Obstructions within the lifting path of the radial gate shall be construction such that they can be dismantled to avoid damaging the gate during lifting.

Should the dimensions of recesses and/or box outs shown require changes based on the actual hydro mechanical equipment supplied. The costs of these changes will be deemed to be included in the tendered rates.

4.1.3 Site Installation

After manufacture (but before dispatch) the gates (complete with all associated and contiguous components) shall be fully assembled in the shop to allow for witness, comprehensive, fit-up and operational checks.

A Method Statement for the manufacture and installation of the Radial Gates shall be supplied by the *Contractor.*

Installation work shall comply with clause "Installation" in GIBB 002 – General Mechanical Specification.

4.2 Screens

The screen shall pose an obstruction to floating debris (size specified in the schedule of quantities or drawings) and shall open when required for maintenance and cleaning proceedings.

The screen shall be easily raised for cleaning of the full screen element and shall then be lowered back into position.

The gate shall open smoothly and easily without snag or slew.

The screen shall be completely removable by any fixed or mobile crane hoisting equipment.

The screen shall be designed to drop down into position under its own weight.

Raising and lowering of the screens shall be by means of manual or actuated lifting equipment or actuation as specified.

Should a hoist mechanism be used, more design requirements can be located in GIBB 008 – Cranes, Gantries, Hoists and Winches Specification.

The screens shall be designed as one fixed, stainless steel unit, as specified below.

The secondary screens shall have a collection tray at the base. The tray shall be EN Grade 1.4401 SS 316.

The screen shall be designed to slide down into position between the vertical guides.

4.2.1 Operation

The operation and control is discussed in detail in the control philosophy or Functional Design Specification.

Raising and lowering of the screen shall be accomplished from an operating panel, which the Contractor shall install within view of the screen.

The screen shall have a position switch for local and remote monitoring. Details regarding position switches are provided in Section 8.

4.2.2 Design and Construction

The screen, when in the raised positions, will be cleaned by operators with pressure hoses, gloves and buckets and the overall design shall be suitable to allow this. Screens shall be provided with a gantry and hoist for lifting and lowering the screen.

The screen shall be designed to slide down into position between the vertical guides.

4.2.2.1 Screen Frames

The screen frame dimensions shall suit apertures as shown in the drawings or provided in the payment items.

The screens shall have frames manufactured from L sections from rolled plate of material EN Grade 1.4404 stainless steel 316L, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification.

Special care shall be taken to ensure that the fully assembled screens are flat and that the sides of the frames are square and parallel to one another. The squareness tolerance of ± 2 mm diagonally across corners and the flatness tolerance of 2 mm shall be strictly adhered to and no deviation from this Specification shall be permitted unless authorised by the *Employer's Agent* in writing.

The frame depth (i.e. in the direction of water flow) shall not be less than 200 mm and the material thickness shall not be less than 10 mm, unless otherwise specified by the screen supplier and approved by the Employer's Agent.

Horizontal frame support members shall be provided at a spacing of not more than 1100 mm, unless otherwise specified by the screen supplier, and the material shall be of EN Grade 1.4404 316L, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification.

The top frame member of the screen shall have a lifting eye (s) for connection of the hoist gantry or for connection by other lifting equipment specified in the, scope of Works, tender drawings, and GIBB 008: Cranes, gantries, Hoists and Winches Specification.

A foot tray shall be provided upstream of the vertical section of screen. The foot tray shall be composed of the same screen element as the vertical section but shall incorporate a small ramp at its toe. The ramp shall be designed to allow the flow to carry solids over it but to capture those solids once they land on the grid portion of the foot tray.

The foot plate(s) for the lower section shall have a plate thickness of not less than 20 mm, shall be well gusseted and the design of the anchor fastening to the concrete structure shall be submitted to the Engineer for approval. Anchors shall be of EN Grade 1.4401 (316) stainless steel and shall have a diameter of not less than 16 mm.

Water shall drain freely from the screen frame and trash collecting trays.

Each frame shall be designed in such a way that it can only be installed in the guides in the correct orientation.

A system for securing the screen at one metre height intervals during cleaning shall be provided. The method of securing is required so that the screen does not only rely on the hoist chain during cleaning. The system shall be safe and easy to implement.

All fasteners used for constructing the complete screen shall be EN Grade 1.4401 SS Grade 316, (A4 to DIN 267 Part II), unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification and shall be pickled and passivated after machining.

4.2.2.2 Screen Slats

The slat dimensions and descriptions are shown in the drawings or described in the payment items or indicated below.

All slats (both vertical and horizontal) shall be manufactured from EN Grade 1.4404 SS 316L, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification and shall fit accurately into the stainless steel frame.

Slats shall be vertically mounted. The tolerance and deviation between each slat shall be no more than 5mm, The vertical bars shall be reinforced with horizontal bars called “screen reinforcing slats) every 1500mm. Specified in more detail later.

If specified, there may be a requirement for grid type screens. These will consist of vertical and horizontal flat bars constructed with the same thickness and width. All grid apertures will be of identical area with tolerance deviation of approximately 5mm squared. The dimension of these apertures shall be mentioned in the tender drawings, scope of works, control philosophy or payment item.

Slats may be cut from flat bar with cross sectional dimensions of not less than 10 mm X 80 mm. Taper bar having an upstream width of 12 mm will also be acceptable.

All sections shall be homogeneous and free of any defects, burrs or flaws and shall have a smooth surface.

The slat cross section shall promote a steady flow of water in both directions through the screen.

The screen slats (both horizontal and vertical) shall be of no less than 8mm thick and 12mm wide

The screen reinforcing slats shall be no less than 12mm thick and 30mm wide

The screen slats shall conform to the following dimensions: width of slat: 8 ± 2 mm and width of gap between slats: 40 ± 2 mm.

Screens shall be designed for a differential head of 1.5 m of the full area of the screen.

4.2.2.3 Vertical Guides

If shown and required recess and/or box-out Indicative details for the vertical screen will be shown on the drawings. Should these dimensions required changes based on the actual hydro mechanical equipment supplied. The costs of these changes will be deemed to be included in the tendered rates.

Vertical guides shall be provided to support the screen frames in position on either side of the screen.

The guides shall be set into recesses and shall be designed by the screen supplier. The screen supplier shall make recommendations for the Employer’s Agent’s approval for the exact positioning.

Preferably, the screens shall be mounted at least 100mm into the wall/column of the structure and shall not protrude into the path of the natural water flow.

The vertical guides and anchors shall be channel sections formed from EN Grade 1.4401 (316) stainless steel, unless otherwise specified in GIBB 007 –Painting and Corrosion Protection Specification.

The clearance between the sliding surfaces and the vertical guides shall not be less than 20 mm and shall not be more than 40 mm (this applies to both the direction of flow and the direction perpendicular to flow).

The size of the channel sections is to the screen supplier dimensions.

The drawings indicating the dimensions of the guide recesses and box outs will thus be subject to change according to the screen supplier.

The Contractor shall be responsible for anchoring the guides and grouting them into position in these recesses. Each channel section shall be of a design, which will allow cavity free grouting without pockets being formed between the frame and the concrete.

The channel guides shall have adequate strength and shall be adequately secured to withstand structural damage, which might be caused by the movement of debris.

The vertical frame members (the material that comes into contact with the vertical guides) shall be provided with low friction polymer sliding surfaces; e.g. a block of a suitable grade of Vesconite or equivalent. The sliding surface need not be continuous along the frame member but shall be replaceable.

4.2.2.4 Seals

Seals are not a necessity for screens as they do not serve a water retaining function, however, as stated above the screens shall be designed so that the vertical guides and the screen frames sit flush with one another with tolerances stated above.

4.2.3 Site Installation

After manufacture (but before dispatch) the gates (complete with all associated and contiguous components) shall be fully assembled in the shop to allow for witness, comprehensive, fit-up and operational checks.

A Method Statement for the manufacture and installation of the screens, hoists and ancillary equipment shall be supplied by the *Contractor.*

Installation work shall comply with clause “Installation” in GIBB 002 – General Mechanical Specification.

The correct operation of the screen installation shall be demonstrated to the Employer’s Agent prior to the commissioning of the Works.

4.3 Sluice Gates

Sluice gates shall include the following chief components for each unit:

a) Sluice gate, including frame, grout, line shafting, headstock, seating and sealing and shaft supports.
b) Electric actuation (where specified)
c) Hydraulic actuation (where specified).
d) Trunnion or cylinder (where specified).
e) Connection to a centralised Hydraulic power pack (HPP) system, hoses and protecting conduits (where specified).
f) Associated electrical equipment, cabling, stainless steel conduits, etc., and including limit and position switches.
g) Control panel, in view of the respective sluice gate.
h) Channel guides
i) Wall or channel mounted

Sluice gate sizes, positions, types and locations shall be provided on the drawings or shall be described in the payment items.

The sluice gate shall open and close smoothly and without snag or slew, Over its full travel and under full design pressure

The sluice gates shall be designed to withstand the maximum specified water pressure for the application and to seal acceptably when subject to this pressure. The pressure is indicated in the payment item

The acceptable leakage rate for off-seating sluice gates is 0,015 ℓ/s per metre of seating perimeter per 3 metre pressure head.

The acceptable leakage rate for on-seating sluice gates is 0,008 ℓ/s per metre of seating perimeter per 3 metre pressure head.

The acceptable leakage between the sluice gate frame and the concrete structure is zero.

Sluice gates will fail in its current position or as specified in the Functional Design Specification.

4.3.1 Operation

The general requirements for operation and control are specified in the control philosophy and the Functional Design Specification.

The sluice gates will need to operate from fully closed to fully open in 4 minutes (within a tolerance limit of +/- 1 minute). The exact time to be determined during installation. No more than one radial gate or sluice gate shall be actuated ant any one time.

4.3.2 Design Requirements

The design shall allow for removal of the gate and replacement of the seals without having to remove or damage the frame structure.

The headstock beam shall accommodate the gate opening and closing forces with no visible deflection.

The gate, when open, shall be out of the path of the maximum design flow.

Sluice gates shall be designed so that solid material in the flow cannot snag on protrusions such as adjusters and, thereby, prevent closing of the gate.

Fabricated gates, which require reinforcing ribs, shall have these ribs welded onto the gate. Bolted ribs are not acceptable. Welded ribs shall be continuously welded, without crevices.

Gates in off-seating applications shall incorporate guides, which provide a sealing force. Such guides shall be of low friction polymer or of non-ferrous metal.

Sluice gates shall have the hydraulic cylinder in the vertical position. The hydraulic cylinder must be reachable at all times on the operating floor platform level indicated on the drawings.

Sluice gates which are operated via line shafting shall be provided with shaft guides so that the maximum length of unsupported shaft is 1 800 mm.

The complete unit shall have environmental protection, which is suitable to wash by hose.

4.3.3 Materials

The following table contains a list of the allowable material used for construction, manufacturing of sluice gates. Each material will be indicated by the Employer's Agent by either drawings, supplier's recommendations (upon approval by the Employer's Agent), schedule of quantities, client's preference and the specifications. This list is non-exhaustive.

- The gates shall be either self-contained with yoke and bench stand operators, or non-self-contained with separate stem guides and operator, in accordance with the requirements of these specifications.
- The gates shall be compliant with the latest version of AWWA C561, as described below.

Specific configurations shall be as noted on the gate schedule or as shown on the plans.

The materials are summarized in the table below. For this Contract the required grades of material highlighted in orange.

Table 4-1: Component Material Composition

COMPONENTS	MATERIALS
Frame, Yoke, Cover Slide, Wall Thimbles	EN Grade 1.4401 (316 stainless steel) Stainless Steel ASTM A240, Type 304L Stainless Steel ASTM A240, Type 316L Stainless Steel ASTM A240, Type 2205 Duplex
Seat/Seals & Stem Sleeves	Ultra-High-Molecular-Weight Polyethylene (UHWMPE) ASTM D4020
Cord Seal	Neoprene ASTM D2000 Nitrile ASTM D2000 Viton ASTM D1418
Flush Bottom Seals	Neoprene ASTM D2000 Viton ASTM D1418
Cylinder Covers	Hydraulic cylinder covers for rising spindles shall be of EN Grade 1.4306 (304 stainless steel) unless otherwise stated by the client Clear butyrate or clear polycarbonate will also be acceptable but clear PVC is not
Spindle Covers	Spindle covers for rising spindles shall be of EN Grade 1.4401 (316 stainless steel) Clear butyrate or clear polycarbonate will also be acceptable but clear PVC is not acceptable.
Spindles, Muff Couplings, Spindle Adaptors	EN Grade 1.4401 (316 stainless steel).
Gate Seals	Synthetic elastomer or non-ferrous alloy materials
Gate and Frame	EN Grade 1.4401 (316 stainless steel)
Stems	EN Grade 1.4401 (316 stainless steel) Stainless Steel ASTM A276, AISI Type 304 Stainless Steel ASTM A276, AISI Type 316 Stainless Steel ASTM A276, AISI Type 2205 Duplex Stainless Steel ASTM A564, AISI Type 630
Stem Cover	Clear Butyrate with Mylar Strip Galvanized A53 Steel Aluminium
Stem Guides	EN Grade 1.4401 (316 stainless steel) Cast Iron (ASTM 126 Class B) Bronze Bushed Cast Iron (with 2% Nickel) Bronze Bushed Ni-Resist Cast Iron (ASTM A436, Type 2 or 2B) Bronze Bushed Stainless Steel (ASTM A240 Type 304L)UHMW Bushed Stainless Steel (ASTM A240 Type 316L)UHMW Bushed Stainless Steel (ASTM A240 Type 2205)UHMW Bushed
Vertical Channel Guides	EN Grade 1.4401 (316 stainless steel) Stainless Steel ASTM A240, AISI Type 304L Stainless Steel ASTM A240, AISI Type 316L

Wall Brackets	EN Grade 1.4401 (316 stainless steel) Cast Iron (ASTM 126 Class B) Cast Iron (with 2% Nickel) Ductile Cast Iron (ASTM A536) Ni-Resist Cast Iron (ASTM A436, Type 2 or 2B) Steel (ASTM A36) Stainless Steel ASTM A240, AISI Type 304L Stainless Steel ASTM A240, AISI Type 316L Stainless Steel ASTM A240, AISI Type 2205
Pedestals	EN Grade 1.4401 (316 stainless steel) Cast Iron (ASTM 126 Class B) Cast Iron (with 2% Nickel) Ductile Cast Iron (ASTM A536) Ni-Resist Cast Iron (ASTM A436, Type 2 or 2B) Steel (ASTM A36/A53) Stainless Steel ASTM A240/A312, AISI Type 304L Stainless Steel ASTM A240/A312, AISI Type 316L Stainless Steel ASTM A240/A312, AISI Type 2205
Fasteners and Anchor Bolts	EN Grade 1.4401 (316 stainless steel) Stainless Steel ASTM A593 & A594, Type 304 CW A193 & A194 Stainless Steel ASTM A593 & A594, Type 316 CW A193 & A194 Stainless Steel ASTM A593 & A594, Type UNS S-32205 Duplex 2205
Finish (Upon client approval)	Polyamide Epoxy Coal Tar Epoxy

4.3.4 Channel Mounted Sluice Gates (where applicable)

Vertical channel guides shall be provided for the sluice gates. The guides shall be set into recesses and shall be designed by the sluice gate supplier. The width of the channel will vary depending on the sluice gate supplier. The recess dimensions on the drawings are subject to change depending on the size of the sluice gate. The channel dimensions on the drawings are indicative should these dimensions required changes based on the actual hydro mechanical equipment supplied. The costs of these changes will be deemed to be included in the tendered rates.

Channel mounted sluice gates shall seal on all four sides, where applicable.

Gates, frames and guides shall be structurally capable of resisting the specified differential pressure, as described in the payment item without unacceptable leakage and shall be capable of operating under this differential pressure.

Fabricated stainless steel heavy-duty service gates shall be fabricated from formed stainless steel plate and structural shapes. The size, quantity, gate configuration and operating conditions shall be as listed on the gate schedule. Gate, frame and yoke design shall conform to AWWA C561 as required.

Manufacturer shall be experienced and in regular production of gates and water control equipment. Welders and procedures shall be certified according to AWS D1.6 or ASME Section IX.

The gate shall be fully shop assembled, adjusted, inspected and tested for proper operation and leakage before shipment.

The gate shall be installed and constructed in such a way that the frame, gate and spindle can be fully removed without damaging the permanent works.

4.3.5 Wall Mounted Sluice Gates (where applicable)

Wall mounted sluice gates shall, unless inapplicable, seal on all four sides.

Gates, frames and guides shall be structurally capable of resisting the specified differential pressure, specified in the payment item without unacceptable leakage and shall be capable of operating under this differential pressure.

Neoprene “P” or “J” type seals are typically used for standard inverts and “rectangular” for flush inverts. This will typically be used in sewage or applications where fluid contains grit, sludge as no “pocket” occur across the invert.

To cater for off-seating pressures, the seals are reversed, so that the bulb is still forced against the frame, and in the cases where both seating and off-seating pressure conditions occur, double seals one in the normal and one in reverse configuration, are used.

4.3.6 Frame

The gate frame and guides shall be composed of material specified in Table 4-1 with UHMW seat/seals upstream and downstream. The seat/seals shall form a tight seal between the frame and the slide (disc).

The vertical frame members (the material that comes into contact with the vertical guides) shall be provided with low friction polymer sliding surfaces; e.g. a block of a suitable grade of Vesconite or equivalent. The sliding surface need not be continuous along the frame member but shall be replaceable.

The frame shall be of flange type design for mounting on anchor bolts and grout pad. Size and spacing of anchor bolt holes shall be suitable for the operating conditions of the gate. Spacing shall not exceed 300mm.

The frame shall be of self-contained or not self-contained design as listed in the gate schedule. The frame shall be sufficiently rigid to transfer hydrostatic loads to the gate anchorage.

The frame shall positively retain the polymer guide/seal strip and the neoprene loading pad on studs welded to it. Nonloosening (prevailing torque) fasteners shall be used on the gate guide assembly. The guide seal assembly shall be field adjustable and replaceable. The length (vertical height) of the guide shall retain at least 1/2 of the slide height in the full open position.

4.3.7 Guide Rails

Vertical guides shall be provided to support the sluice gates in position on either side of the screen. The sluice gate supplier shall make recommendations for the Employer’s Agent’s approval for the exact positioning. Preferably, the sluice gates shall be mounted at least 100mm into the wall/column of the structure and shall not protrude into the path of the natural water flow.

The vertical guides and anchors materials are specified in Table 4-1.

The clearance between the sliding surfaces and the vertical guides shall not be less than 20 mm and shall not be more than 40 mm (this applies to both the direction of flow and the direction perpendicular to flow).

The size of the channel sections is to the screen supplier dimensions.

The drawings indicating the dimensions of the guide recesses and box outs will thus be subject to change according to the sluice gate supplier.

The Contractor shall be responsible for anchoring the guides and grouting them into position in these recesses. Each channel section shall be of a design, which will allow cavity free grouting without pockets being formed between the frame and the concrete.

The channel guides shall have adequate strength and shall be adequately secured to withstand structural damage, which might be caused by the movement of debris.

The guides will be of sufficient length to support 1/2 the height of the slide when in the full open position.

Guides shall be spaced as per the manufacturer's recommendations.

4.3.8 Seals

Seals shall be replaceable without removing the frame from the wall. In the case of embedded gates, they shall be constructed in a manner that allows replacement of the seals without removal of the gate frame from the embedment.

The seals shall be self-adjusting. Seals requiring periodic maintenance and adjustments to maintain specified leakage rates will not be permitted.

The top seal design on upward opening gates consisting of four side seals shall incorporate a self-cleaning wiping function that prevents debris from building-up above the top seal and causing premature wear of the seats, seals and gate face.

Sluice gates shall be fitted with Neoprene "J-type" seals and channel gates, which are only 3 sided seating, shall use neoprene angle "L-type".

Important to note, that should none of the seals be applicable or suitable to use in a particular application, metal will have to be considered upon approval of the Employer's Agent.

Side sealing sluice gates shall use Neoprene "J" type for the side sealing. The bottom seal shall be Neoprene "J" type for a standard invert or for where grit type applications a Neoprene "rectangular compression" type bottom seal will be used that can easily be flushed and will not be damaged during flushing proceedings.

The resilient bottom seal shall be set into the invert member of the frame, which shall be formed in a manor to protect three sides of the seal only exposing the side that will come in contact with the slide. Disc-mounted invert seals exposing additional surface area will not be permitted in this instance. The bottom seal shall Neoprene "rectangular compression" type bottom seal will be used that can easily be flushed and will not be damaged during flushing proceedings.

The self-adjusting seal system shall provide an allowable leakage rate of no more than $^{1}/_{2}$ AWWA C 501 leakage rate per minute per peripheral foot of perimeter opening for seating and unseating.

4.3.9 Slide Cover (Disc)

The slide cover (disc) shall be stainless steel plate reinforced with structural shapes welded to the plate.

The slide cover shall not deflect more than 1/720th of the span, or 1/16" at the seated sealing surface of the gate under maximum specified head.

The stem to gate connection shall be either the clevis type, with structural members welded to the slide and a bolt or bolts to act as a securing method, or a threaded and bolted (or keyed) thrust nut supported in a welded nut pocket.

The clevis, or pocket and yoke, of the gate shall be capable of taking, without damage, at least twice the rated weight of the gate. The Yoke shall be bolted in an easy to reach position (preferably bolted at the floor level above the sluice gate box outs at operator level.

The slide cover shall be constructed with vertical and horizontal reinforcement ribs.

All welds shall be performed by an AWS-certified welding technician.

All slide discs and sealing faces shall be provided with shop fittings and approval by the Employer's Agent before manufacture.

4.3.9.1 Stems (Hydraulic Actuation)

Gate stem, hydraulic piston and yoke to be designed by a reputable supplier.

Gate stem diameter shall be adequate to withstand twice the force created by the self weight of the gate. This includes the weight of any debris latched into the gate.

The stems shall be adequately and securely connected (fastened) to the hydraulic actuator in such a manner that it can be easily removed without damaging, breaking the connection.

The stem shall be supported by integral stem guide angles or wall mounted brackets with bronze split type stem collars, spaced to provide an l/r ratio of 200 or less.

Yoke shall not deflect more than 1/360th of the span under full head break load.

4.3.9.2 Stems (Electric Actuation or hand operated)

The stem shall be supported by integral stem guide angles or wall mounted brackets with bronze split type stem collars, spaced to provide an l/r ratio of 200 or less.

Stem threads shall be machine cut 29 degree full Acme or stub Acme type. The screw thread profile on the stems must be Acme or Trapezoidal, NOT square threads.

Nominal diameter of the stem shall not be less than the crest of the threaded portion.

Thread depth must be a minimum of 0.5 of the pitch.

Machining of threads must be of highest quality with smooth.

The actuator or gearbox stem nut must be a minimum length of 1.5 times the diameter of the stem.

Install suitable weather and dust proof bellows on stems (avoid exposing threads to the elements).

If applicable, install auto lubrication devices at the stem where indicated by the Employer's Agent

Speed of stem nut not to exceed 63 rpm (Pitch of thread i.e. 2 start etc., to be designed to achieve desired operating time with stem nut not exceeding 63 rpm).

4.3.9.3 Anchor Bolts

Anchor hardware shall be provided by the slide gate manufacturer.

The size, quantity, and location of the anchor hardware shall be Employer's Agented by the slide gate manufacturer. Upon client request manufacturer shall provide calculations for anchor bolt sizing and quantity.

Anchor hardware consisting of studs, nuts and washers shall be provided by the manufacturer.

4.3.9.4 Structural Members

The design of all sluice gate structural members complies with the requirements of DIN Spec. 19704, and under full head conditions there are simple margins of safety over the yield and ultimate strengths of the materials used. In addition, deflections are calculated to be less than those allowable for the type of seals employed.

4.3.10 Bearing Strips

Hydraulic thrust is taken on low friction HDPE strips fitted to the gate, and which slide on the frame as the gate moves. These strips are sized to give low bearing loading, resulting in long life and easy operation. They are also fitted to the larger sizes of the channel gates for the same reason.

4.3.11 Hand operation

For manual operation, handwheel diameters and gearbox ratios are matched to spindle sizes and thread pitches, so that the time required to stroke the gate is kept to a minimum, at the same time limiting handwheel rim effort to normal acceptable levels of between 100 N and

150 N. If gearing is necessary, bevel or combined bevel / spur gearboxes are used.

4.3.12 Installation

Installation work shall comply with clause “Installation” in GIBB 002 – General Mechanical Specification. Sluice gates shall be installed by personnel skilled in such installations. During installation, the top frame member shall be connected. Installation of the gates shall be performed in accordance with standard industry practices. It shall be the responsibility of the Contractor to handle, store, and install the equipment specified in this Specification in strict accordance with the Manufacturer’s recommendations.

The Contractor shall review the installation drawings and installation instructions prior to installing the gates.

The gate frames shall be installed in a true vertical plane, square and plumb, with no twist, convergence, or divergence between the vertical legs of the guide frame.

The Contractor shall fill any void between the guide frames and the structure with non-shrink grout as shown on the installation drawing and in accordance with the grout manufacturer’s recommendations. The frame cross rail shall be adjusted as required to maintain consistent seal compression across the full width of the gate.

Channel mounted sluice gate frames to be mounted within recesses shall be positioned accurately and held securely with at least four permanent anchors. Smooth and easy operation of the gate along its full operating distance shall be demonstrated to the Employer’s Agent before the frame is cast into position.

Channel mounted sluice gate frames to be mounted on the flat surfaces of channel walls and floor shall be bolted into position using chemical anchors. Smooth and easy operation along its full operating distance shall be demonstrated to the Employer’s Agent before the frame is grouted into position. Suitable gaps shall be left for the application of grout.

Anchor bolts shall be secured with chemical anchor.

Grout shall be of the non-shrink type and shall be applied strictly in accordance with the manufacturer's instructions.

Installation shall comply with the clause “Installation” in GIBB 002 – General Mechanical Specification.

4.3.13 Fabrication

Fabrication shall comply with the clause “Fabrication of Steels” and welding shall comply with GIBB 002 – General Mechanical Specification.

Fabrications will generally be inspected by the Employer’s Agent after fabrication is complete.

4.3.14 Inspections

The Contractor shall arrange for the Employer’s Agent to inspect the equipment for compliance prior to payment being made.

If the equipment is manufactured and assembled in South Africa, the Contractor shall make all arrangements and carry all costs for the Employer’s Agent to inspect equipment and fabrications in the workshop prior to despatch to Site. Fabrications shall be inspected prior to corrosion protection.

If the equipment is manufactured and assembled outside South Africa, the Contractor shall make all arrangements and carry all costs for an Employer’s Agent approved inspection authority to inspect the equipment in the workshop prior to dispatch. The inspection shall include a full report on compliance of the equipment with this specification and this report shall be submitted to the Employer’s Agent prior to dispatch of the unit from the workshop.

4.4 Stop Logs

The stop logs will be used for maintenance and during construction. Their primary purpose will be to retain water at an appropriate leakage rate indicated in the performance section.

Stop logs shall be provided with P&ID Tag numbers. The locations are shown in the Tender Drawings.

The clear openings to be closed by the stop logs are shown on the Drawings, and/or detailed in the payment item.

4.4.1 Performance Requirements

The stop logs shall be suitable for being deployed when the channel contains water but the water is not flowing.

The stop log shall be heavy enough to fall down into position under its own weight. It is not required that this is done during flow through the channel but it must be assumed that some water movement will be present.

They shall provide a relatively dry area working area in order to allow maintenance activities. Leakage shall not be greater than 0,1 l/s per pressure head shown in the Scope of works or the payment items.

Unless stated, the design heads are to be determined by the manufacture and approved by the Employers Agent.

The stop logs shall be inserted and raised only under balanced static water pressures (heads) on both sides of the stop logs. There is no requirement for emergency closure against water flow.

All location details of the guide rails for the stop logs is shown on the drawings.

Hoisting (raising and lowering) of the stop logs shall be by means of a local hoist and gantry system, or actuation, or as described in the tender drawings, or as specified in the Scope of Works. The design of the stop logs are to take the safe working load of the respective lifting equipment into account.

4.4.2 Operation

The operation and control is discussed in detail in the control philosophy or Functional Design Specification.

4.4.3 Design and Construction

4.4.3.1 Stop log components

The stop log sections shall be of single piece construction with carbon steel frame, plate and rib reinforcement and shall be hot-dip galvanised after all fabrication is complete. Hot metal zinc spray, sealant and coating, all in accordance with GIBB 007 – Painting and Corrosion Protection Specification, will be acceptable.

Recessed lifting lugs shall be provided on the top of each stop log section to lift the sections directly with the crane hook or grapple beam.

Lifting lugs shall also be provided at all four corners on the back of each stop log section to permit it to be lifted in a horizontal position from the deck onto a low-bed transport truck.

All dimensions of stop logs and stop log guide rails must be issued to the Employer's Agent for approval.

4.4.3.2 Vertical Guides

Vertical guides shall be provided to support the stop logs in position on all sides of the stop log, unless otherwise specified in the GIBB 007 – Painting and Corrosion Protection Specification.

The guides shall be set into recesses and shall be designed by the stop log supplier or by a suitably qualified Engineer. The stop log supplier shall make recommendations for the Employer's Agent's approval for the exact positioning.

Preferably, the stop logs shall be mounted at least 100mm into the wall/column of the structure.

The vertical guides and anchors shall be channel sections formed from EN Grade 1.4401 (316) stainless steel material, unless otherwise specified as specified in GIBB 007 – Painting and Corrosion Protection Specification.

The clearance between the sliding surfaces and the vertical guides shall not be less than 20 mm and shall not be more than 40 mm (this applies to both the direction of flow and the direction perpendicular to flow).

The size of the channel sections is to the stop log supplier dimension and upon approval of the Employer's Agent.

The drawings indicating the dimensions of the guide recesses and box outs will thus be subject to change according to the stop log supplier/manufacturer. Should the dimensions of recesses and/or box outs shown require changes based on the actual hydro mechanical equipment supplied. The costs of these changes will be deemed to be included in the tendered rates.

The Contractor shall be responsible for anchoring the guides and grouting them into position in these recesses. Each channel section shall be of a design, which will allow cavity free grouting without pockets being formed between the frame and the concrete.

The channel guides shall have adequate strength and shall be adequately secured to withstand structural damage, which might be caused by the movement of boulders.

The vertical frame members (the material that comes into contact with the vertical guides) shall be provided with low friction polymer sliding surfaces; e.g. a block of a suitable grade of Vesconite or equivalent. The sliding surface need not be continuous along the frame member but shall be replaceable.

4.4.3.3 Seals

Seals shall be designed in accordance with this specification discussed earlier, or to the supplier's recommendations with approval of the Employer's Agent.

Side and lintel seals shall be "J"-bulb type as specified herein. Bottom seals shall be rectangular compression seals mounted on the stop log/gate lip. Bearing bars shall be provided on each side of the sections to prevent crushing of the seals, but permit a minimum 5 mm deflection of the "J"-bulb seals.

4.4.3.4 Stop log storage

A docking station shall be provided. This shall consist of a dedicated station with a hook arrangement for permanent storage of each stop log when it is not in use. It shall be possible for the lifting equipment to connect to the stop log at its station and convey to the stop log channel guides and this shall be accomplished safely and easily. The stop log shall be safely docked before the crane hook is unhitched.

4.4.4 Site Installation

After manufacture (but before dispatch) the stop logs (complete with all associated and contiguous components) shall be fully assembled in the shop to allow for witness, comprehensive, fit-up and operational checks.

A Method Statement for the manufacture and installation of the hoists and ancillary equipment shall be supplied by the *Contractor.*

Installation work shall comply with clause "Installation" in GIBB 002 – General Mechanical Specification.

5 BUILT-IN PARTS

Those parts of the Works, which are required to be built into the concrete structure with precision, are referred to herein as "second stage built-in parts".

In order that the second stage built-in parts may be rigidly supported during the building in, they shall be attached by means of adjustable bolts and the like to anchors, ties, etc., already incorporated into the structure and these anchors, ties, etc., are referred to herein as "first stage built-in parts".

First stage built-in parts shall be built into the structure by the Contractor in accordance with Drawings and information supplied by the manufacturer of the Hydro-Mechanical Equipment and to the approval of the Employer's Agent.

The Mechanical Subcontractor shall be responsible for ensuring that the parts are built in by the Contractor with sufficient accuracy for his purposes. First stage built-in parts shall have not less than two 6 mm diameter holes (suitably spaced) drilled in them so that the parts may be bolted or nailed to formwork to hold them securely in position during first stage concreting.

The Mechanical Subcontractor shall ensure that the first stage built-in parts are delivered to Site and that the Employer's Agent receives the necessary Drawings and information, by the dates shown on the approved programme.

The Contractor shall be responsible for the design, detailing, manufacture, painting, trial erection, transport, storage and supervision of embedding in first stage concrete of first stage built-in parts. The Contractor shall ensure the correctness of the line and level of such parts before and after the concrete has been placed, all to the satisfaction of the Employer's Agent. The Contractor shall nevertheless ensure that first and second stage built-in parts are designed and manufactured in such a way that adjustment is possible between the first stage built-in parts and second stage built-in parts to allow precise setting of the latter.

Special attention shall be given to the provisions made to facilitate erection and alignment. All first stage anchor plates for building into the primary concrete shall be provided. All second stage anchor bolts/bars and adjusting nuts shall be provided for the gate and screen sealing frames and guides.

Second stage anchor bolts/bars shall be a minimum of 16 mm diameter and shall be welded to the anchor plates to enable accurate adjustment and alignment of the frame and guide sections to be made. The anchors shall be arranged to ensure that no movement of the members occur during placing of the secondary concrete around them.

All welds on built-in parts, including those between adjusting bolts and first stage anchors, shall be adequate to develop the full strength of the abutting members in order to resist separation of the built-in parts from the surrounding first and second stage concrete and of the adjusting bolts from the first stage anchors.

All first and second stage built-in parts shall be arranged so as to allow the proper placing and compaction of concrete and eliminate any air voids around the embedded parts. They shall be suitably shaped to allow fixing of second stage reinforcement generally as shown on the Drawings.

All permanently immersed built-in parts in contact with water, or where maintenance painting is not possible, shall be of EN Grade 1.4404 316L stainless steel up to a water path of 150 mm. All parts covered in concrete but within 50 mm of the surface shall also be considered to be in contact with water and be treated as above. Nuts, bolts and washers of second stage built-in parts which will be subject to an exterior environment in the completed Works shall be stainless steel.

Nuts, bolts and washers of second stage built-in parts which will be subject to an interior environment in the completed Works shall be HDG. Electro-plated metallic coatings to fasteners shall not be acceptable.

Stainless steel nuts, bolts and washers shall be insulated from mild steel parts using sleeves and washers to the approval of the Employer's Agent.

All first stage built-in parts shall be coated with a hold primer to prevent corrosion of the parts until such time that the second stage built-in parts can be erected.

6 AUXILIARY EQUIPMENT

6.1 Lifting Apparatus:

Lifting apparatus shall be provided for all hydro-mechanical equipment unless otherwise specified

6.1.1 Radial Gates

All radial gates shall be fitted with lifting lugs (or facilities for fitting temporary lifting lugs) designed for the lifting of the gate or applicable portion (i.e. truss arms, gate frame, gate face, etc) Either Vertically via lugs on top for installation or removal from installed position, or horizontally to a vertically suspended position (in dry air) and vice versa, or for lifting the section from or too a horizontal position such as a flatbed truck or similar for transportation.

6.1.2 Screens

Screens shall have their own independent gantry and hoisting equipment with built in caged access ladder, service platform and safety equipment.

The gantry material and corrosion protection shall be stated in the GIBB 007 – Painting and Corrosion Protection Specification. It shall be configured as a rectangular portal frame with two primary upright steel members and a bolted on horizontal member where the hoist will rest centrally.

Each vertical leg of the portal frame shall be provided with a flanged and bolted connection approximately one metre above floor level. The lower portion of each leg shall be permanently anchored and grouted to the concrete surface whereas the upper section shall be removable to provide increased space for operation if required. The top horizontal member of the portal frame shall be provided with two lifting eyes suitable for removal of the upper and support sections as a single unit.

The foot plate(s) for the lower section shall have a plate thickness of not less than 20 mm, shall be well gusseted and the design of the anchor fastening to the concrete structure shall be submitted to the Engineer for approval.

The height of the screen lifting apparatus shall suit the entire length and width of the screen and be capable of handling the total design load as indicated in the payment item.

All of these items shall be removable by unbolting in order to allow complete removal of a screen from its guides when it is being lifted out. The above is not required if the goliath crane is able to lift the screens high enough to be clear all other items or lifting equipment.

6.1.3 Stop Logs

All stop logs shall be fitted with lifting lugs (or facilities for fitting temporary lifting lugs) designed for lifting of the stop logs by the goliath crane vertically (lugs on top), or from a horizontal position to a vertical suspended position in dry air (and vice versa), or for lifting the stop log in a horizontal position on or off a flatbed truck for transportation.

The flushing channel stop log shall in addition have its own independent gantry frame and hoisting equipment as part of the permanent works and have an open grid flooring spanning the flushing channel for access to the central hoist mechanism.

The gantry material and corrosion protection shall be stated in the GIBB 007 – Painting and Corrosion Protection Specification. It shall be configured as a rectangular portal frame with two primary upright steel members and a bolted on horizontal member where the hoist will rest centrally.

Each vertical leg of the portal frame shall be provided with a flanged and bolted connection approximately one metre above floor level. The lower portion of each leg shall be permanently anchored and grouted to the concrete surface whereas the upper section shall be removable to provide increased space for operation if required. The top horizontal member of the portal frame shall be provided with two lifting eyes suitable for removal of the upper and support sections as a single unit.

The foot plate(s) for the lower section shall have a plate thickness of not less than 20 mm, shall be well gusseted and the design of the anchor fastening to the concrete structure shall be submitted to the Engineer for approval.

The height of the screen lifting apparatus shall suit the entire length and width of the screen and be capable of handling the total design load as indicated in the payment item.

All of these items shall be removable by unbolting in order to allow complete removal of a screen from its guides when it is being lifted out using a mobile crane.

Further details are located in the tender drawings and must be read in conjunction with the GIBB 008 – Cranes, Gantries, Hoists and Winches Specification.

7 HYDRAULIC EQUIPMENT AND CONTROLS

The Contractor shall include the design, supply of all materials, manufacture, shop assembly and testing, corrosion protection, delivery to site, storage, installation and erection at site, site painting, tests on completion and commissioning, and maintenance until takeover of the Works.

The actuator assembly shall include the power packs, cylinder, pressure switches, position switches, limit switches, and valve/gate position indicator and all other appurtenances required to rigidly mount the actuator.

Note: Hydraulic cylinders/rams/pistons shall be measured as part of the hydro-mechanical equipment where hydraulic actuation is specified. HPP are measured separately as mentioned in the Section 11 – Payment.

This is a centrally managed hydraulic system where the HPP(s) along with the local master controller will manage and control the hydro-mechanical equipment based on input from the local controllers at the Hydro-Mechanical Equipment (HME).

7.1 Hydraulic Power Packs (HPP)

The design of the hydraulic power packs shall provide all features listed below and perform all functions required to meet all gate control requirements and supply reliable hydraulic oil pressure to the hydraulic cylinders and/or servomotors.

The Scope of Supply for the HPP will include all hydraulic valves, pumps/motors, solenoids, filters, orifices, steel valve manifolds, fittings, connectors, piping/tubing and supports to the hydraulic cylinders necessary for all functions. All supply and drain piping/tubing, connectors, etc. to and from the hydraulic cylinders shall be EN Grade 1.4404 316L seamless stainless steel and included in the supply, except for the final connection to the cylinder, which shall be by armoured, flexible, high

pressure hydraulic hoses. A 400V, 3 phase, 4 wire, 50 Hz power supply will be provided for HPP power unless stated otherwise.

As a minimum, each HPP shall be furnished and installed complete with:

- painted Stainless Steel oil reservoir
- complete with drip pan
- leak-tight inspection port
- baffles as required
- oil heating element
- filtered vent
- drain line/valve
- filling line and cap
- low oil level alarm
- local level indicator
- oil temperature RTD.

Each HPP shall have one (1) full capacity, positive displacement, oil pressure pumps and motors, complete with inlet strainers, check, unloading and relief valves, The pump shall be capable of providing the capacity required for raising the gates and other hydro-mechanical equipment specified from the closed position to cracked open, ready, flushing and maintenance positions;

Instrumentation for temperature, pressure, and position feedback as required for actuation of gates and alarm and trip for fault conditions;

- all input/output required to match system with motor starters and PLC;
- all other appurtenances, control accessories, heaters and fasteners for fixing all parts to the concrete structures, as specified or as required for proper installation and operation, including an accepted coating system for all parts.
- 120% of total hydraulic oil supply required for HPP systems.
- all wiring, cabling, junction boxes, terminal strips, connectors, etc, to connect HPP devices and motors to starters, field devices and instrumentation for the HPP, hydraulic pistons, gate servomotors and other head gate instrumentation, per specifications herein.
- all materials, accessories, special tools, drawings, operations and maintenance manuals, installation and commissioning instructions required for satisfactory installation, testing and operation of the HPP.

The HPP, motors and associated hydraulic services shall be linked to a local area PLC, incorporating the required logic and analogue and discrete I/O and limit switches, protection signals and position indicators and relays to provide proper control of all specified or required electro-hydraulic signalling and feedback from instrumentation devices.

The HPP hydraulic system shall be capable of compensating for minor pressure and viscosity changes in the oil supply during operation, including allowance in the reservoir capacity for at least 120% of the total volume of oil in the entire system. The hydraulic equipment shall comply with BS 4575.

Pressure gauge test-point connections shall be provided on the pump discharges, duplex and return filters, relief/unloading circuits, and supplies to all hydraulic pistons, along with a high quality, oil-filled, portable test pressure gauge with a large scale over the system pressure range.

Where multiple HPPs operate in duty-standby configurations, the 'duty' HPP shall be rotated based on a duty rotation rule, where the last duty HPP shall act as the next standby HPP, and the last standby HPP shall act as the next duty HPP. The duty rotation shall be managed by the master controller of the HPPs.

7.2 Pumps and Motors

Each HPP shall be equipped with one (1) positive displacement, self-priming, hydraulic, gear-type pump and AC motor sets. If there are more than one pump present in a single HPP set, There shall be a duty standby arrangement. At least one of the pumps shall be a "main" pump, rated for 125% of the required system capacity and the pumps shall be arranged for parallel operation with on duty and on standby, with alarm and automatic changeover upon fault detection of the on-duty pump, or manual changeover by selector switch. Each main pump shall be capable of providing the capacity required for raising the gate from the closed position to fully open, and maintenance positions. All pumps shall be rated for continuous operation.

Where pumps are managed by the HPP, the duty pump shall be rotated based on a duty rotation rule, where the last duty pump shall act as the next standby pump, and the last standby pump shall act as the next duty pump. The duty rotation shall be managed by the HPP, or the master controller thereof.

Pumps shall be continuously rated to pass full pump output through the system relief valve or unloading valve. The oil reservoir shall have sufficient excess capacity over maximum draw-off to permit this pumping for 30 minutes without the oil temperature rising above the maximum specified for the hydraulic oil, pumps, valves and circuits. Pumps shall not require a boosted inlet.

Pumps shall be equipped with unloading valves to bypass the oil back to the reservoir when the system has reached its maximum normal operating pressure. Pumps to start up under no load. Starting equipment shall be arranged to permit the motors to reach full speed before applying the pump load and to unload the pumps before stopping the motors. Relief valves shall be provided on the pump discharges, rated at the full pump discharge capacity, and set at 115% of the unloading valve settings. Pumps shall also be equipped with discharge check valves, suction strainers, pressure switches, and manual isolation valves for on-line removal.

The pump system shall incorporate duplex full-flow oil synthetic filter systems (manual changeover), with cleanable or replaceable synthetic filter elements, on the common pump discharge and on the common oil return line to the reservoirs. Filters shall be 3 micron pressure pipe filter with a minimum beta value of 1000. Filters shall be of the full synthetic type with outer spiral wrapping bonded to the filter element, suitable for the maximum circuit pressure including transient pressures. All filters shall be fitted with internal bypasses, a 110 VAC differential pressure switch alarming at the PLC, and visual clogging/differential pressure indication. Filters shall be constructed and installed so that the filter elements may be changed without disturbing piping, valves or components and with minimal loss of oil.

Pumps shall be suitable for full load application and continuous operation after being idle for more than 40 days, and for operation on hydraulic mineral oil at ambient temperatures between -10^{o} C and +45^{o} C.

Bearings and other sliding parts shall be suitable for 10 000 hours operation at the continuous rated output of the pumps.

Where the drive shaft emerges from the pump casing, two separate seals, each being a continuous ring, shall be provided, the outer to exclude dirt and the inner to retain oil. The seals shall be compatible with the lubricants, hydraulic oils and flushing fluids likely to come into contact with them and shall run on non-corrodible material compatible with the respective shafts. A drain shall be provided between seals and the seals shall not be subject to seizure on the running face during long periods of idleness.

Pumps shall be coupled to drive machinery in such a way that no radial or axial loads are transmitted to the pump and such that the pump does not transmit radial or axial loads to the drive machinery.

Pumps shall be flange mounted to equipment in such a way that a pump may be removed and then replaced without the need for elaborate re-alignment procedures.

All hydraulic pumps shall be tested in accordance with BS 4617 Class B.

Power for the motors and motor starters will be available at 400 Volt, 3 phase, 4 wire, 50 Hertz. Starter coils shall be provided at 230 VAC.

Motors shall be 3 phase, 400 volt, 50 Hz, TEFC, T-frame, squirrel cage induction motors, with 1.15 service factor, suitable for direct across the line starting at full voltage, and capable of continuous operation at nominated load ratings with a supply voltage of 400 VAC ±10% and a frequency of 50 Hz ± 2 Hz.

Motors shall have ANSI/IEEE Class F insulation, but selected for Class B temperature rise of not more than 80°C by resistance over an ambient 40°C, at full load, 1.0 service factor. Motors shall be designed for minimum 5 starts per hour, direct on line. Motors shall be equipped with thermal overload protection.

Motor bearings shall be anti-friction type, of vacuum degassed steel and generously sized for the application, with C3 clearances. Ball bearings shall be of the deep groove rolling element carriage type. Bearings shall be re-greasable, with grease release plugs provided to allow escape of old grease during greasing. Bearings shall be greased in the factory with premium grade grease suitable for the temperature requirements, having extra additives to prevent oxidation.

Motor housings, bearing end shields and fan housings shall be constructed of high-grade cast iron and provided with stud terminals complete with lock nuts for the motor leads, including an internal ground stud. Links shall be provided to achieve the required motor connection configuration. Terminal boxes shall be water tight, NEMA 4X, equipped with desiccators. Motors shall be equipped with drains.

Pumps and motors shall be mounted on vibration isolators on top of the HPP, with flexible hose connections to the oil supply lines and/or valve manifold.

Corrosion protection is specified in GIBB 007 – Painting and Corrosion Protection Specification.

7.3 Reservoirs

The oil reservoirs (sump) shall be EN Grade 1.4306/7 SS 304L unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification, with a capacity not less than 150% of all the total oil volume in the entire oil system, including hydraulic pistons, servomotors and oil lines. The interiors shall be free of all crevasses, open-joints, dead-ends, etc., with continuous welds throughout.

Reservoir volume shall ensure completely flooded pump suctions under all conditions without and vortex formation. Internal vertical baffles shall be provided to separate the return oil from the pump suction, prevent turbulence and reinforce the tank.

The reservoir shall be equipped with leak-tight clean-out and inspection ports (one on each of supply and drain sides), sight-glass level indicators, vents with replaceable desiccant breathers and filters, filling line and cap, drain line and lockable valve. The reservoir bottom shall slope 1% minimum with a drainpipe and transparent glass water trap at the lower end. The water trap shall be fitted with a stainless steel ball valve, 250 mm minimum from floor level for draining purposes and sealed with a taper plug. A magnetic particle detector shall be provided to detect metal particles in the oil.

The reservoir shall be mounted on an angle iron support frame, 150 mm minimum from the wall, with EN Grade 1.4306/7 SS 304L legs, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification, fixed to the floor with M16 stainless steel wedge anchors. It shall be mounted inside an external, leak tight, aluminium drip pan with sufficient capacity to contain 100% of the total oil volume of the HPP and piping. Dimensions to be accepted prior to construction.

Provide a visual hydraulic fluid level indicator, mounted on the reservoir in such a way that it is clearly visible whilst working on the control panel. Provide 110 VAC level switches for low level alarm and low level pump trip.

Vents to be provided with replaceable desiccant breathers and 3 micron air filters having sufficient flow capacity to maintain atmospheric pressure within the reservoir at maximum system demand.

Provide a separately pumped oil filtration and cleaning system to filter oil to 3 microns and remove water entrapped in the oil. This system shall be connected to the bottom of the reservoir in the same manner as the pump suction line and have a return line on the opposite side. The system shall work on a timer to automatically clean the oil during long periods of no operation. The filling connection shall be arranged such that oil may only be placed in the hydraulic reservoir via the filtration system. Provide a test point connected to the tank return pipe for oil sampling.

Pipe and other connections to reservoirs shall be welded internally and externally. Facings and tappings shall be provided where necessary for mounting instruments and other devices. Seals shall be compatible with the operating fluids for the full temperature range. The stainless steel pads shall be welded internally and externally to the reservoir walls. Pipe connections, clamps and fasteners for sub-plates, valves and all parts of the hydraulic system shall suit and be accessible by standard tools to allow proper assembly and dismantling of an item without the necessity to disturb or remove any other component or pipe.

7.4 Hydraulic Valves

All control hydraulic valves and solenoids shall be 110 VAC high quality valves from reputable manufacturers (Parker Hannifen, Vickers, Bosch, Rexworth or similar approved), as accepted by the *Employer's Agent*. Valves shall be clearly and permanently marked with the manufacturer's name and type and size code.

Hydraulic valves may be of the poppet, spool or cartridge types and shall be selected to minimise leakage and maximize repeatability and threshold response (servo-valves are preferred to proportional valves). Valves shall have mounting dimensions complying with internationally accepted standards. Where appropriate, poppet valves shall be used in preference to spool valves. All hand-operated valves shall be fitted with a tamper-proof locking device.

A solid stainless steel manifold block shall be mounted on the top of the reservoir and all valves, filters and instruments shall be directly bolted to machined bosses on the manifold. All other oil routing shall occur within the manifold, with external pipe work permitted only between the pump and manifold block and reservoir. The manifold block shall be machined on all faces to which valves and other components are bolted so that no distortion is caused either in the manifold or valve component when assembled and it is possible to remove the manifold block as a compete unit from the reservoir and such that all valves may be removed from the circuit for maintenance without disturbing the pipe work. Drawings shall be provided showing all oil routing inside the manifolds.

As far as possible valves and pipe work shall be designed such that assembly of the equipment is only possible in the correct manner. Valves shall operate without vibration for all conditions of flow throughout the working range of pressure and temperature.

Catalogue cuts and/or specification sheets shall be supplied for each and every hydraulic valve, along with complete Bills of Materials, in the Submissions accompanying the hydraulic Schematic Diagrams for the complete HPP system. These shall show the functions, features, construction, adjustments and hydraulic symbols used for them on the Schematics.

Shut-off, non-return and direction control valves shall seal off the appropriate fluid passages completely. Directional control valves shall have the P port open to Tank in the neutral position when possible. Shut off and direction control valves shall be provided with indicators showing clearly the position or degree of opening. Non-return valves shall have head loss characteristics for all conditions of flow compatible with the inlet pressure requirements of pumps for both directions of rotation of pump drive shafts.

Pressure relief and pilot relief valves shall be of balanced piston/spool type with adjustable pressure relief ranges and settings. Pressure relief valves shall have provision for fine adjustment and shall be fitted with a tamper-proof locking device. They shall be capable of discharging the maximum design flow with a pressure variation not exceeding 5% above and below the design relief pressure.

At the common pump discharge, a pressure unloading valve shall be incorporated in the circuit so that pumps may circulate oil to tank at low pressure when the system demand is very small. The valves shall have switching pressure differentials compatible with proper operation of the equipment in the hydraulic circuit and shall be of the pilot operated accumulator charging type.

7.5 Oil Piping

Steel ball valves shall be provided at each end for isolation, near the HPP manifold. All tubing, piping and flexible hydraulic hose design shall employ a safety factor of five (5) against the maximum system operating pressure to allow for shock or vibration. Tube/pipe hangers and supports shall include phenolic shock absorbing inserts.

Pressure gauge test ports shall be provided on each service line. Air bleed valves shall be provided at the high points of all pipe/tube runs, where applicable.

Supply/pressure, pilot and return/drain lines shall be designed for a maximum fluid velocity of 3.0 m/s. pump suction lines shall be designed for a maximum fluid velocity of 0.5 m/s.

All piping/tubing and connectors shall be hydrostatically tested to 150% of the maximum system operating pressure.

Pipes and tubes for hydraulic power transmission and hydraulic control circuits shall be manufactured from seamless cold drawn EN Grade 1.4404 SS 316L tubing, unless otherwise specified in GIBB 007 – Painting and Corrosion Protection Specification.

Where the materials to be joined are suitable and where the joint is unlikely to require dismantling for any purpose the pipe joints shall be welded. Wherever possible welded joints shall be factory fabricated.

Field couplings shall be of the Ermelo, double ferrule or compression type.

Compression couplings shall conform to BS 4368 and shall not be fitted closer to the start of a bend than four times the outside diameter of the tube being joined. Compression couplings shall be tightened in accordance with the manufacturer's fitting instructions.

Quick release self-sealing couplings shall be leak proof under positive and negative pressures and shall be provided with a screw-on dust-tight cap manufactured from the same material as the coupling body. Where appropriate an anti-seize lubricant shall be applied to dust cap threads.

Joints in pipe work shall be located so that any length of pipe work can be removed without disturbing other pipe work, all subject to the acceptance of the *Employer's Agent*.

Flanges shall be of a type subject to the acceptance of the *Employer's Agent*. All flanges and coupling bolts shall be manufactured from corrosion resistant material compatible with the pipe, operating pressure, temperature and fluid. Flanged joints shall be arranged such that sealing faces are not damaged or distorted during coupling or re-coupling of the joint.

The ends of all pipes which are to be coupled using compression fittings shall be suitably rounded to prevent damage to the O-ring seals during assembly of the couplings.

Hydraulic pipe work shall be designed for the appropriate operating pressure, including transient positive and negative surges, together with all gravitational, thermal and inertial forces.

All pipe work, valves, joints, couplings, fittings and seals shall be compatible with the operating and flushing fluids used, for the full range of operating temperatures.

Where practicable, hydraulic systems shall be prefabricated and brought onto Site cleaned, complete and sealed.

Pipe runs, where appropriate, shall be designed for temperature variations and differential structural or plant movement. Movement as required shall be permitted through adjacent supports which shall not damage the pipe work.

Pipe work shall be labelled as per the hydraulic diagram.

Supports shall also be provided immediately before and after a bend or offset and immediately before a change to flexible hose.

On completion each section of pipe work including hydraulic equipment, valves and the like shall be subjected for a period of not less than 8 hours to a test pressure of the appropriate relief valve setting. The system shall be leak-free throughout the test.

All hydraulic pipe work including control, drain and return lines shall be designed as pressure lines suitable for the maximum operating pressure in power transmission lines.

All pipes shall be supported in properly made clamps manufactured in high density polypropylene. Clamps shall not damage the pipe and shall be designed for the size of pipe being clamped and allow, where necessary, axial movement to take account of thermal movement. Fixing bolts shall be stainless steel.

7.6 Flexible Pressure Hose

All flexible pressure hose shall be long-life multi-spiral hose.

Flexible hose shall be installed into the pipe work system at suitable locations to take up thermal movement and at points of differential movement between adjacent structures and/or equipment and where installation of rigid pipe work might transmit unacceptable loads to a particular piece of equipment. The hose shall be installed in accordance with the manufacturer's recommendations, and shall be suitable for use with the fluid being transmitted at the operating vibration frequencies, pressures and temperatures.

The inner tube shall be seamless and shall be wound with alternate layers of spiral reinforcement in opposite directions, each separated by a layer of suitable synthetic rubber. The outer cover shall be resistant to abrasion and weathering in the environment of the installation.

Flexible hose end fittings shall be factory swaged into position and shall be manufactured from the same material as the pipe onto which it fits.

Flexible hoses shall be installed such that:

- They are the correct length

- Motion is in one plane and torsional stresses are avoided
- Short radii and S-bends are avoided
- Bend radii shall not be less than 1.2 times the minimum recommended in the appropriate British Standards
- They are securely supported and not subject to torsion or compression
- They do not rub against any other hose, item or structure of any kind
- They are protected against accidental damage and suitably restrained in areas where their failure might constitute a hazard
- They are easily accessible for maintenance and inspection
- Under normal working conditions that part of the hose adjacent to end fittings shall not flex for a distance equal to eight times the outside diameter of the hose
- As far as is practicable they do not run horizontally.

7.7 Pressure Gauges

Pressure gauges for use in hydraulic systems shall be of the Bourdon tube type, shall be glycerine filled and shall generally comply with the requirements of BS 1780.

Gauge dials shall be not less than 100 mm diameter and shall have clearly marked divisions and figures in black on a white background.

Scale graduations shall be in units of MPa and the maximum scale readings shall be not more than 50% higher than the nominal working pressure of the system served.

No aluminium shall be used in the construction of the gauges; housing and bezels shall be of stainless steel. The internal components shall be of stainless steel, bronze or some other corrosion resistant material other than aluminium.

The gauges shall be mounted directly on a sub-plate or mounted flush on a panel. Each pressure gauge shall be fitted with an isolation valve.

The normal operating pressure shall be indicated with a red line on the gauges. Pressure gauges shall be provided to measure the following:

- Pump delivery pressure
- Cylinder feed pressure
- Cylinder return pressure.

7.8 Filling Hydraulic Circuits

Each part of the hydraulic circuit shall be thoroughly cleaned before, and maintained clean during assembly.

After assembly the whole system shall be flushed using clean flushing oil at three (3) times the normal flow rate or an airmatic system until the *Contractor* has demonstrated that the system is as clean as may be expected when operating with the specified standard of filtration and new filters shall be fitted prior to filling the circuit with new hydraulic oil.

The circuit shall be designed in such a way that it may be filled or replenished only via the filters. The system shall be filled with hydraulic oil of a 14/12 cleanliness rating.

7.9 Control and Instrumentation

7.9.1 Master Controller

The HPP, motors and associated hydraulic services shall be managed at a master control panel complete with master controller (micro PLC). The master control panel is considered part of the

HPP(s) and is not a standalone item, and thus shall be designed with the HPP so it functions as an integrated unit.

The master controller will be hard-wired to the individual controllers (local control panels) situated near as is practical to the hydro-mechanical equipment (HME) or as shown on the drawings. The limit switches shall be hard-wired to the master controller. The position status indication of the HME will be communicated at the local controller, via indication lamps, through a hard-wired connection. The actuator push buttons shall be hard wired to the master controller to enable the Opening and closing of the HME.

The control Philosophy of the master controller is a follows:

The master controller will be programed to incorporate the above stated functionality for all HME controlled by the HPP(s).

The master controller will manage the duty rotation of HPP's. The Contractor will design, program and install the master controller to incorporate the duty rotation function.

The master controller will communicate with the main PLC via Ethernet IP, indicating the status, position and health of the hydro-mechanical equipment and HPP(s). These signals shall be visible on the HMI/SCADA. The master controller shall connect with the main PLC and network (HMI/SCADA) via the local Ethernet Switch.

7.9.2 Instrumentation and Logic

Measurement for pressure of the hydraulic system and temperature of the hydraulic fluid (4-20 mA transducers) for the HPP(s) shall form part of the feedback for monitoring and alarm purposes.

Reference for HME position indication is as described in Section 8 of this specification.

The HPP supplier(s) shall provide a list of all electrical IO signals (both 4-20 mA analogue and dry contact discrete devices) to and from the, HME and HPP system, along with a flow chart showing his hydraulic circuit logic and devices for the functioning of each gate, for review, approval and use by the *Employer's Agent*.

The *Contractor* will generate a complete set of submittals (as stated in Section 3.1) complete with flow chart, hydraulic schematic, flow diagram, P&ID, showing the controller logic and its I/O signals to the HPP and its valves, solenoids and devices, for review and approval by the *Employer's Agent*.

A list of the minimum required instrumentation is provided below, however, the tendered rates or sums shall cover the cost of anything not specially mentioned, but which an experienced contractor can reasonably foresee as being required to enable the apparatus and equipment to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of equipment or part thereof is not specifically mentioned

Minimum instrumentation in the HPPs shall include:

- Reservoir 110 VAC level switches for low level alarm, low level pump trip, and high level alarm
- High and low pressure switches on pump outlets
- Oil temperature RTD and 24 VDC transmitter for high and low temperature alarm in reservoir
- Both supply and return filters to be fitted with 110 VAC differential pressure switches alarming at the master controller.

7.10 Switches

Switches must be encapsulated to IP68 to IEC 144, as a separate part to protect them against getting wet during setting work on the actuators and allow setting while power is on. They shall be rated at 5 Amps at 240 V DC. Switches shall be bounce-free. A minimum load of 20 mA at 24 V AC must be operated by a standard switch.

7.10.1 Position Switches

The position sensor shall be integrated directly into the cylinder to measure the stroke. The wire of the wire-actuated mechanism is attached to the piston head. When the cylinder extends, the wire wound on a wire drum is pulled out. The resulting rotation of the wire drum is detected without contact by the sensor electronics and converted to a linear path. This means that precise and absolute position tracking of the cylinder is possible at any time.

The electronic components are fully encapsulated on the non-pressurised side of the system. The entire measuring system is therefore incorporated into the cylinder and optimally protected against external environmental influences.

The equipment position shall be determined from a 4-20mA signal representing the valve percentage open and shall be wired to terminals for local and remote indication.

Position sensors for hydraulic cylinders must meet one central requirement: they should not negatively affect the compactness of a hydraulic cylinder. This means that when a position sensor is fitted, the length of the cylinder should not grow if possible and the extended installation length should be as short as possible.

The electrical circuit diagram of the actuator shall not vary with valve type; remaining identical regardless of whether the valve is to open or close on position limit.

7.10.2 Limit switches

Limit switches shall be provided on the hydraulic cylinders.

Limit switches (4-20 mA analogue) shall be provided as required for position feedback and monitoring signals from the gates to the local PLC and HMI for the following local functions and gate positions.

Limit devices shall be placed on the solenoid control valves to enable an additional switching point to be set for each direction of rotation (e.g. to signal a certain valve position or start/switch off and equipment connected to the HPP).

The above signals shall be from potential free/dry change over contacts rated 5 amp 240 volt AC inductive and 5 amp 24 volt DC. A 24 volt DC supply shall be made available for remote and location indication.

Local and remote limits at the actuator shall include:

- Valve fully closed
- Valve fully open.

a) Magnetic proximity sensors shall be used (sensing range >=40 mm and hysteresis <1 mm).

b) All limit switches shall have hermetically sealed contacts to reduce the potential for corrosion.

c) The upper limit switch shall be made when the gate is raised, and the lower limit switch shall be made when the gate is in the lowered position.

d) For gates operated by hydraulic cylinders, the limit switches shall only be used for lowered and raised position indication. The movement control shall be terminated when the maximum pressure is reached.

For limit switch positions refer to the; P&ID's, Control Narrative and ,Functional design Specification. Actual positions to be concluded on site upon approval of the Employer's Agent.

7.10.3 Pressure switches

The cylinders shall be provided with pressure switches for overpressure to prevent continued raising against undue resistance from a jammed gate or excessive friction in the gate guides or in the cylinder. The signal from this switch shall be arranged to de-energize the HPP pumps. The pressure switches shall be linked to the master controller for local position indication (on the master controller interface and local controller lighting display), which in turn which will relay signals to the main PLC for indication on HMI/SCADA for remote monitoring.

7.11 Installation

Installation work shall comply with the clause "Installation" in GIBB 002 – General Mechanical Specification.

Installation of the HPP's shall occur simultaneously with the hydro-mechanical equipment and both contractors/suppliers, should they be separate companies, shall communicate and work alongside each other ensuring an effective and efficient system is installed.

7.12 Testing

Field-testing of the HPP's shall only occur once all the hydro-mechanical equipment is installed and all piping and tubing is connected. The testing shall be conducted in parallel and together with the hydro mechanical equipment.

There shall be separate payment items for testing each equipment (which is more focused on structural integrity, bearing movement, hydraulic piston movement, and seal effectiveness. There shall be a separate payment item for the individual HPP testing and for an overall hydraulic systems test. Refer to payment section for more details.

8 HYDRO-MECHANICAL EQUIPMENT CONTROLS

This section must be read in conjunction with the Control Philosophy and Functional Design Specification for enhanced clarity.

8.1 Control Local and Remote

There shall be no remote control of the hydro-mechanical works described in this specification unless specifically stated otherwise in the Payment Item or the Functional Design Specification.

The Control panel, shall consist of one complete set of indicator lights as described below, as well indications displayed on all HMI units.

The HMI shall be used to access the service mode of the HME, to provide information as to what operation is underway, as well as to indicate the gate open or closed position. The panel shall also display information concerning any fault that may occur and what may be done to remedy the situation.

Control Panel hydraulic push button functions should be read in conjunction with the requirements of the control philosophy and FDS, Manufacture may only commence once the *Employer's Agent* has approved the layout.

8.2 Controls of the Radial Gates

a) The radial gates control shall be described in the Control Philosophy and Functional Design Specification.

b) The emergency stop pushbutton on the control panel shall override all modes of operation

c) The radial gate controls shall be designed in such a manner that the gate shall automatically close in the event of a power failure

d) Manufacture may only commence once the Employer's Agent has approved the layout.

e) All controls shall be such that once the motion has been initiated it shall continue, even when the button is released. The continued motion of the gate, once the motion has been initiated, shall be automatically arrested at both the fully raised and fully lowered positions by limit switches. It shall be possible to change the direction of gate travel at any point of travel by pressing the STOP button first.

8.2.1 Gate Control Panel

The control panel shall have one complete set of controls and indicator lights, as listed below, for operation of a gate.

Below is an indicative list of requirements for the control panel:

a) The whole control panel shall be lockable by a key-switch. The key shall be trapped in the UNLOCK position,

b) A key operated local / remote selector switch. The key shall be trapped in the local position. (no selector switch applicable for this contract).

c) One 400 V voltmeter with 4 position switch to indicate the potential over each phase.

d) One ammeter with 3 positions to indicate the current in each phase.

e) A RED coloured LAMP TEST button. This button shall be labelled accordingly and shall illuminate all the indicator lamps on the control desk when depressed.

f) A GREEN coloured push button shall be provided and labelled RAISE.

g) A GREEN coloured indicating light shall be provided and labelled RAISING. This indicating light shall illuminate only when the gate is opening.

h) A GREEN coloured push button shall be provided and labelled LOWER.

i) A GREEN coloured indicating light shall be provided and labelled LOWERING. This indicating light shall illuminate only when the gate is closing.

j) A RED coloured push button switch shall be provided and labelled STOP. This button shall arrest the movement of the gate and hold it stationary in that position.

k) A 50 mm diameter mushroom headed RED coloured emergency stop push button switch shall be provided and labelled EMERGENCY STOP. This switch shall be the push to latch – twist to release type. In the operated or pushed in position, the contacts of the switch shall break the circuit of the main contactor supplying all the circuits of the gate. This main contactor shall be on the supply side of the up and down motion operating circuit.

l) A RED coloured indicating light shall be provided and labelled SYSTEM UNAVAILABLE. This light shall illuminate when there is a fault with the system.

m) A YELLOW alarm lamp indicating and labelled GATE JAMMED.

n) Should servomotors be present, a digital position indicator accurate to the nearest centimetre for gate position and a second position indicator displaying the percentage of gate opening between the closed and ready positions. The input for the digital position

display will come from limit servomotor LVDT via the PLC. The display shall have numbers 2 cm high.

o) A digital position indicator (open closed) for display on the HMI in the control room.

The below pertains to the control panel and remote HMI for the following elements in addition to the above:

a) A flashing RED coloured indicating light shall appear at the local control and an alarm (and/or Flashing RED light) will appear on the HMI in the control room should the radial gates not be fully seated.

8.3 Controls of Abstraction Works Sluice Gates

Control of the sluice gate(s) raising and lowering will be local only unless specifically stated otherwise

a) The sluice gates control shall be described in the Control Philosophy and Functional Design Specification.

b) The emergency stop pushbutton on the control panel shall override all modes of operation

c) The sluice gate controls shall be designed in such a manner that the gate shall automatically fail in current position in the event of a power failure.

d) Manufacture may only commence once the Employer's Agent has approved the layout.

e) All controls shall be such that once the motion has been initiated it shall continue, even when the button is released. The continued motion of the gate, once the motion has been initiated, shall be automatically arrested at both the fully raised and fully lowered positions by limit switches. It shall be possible to change the direction of gate travel at any point of travel by pressing the STOP button first.

8.3.1 Sluice Gate Control Panel

Where practically possible equipment in close proximity and if approved by the Employers Agent may be controlled via a common same control panel.

The control panel position shall be indicated on the drawings.

A 2-way rotary switch will be required on each sand trap control panel to select the required upstream or downstream sluice gates or primary or secondary screens. Each position to be labelled accordingly.

The control panel shall have one complete set of controls and indicator lights, as listed below, for operation of a sluice gate.

This control will be done in conjunction with the Control Philosophy and FDS. Below is an indicative list of requirements for the control panel:

a) The whole control panel shall be lockable by a key-switch. The key shall be trapped in the UNLOCK position.

b) A key operated local / remote selector switch. The key shall be trapped in the local position. (Omit this line for the purposes of this project.)

c) One 400 V voltmeter with four (4) position switch to indicate the potential over each phase.

d) One ammeter with three (3) positions to indicate the current in each phase.

e) A RED coloured LAMP TEST button. This button shall be labelled accordingly and shall illuminate all the indicator lamps on the control desk when depressed.

f) A GREEN coloured push button shall be provided and labelled RAISE.

g) A GREEN coloured indicating light shall be provided and labelled RAISING. This indicating light shall illuminate only when the sluice gate is opening.

h) A GREEN coloured push button shall be provided and labelled LOWER.

i) A GREEN coloured indicating light shall be provided and labelled LOWERING. This indicating light shall illuminate only when the sluice gate is closing.

j) A RED coloured push button switch shall be provided and labelled STOP. This button shall arrest the movement of the sluice gate and hold it stationary in that position.

k) A 50 mm diameter mushroom headed RED coloured emergency stop push button switch shall be provided and labelled EMERGENCY STOP. This switch shall be the push to latch – twist to release type. In the operated or pushed in position, the contacts of the switch shall break the circuit of the main contactor supplying all the circuits of the sluice gate. This main contactor shall be on the supply side of the up and down motion operating circuit.

l) A RED coloured indicating light shall be provided and labelled SYSTEM UNAVAILABLE. This light shall illuminate when there is a fault with the system.

m) A YELLOW alarm lamp indicating and labelled GATE JAMMED.

n) A digital position indicator (open/closed) for display on the HMI in the control room.

The below pertains to the control panel and remote HMI for the following elements in addition to the above:

a) A flashing RED coloured indicating light shall appear at the local control and an alarm (and/or Flashing RED light) will appear on the HMI in the control room should the sluice gate not be fully seated.

8.4 Controls of Balancing Tank Sluice Gates

Control of the sluice gate(s) raising and lowering will be local only unless specifically stated otherwise.

a) The sluice gates control shall be described in the Control Philosophy and FDS.

b) The emergency stop pushbutton on the control panel shall override all modes of operation

c) The sluice gate controls shall be designed in such a manner that the gate shall automatically fail in current position in the event of a power failure (HPP failure).

d) Manufacture may only commence once the Employer's Agent has approved the layout.

e) All controls shall be such that once the motion has been initiated it shall continue, even when the button is released. The continued motion of the gate, once the motion has been initiated, shall be automatically arrested at both the fully raised and fully lowered positions by limit switches. It shall be possible to change the direction of gate travel at any point of travel by pressing the STOP button first.

8.4.1 Sluice Gate Control Panel

Each balancing tank compartment shall have its own control panel. The sluice gates that are present in the Balancing tank compartment shall be grouped and hard-wired to the compartments control panel.

The control panel position shall be indicated on the drawings. A rotary switch will be required on control panel to select the required sluice gates. Each position to be labelled accordingly.

The control panel shall have one complete set of controls and indicator lights, as listed below, for operation of a sluice gate.

This control will be done in conjunction with the Control Philosophy and FDS. Below is an indicative list of requirements for the control panel:

a) The whole control panel shall be lockable by a key-switch. The key shall be trapped in the UNLOCK position.

b) A key operated local / remote selector switch. The key shall be trapped in the local position. (Omit this line for the purposes of this project.)

c) One 400 V voltmeter with four (4) position switch to indicate the potential over each phase.

d) One ammeter with three (3) positions to indicate the current in each phase.

e) A RED coloured LAMP TEST button. This button shall be labelled accordingly and shall illuminate all the indicator lamps on the control desk when depressed.

f) A GREEN coloured push button shall be provided and labelled RAISE.

g) A GREEN coloured indicating light shall be provided and labelled RAISING. This indicating light shall illuminate only when the sluice gate is opening.

h) A GREEN coloured push button shall be provided and labelled LOWER.

i) A GREEN coloured indicating light shall be provided and labelled LOWERING. This indicating light shall illuminate only when the sluice gate is closing.

j) A RED coloured push button switch shall be provided and labelled STOP. This button shall arrest the movement of the sluice gate and hold it stationary in that position.

k) A 50 mm diameter mushroom headed RED coloured emergency stop push button switch shall be provided and labelled EMERGENCY STOP. This switch shall be the push to latch – twist to release type. In the operated or pushed in position, the contacts of the switch shall break the circuit of the main contactor supplying all the circuits of the sluice gate. This main contactor shall be on the supply side of the up and down motion operating circuit.

l) A RED coloured indicating light shall be provided and labelled SYSTEM UNAVAILABLE. This light shall illuminate when there is a fault with the system.

m) A digital position indicator (open/closed) for display on the Interface in the control room.

The below pertains to the control panel and remote HMI for the following elements in addition to the above:

a) A flashing RED coloured indicating light shall appear at the local control and an alarm (and/or Flashing RED light) will appear on the Interface in the control room should the sluice gate not be fully seated.

The balancing tank control panels will be provided with additional indicator lights and pushbuttons as specified in the FDS. This shall include pushbuttons that remotely initiate PLC sequences (flushing and filling), as well as indicator lamps used to show the status of certain PLC sequences. The Contractor shall design these additional features in accordance with the provisions of the FDS.

The final design shall be subject to the review and approval of the Employer's Agent.

8.5 Controls of Abstraction Works Screens

Control of the screens(s) raising and lowering will be local or remotely if specified, by means of a lifting device as specified in this specification, and/or GIBB 008 – Cranes, Gantries, Hoists and Winches..

a) The screens control shall be described in the Control Philosophy and FDS.

b) The emergency stop pushbutton on the control panel shall override all modes of operation

c) The screen controls shall be designed in such a manner that the gate shall automatically fail in current position in the event of a power failure.

d) Manufacture may only commence once the Employer's Agent has approved the layout.

e) All controls shall be such that once the motion has been initiated it shall continue, even when the button is released. The continued motion of the gate, once the motion has been initiated, shall be automatically arrested at both the fully raised and fully lowered positions by limit switches. It shall be possible to change the direction of gate travel at any point of travel by pressing the STOP button first.

Approval of the controls subject to the decision of the Employer's Agent.

8.5.1 Screen Control Panel

Where practically possible equipment in close proximity and if approved by the Employers Agent may be controlled via a common control panel.

A 2-way rotary switch will be required on each sand trap control panel to select the required upstream or downstream sluice gates. Each position to be labelled accordingly.

The control panel will have the same master buttons as indicated in Section 8.3.

8.6 Instrumentation

Refer to the following for project specific details on the various instrumentation used for the Works:

- Functional Design Specification
- Control Narrative
- Data sheets.

8.6.1 Limit switches

a) Magnetic proximity sensors shall be used (sensing range >=40 mm and hysteresis <1 mm).

b) All limit switches shall have hermetically sealed contacts to reduce the potential for corrosion.

c) The upper limit switch shall be made when the gate is raised, and the lower limit switch shall be made when the gate is in the lowered position.

d) For gates operated by hydraulic cylinders, the limit switches shall only be used for lowered and raised position indication. The movement control shall be terminated when the maximum pressure is reached.

Positions of the limit switches described in high-level detail in the P&ID, control philosophy and FDS. Actual positions to be concluded on site upon approval of the Employer's Agent.

8.6.2 Position indicator

Provision shall be made for position indication.

A terminal strip with potential free contacts for remote indication shall be provided as follows:

- Gate/screen opened
- Gate/screen closed.

A 4 -20 mA position indication signal shall also be wired to this terminal strip.

a) The position indicator shall be sealed to at least IP 68

b) Position indication to be accurate to the nearest 10 mm of gate opening.

Equipment position switches are described in the P&ID's. Actual positions to be concluded on site upon approval of the Employer's Agent.

Should hydraulic actuation be used, the position switch is described in Section 3.5.12 or unless otherwise stated by the Employer's Agent.

9 TESTING AND INSPECTIONS

9.1 Quality Control and Quality Assurance

All Plant supplied shall be subjected to a Quality Control and Quality Assurance Program designed and implemented to prevent, or readily detect and correct, defects or non-conformities in the work. This QA/QC program shall be in accordance with ISO 9000 and GIBB 002 - General Mechanical Specification, shall be in effect at all times, and shall clearly establish the authority and responsibility of those responsible for it. Persons performing such functions shall have sufficient, well-defined responsibility and authority to enforce the quality plan and requirements, to identify and initiate solutions to quality problems, and to verify the effectiveness of the solution.

The *Contractor* shall provide a summary of his QA/QC Program in his proposal documentation, and shall include a description of all shop tests and inspections that will be performed, including material testing, weld testing, and tests or inspections of purchased or manufactured components and parts, and on the fully assembled Work. Within thirty (30) days following the s*tarting date*, the *Contractor* shall submit a formal Schedule of Tests and Inspections, which shall include details of materials and material tests, welds, weld qualifications, non-destructive examination and testing (such as radiographic, ultrasonic, magnetic particle and liquid penetrant weld testing, along with quality levels and acceptance Standards applied), inspections of purchased and manufactured components and assemblies, workmanship Standards and inspections, and details of tests and inspections of all surface preparations and coating, which will be carried out by the *Contractor* during the course of design, manufacture, supply, installation manufacture. All details of the *Contractor*'s Quality Control Program shall be set out in the Schedule of Tests and Inspections for the *Employer's Agent*'s acceptance before any manufacturing begins.

The *Contractor* shall conduct sufficient shop inspections and tests, and provide the *Employer's Agent* with three (3) copies of all required reports or certificates of tests or inspections, test reports and samples, to demonstrate that the requirements of these specifications and the applicable Standards and specifications are being met with respect to materials, design, manufacture and testing. The reports shall be complete with all pertinent data, test criteria, Standards employed, descriptions of apparatus, and photographs to present clear, concise and factual evidence of the tests. Tests and reports shall include, but not be limited to, mill certificates, Charpy V-notch tests and other material testing certificates, radiographic and ultrasonic test files and other non-destructive test reports, reports on leak testing and functional testing, and qualifications and certification records on non-destructive testing procedures, welding equipment and materials, and welding personnel. The *Employer's Agent* shall be permitted to make any reasonable request for additional inspections and/or testing as may be required to demonstrate compliance of the Work, and these shall be performed at no additional costs.

9.1.1 Additional Quality requirements

9.1.1.1 Radial gates:

All of the radial gates shall be furnished by a single manufacturer with a minimum of 20-years of experience designing and manufacturing sluice gates. The manufacturer shall have manufactured slide gates of similar type, size, material, mounting, seals and actuation equipment described herein for a minimum of 20 similar projects.

The sealing system shall be certified and tested for operation and performance to leakage specifications compliant with AWWA C-561 for a minimum of 100,000 cycles.

To insure quality and consistency, the radial gates listed in this section shall be manufactured and assembled in a facility owned and operated by the radial gate manufacturer. Third-party manufacturers contracted for fabrication and assembly shall not be permitted.

9.1.1.2 Sluice gates:

All of the Sluice gates shall be furnished by a single manufacturer with a minimum of 20-years of experience designing and manufacturing sluice gates. The manufacturer shall have manufactured slide gates of similar type, size, material, mounting, seals and actuation equipment described herein for a minimum of 20 similar projects.

The sealing system shall be certified and tested for operation and performance to leakage specifications compliant with AWWA C-561 for a minimum of 100,000 cycles.

Leakage testing shall be done under maximum specified pressure and after all installation work has been completed. Leakage shall comply with AWWA Spec. C 501. Each gate assembly shall be water tested by the Contractor at the discretion of the Employer's Agent and Client, to confirm that leakage does not exceed the specified allowed leakage.

To insure quality and consistency, the Sluice gates listed in this section shall be manufactured and assembled in a facility owned and operated by the Sluice gate manufacturer. Third-party manufacturers contracted for fabrication and assembly shall not be permitted.

The units shall be shall be tested for compliance with the maximum peripheral force required for their operation.

9.1.1.3 Screens:

All of the Screens shall be furnished by a single manufacturer with a minimum of 20-years of experience designing and manufacturing sluice gates. The manufacturer shall have manufactured slide gates of similar type, size, material, mounting, seals and actuation equipment described herein for a minimum of 20 similar projects.

To insure quality and consistency, the Screens shall be manufactured and assembled in a facility owned and operated by the Screens manufacturer. Third-party manufacturers contracted for fabrication and assembly shall not be permitted.

9.1.1.4 Stop logs:

All of the stop logs shall be furnished by a single manufacturer with a minimum of 20-years of experience designing and manufacturing sluice gates. The manufacturer shall have manufactured slide gates of similar type, size, material, mounting, seals and actuation equipment described herein for a minimum of 20 similar projects.

The sealing system shall be certified and tested for operation and performance to leakage specifications compliant with AWWA C-561 for a minimum of 100,000 cycles.

To insure quality and consistency, the stop logs shall be manufactured and assembled in a facility owned and operated by the stop logs manufacturer. Third-party manufacturers contracted for fabrication and assembly shall not be permitted.

For more quality details refer to GIBB 002 – General Mechanical Specification for more details.

9.2 Destructive and Non-Destructive Testing and Inspections

Minimum testing and inspection procedures for all gates and stop logs shall include, but not be limited to, the following:

9.2.1 Shop Tests:

a) Mill samples and chemical, mechanical tests of steel, including Charpy V-notch testing, of all major steel load bearing members such as skinplates, girders, etc.

b) Functional testing of all moving parts of gates, hoists and auxiliary equipment.

c) Assembly of all gates, stop logs and screens to examine clearances, fits, tolerances, alignments, assembled dimensions, surface finish, etc. and match-mark and dowel as required to ease correct assembly at site.

d) Examination of all surface preparations prior to coating. Holiday, adhesion and dry film thickness testing of all coatings.

e) Dimensional checks for all parts, but particularly for close tolerances and fits, bearing, pin and seal clearances, etc.

f) All lubricated parts correctly cleaned and lubricated.

g) Visual and die penetrant testing of all major welds.

h) All major butt welds and welds subject to high stresses in service shall be 100% radiograph tested per BS 2600: Parts 1 or 2, or BS 2910 as appropriate, using ultra-fine-grain-high-contrast direct-type film. Acceptance standards shall be per BS 5500 Table 5.7 or the EN 13445 or SANS. Where site welding is necessary and radiographic examination is not practical, 100% ultrasonic examination of in-situ welds per BS 3923: Parts 1 or 2 may be accepted. Adjacent parent metal shall be ultrasonically examined to locate any imperfections, which might prevent effective examination of the weld. All welding tests shall be documented and certified.

i) Where necessary, gate wheels shall be assembled, mounted, lubricated, and adjusted/aligned in the shop to the full extent possible. Wheel alignment shall be such that wheel treads are tangential to the plane of their tracks, after which the axles/pins shall be locked in position for transportation but so that adjustment may be made on Site during installation.

j) Gate and stop log seals shall be fitted to the assembled gate in the shop and shall be match-marked prior to removal for shipping. Joints in the seals shall be minimized and only moulded corner seals are permitted. All joints shall be shop-made, fitted to produce a smooth finish, and vulcanised. Joints to be made in the field shall be accurately shop fitted first, secured with double fasteners.

k) All electrical systems and circuits shall be assembled, wired, tested for continuity, energized and tested for functionality, continuity and insulation in the shop prior to shipment. All wiring disconnected for shipment shall be tagged at both ends, using a coordinated labelling system, to ensure correct reconnection at Site.

l) Hoists shall be assembled, operated and fully tested in the shop to the greatest extent possible over their complete range of operation, and shall be shipped as a complete unit, with the exceptions of HPP units or wire rope. Wire rope shall be shipped on its reel without any sheaves reeved on it.

m) Complete inventory and visual checking of all assemblies, materials and packing prior to shipping.

n) If deemed necessary by the client, the Contractor shall make all arrangements and carry all costs for the Employer's Agent to inspect the fully assembled radial gate in the workshop for approval prior to dispatch to Site.

9.2.2 Field Tests:

a) Dry and Wet tests. Wet test to include all dry tests under wet conditions and full head against the gates.

b) Dry tests to include seal operation per pre-compression recommended by the gate designer, the clearances in the guides are adequate, and that the gates work correctly under all specified conditions that may be simulated in the absence of water head.

c) Water pressure and leakage testing.

d) Functional testing of all moving parts of gates, hoists, grappling beams, controls and auxiliary equipment.

e) Raising and lowering speed tests of all hoists with gates loaded.

f) Holiday and dry film thickness testing of all coatings.

g) Radiographic testing of all permanent field welds on built-in parts (minimum 50%).

h) Visual inspection and fastening of all bolted field connections, with torque measurements.

i) Wet and dry functional testing of filling operation by emergency gate and draft tube gate cracking, including hoist operation, gate lift to correct height, and stability of gates.

j) Wet emergency closure testing of emergency gates and draft tube gates.

k) Hoist speed tests.

l) Checking of correct lubrication of all lubricated parts.

m) Bypass valve functional testing from extended stems.

n) Electrical continuity testing & proving of all circuits and wiring for all control, alarm and auxiliary power circuits.

o) All instrumentation to be calibrated and proved correct.

p) Testing of oil pressure curve over entire range of raising and lowering.

q) All dogging and mooring equipment (stop logs, screens etc.) shall be tested for functionality, fits, tolerances, ease of installation, security, etc.

9.3 Tests on Completion

'Dry' and 'wet' commissioning tests and inspections shall be performed as specified and as detailed in the *Contractor*'s Schedule of Tests and Inspections (during and after installation) on the equipment supplied herein to demonstrate to the *Contractor*, the *Employer's Agent* and the *Employer's Agent* that the equipment supplied operates together safely and reliably and in accordance with the specifications, and will so operate over the service life of the equipment. First stage (Dry) testing shall commence without delay upon completion of erection. Second stage (Wet) testing shall take place as soon as practical after the completion of the entire *works* and shall be coordinated with the commissioning work of all other Parts of the Plant. All testing shall be performed in a coordinated manner in collaboration with all other Contractors and suppliers involved to ensure safety of all Plant and personnel, and an efficient testing programme in accordance with the construction and commissioning schedule.

At least six(6) months prior to the commencement of erection, the *Contractor* shall supply the *Employer's Agent* with comprehensive draft copies of all Operation and Maintenance manuals and Installation and Commissioning Instructions, which shall include the Schedule of Tests and Inspections, which in turn shall include details of all Wet and Dry Testing procedures. All Plant and

equipment shall be carefully inspected and tested at the Site during and after erection in the presence of the *Employer's Agent* to show that it is functioning correctly. Detailed Installation, erection and Commissioning Instructions shall be provided for the *Employer's Agent*. Such Instructions shall provide all technical installation and functional testing procedures considered necessary by the *Contractor* to correctly install the gate and all appurtenances and hoisting equipment, and to prove correct function and operation of the gate under all operating conditions.

No separate Taking-Over Certificate for the Hydro-Mechanical Equipment shall be issued. The results of all off-site (factory and other locations) and Site tests carried out by the *Contractor* in accordance with the requirements of the Specification shall be recorded, certified and submitted to the *Employer's Agent*. No separate payment for providing all certificates and reports will be made and payment shall be deemed to be included in the rates and sums listed in the Bill of Quantities.

After installation, all gates and stop logs will be field tested in the presence of the Employer's Agent and Client to ensure that all items of equipment are in full compliance with this Specification.

The correct operation of the equipment and achievement of the specified performance requirements shall be demonstrated to the Employer's Agent prior to the commissioning of the Works.

Leakage testing shall be done under maximum specified pressure and after all installation work has been completed. Leakage shall comply with AWWA Spec. C 501. Each gate assembly shall be water tested by the Contractor at the discretion of the Employer's Agent and Client, to confirm that leakage does not exceed the specified allowed leakage.

The units shall be shall be tested for compliance with the maximum peripheral force required for their operation.

Testing work shall comply with the clause "Testing" in GIBB 002 – General Mechanical Specification.

9.4 Commissioning

Commissioning work shall comply with the clause "Commissioning" in GIBB 002 – General Mechanical Specification.

10 SUBMITTALS, DRAWINGS AND DOCUMENTATION

a) The SI (Metric, MKS) system shall be used for all dimensions, loads, weights, masses, etc. wherever possible on all drawings and submissions. All drawings and submissions shall be in the English language.

b) Preliminary Proposal Submittal: basic design, weights, dimensions, materials, concrete loading requirements, bolting and anchoring requirements, secondary concrete blockouts, tolerances, embedments, dimensions and elevations required to support and incorporate the gates into the concrete, hoist arrangements, capacity and loads, gate load and force assessment, and Submission Schedule.

c) Details of all requirements for concrete and structural foundations and supports, including static and dynamic loads, weights of all major gates and hoist assemblies, dimensions, elevations, first stage blockouts, tolerances, shapes, embedments, bolting and anchoring requirements, guides, and bearing beams, seal faces, anchors, thrust blocks and embedded parts, storage arrangements, hoist mountings, anchors, etc. required to support and incorporate the hydro-mechanical equipment into the structures.

d) General arrangement plans, sections, elevations and installation drawings of the gate and all principal components and appurtenant equipment, all assembly and sub-assembly and detail drawings, including details of all embedded parts and gate parts (e.g. guides, seals, seal connections, seal faces, and stem connections), all hoisting and dogging equipment, and all connections, welds, welding materials, bolts, torques, materials, dimensions, weights, loads, tolerances, etc. Locations and details of all field joints.

e) Detailed drawings and Bills of Materials of all assemblies, subassemblies and purchased equipment with dimensions, manufacturers and product catalogue cuts, specifications, descriptions, lubrication requirements and lubrication schedules. Instrumentation, electrical and control panel arrangements, schematic, wiring and electrical connection diagrams, etc. including wire sizes and terminal blocks and terminal boxes, and earthing details.

f) Coating Plan: Full description of all procedures, products and Standards that are proposed and will be employed for coating all parts of the gates and appurtenant equipment, including surface preparation procedures, primers and under-coatings, top coats, specifications and manufacturer's instructions and recommendations, Standards, field coating and touch-up procedures, lists of parts to be coated or not coated.

g) A Coating Plan is required prior to commencement of manufacture and is subject to acceptance by the *Employer's Agent*.

h) The coating procedures must comply with GIBB 007 – Painting and Corrosion Protection Specification.

i) Schedule of Tests & Inspections: In accordance with the Quality Control/Assurance Plan, to be submitted within six weeks of the s*tarting date*.

j) Installation and Commissioning Instructions providing drawings, instructions, installation requirements and procedures for all equipment, for field assembly, erection, installation, alignment and embedment of anchors, guides, sills, lintels, frames, gates, hoists and structures, and instructions for field-testing procedures. Submission requires six (6) months prior to delivery to site.

k) Operation and Maintenance Manuals: The *Contractor* shall submit operation, maintenance, and parts manuals for acceptance before final acceptance of products. The manuals shall include all information, diagrams, and drawings plus instructions for operating and maintaining the gate and equipment. All components shall be catalogued so that replacement parts can be purchased in the future. The O&M manual shall include a list of recommended spare parts, lubricants, coatings, etc. with local RSA suppliers. A complete set of As-Built drawings shall be included.

l) The *Employer's Agent's* review of drawings and documents submitted will be general, and not relieve the *Contractor* of his responsibility for correctness of the design, material selection, fits, loads, calculations and details.

11 MEASUREMENT AND PAYMENT

This Section shall be read in conjunction with the, GIBB 010 - Electric Actuation Specification, (should there be electric actuated sluice gates present in the Works). The actuation, (being pneumatic, electric or hydraulic pistons/rams) equipment shall be priced in conjunction but as a separate payment item with the hydro-mechanical equipment specified in this specification.

The payment items for the complete design, manufacture, supply, delivery, storing, installing, testing, inclusive of arranging witness testing at factories prior to delivery, O&M manuals, drawings and spare require for the complete operation of the HPP's and all the hosing, connections, piping, oil supply to the hydraulic cylinders for complete functioning of the specified hydraulically actuated hydro-mechanical equipment shall be measured separately and not as part of the hydro-mechanical equipment.

The auxiliary lifting equipment, which doesn't include actuation, specified herein shall be priced separately as per the GIBB 008 – Cranes, Gantries, Hoist and Winches Specification as specified in this Specification, and/or the drawings but shall nevertheless be designed alongside the hydro-mechanical equipment for the complete functioning of the gates, screens and stop logs.

All payment items shall be inclusive of all painting and corrosion protection as specified in this Specification and/or GIBB 007 and shall be applied in accordance to the GIBB 007 – Painting and Corrosion Protection Specification.

All payment stages listed below shall be inclusive of all designs, labour, materials, products, testing, coatings, workmanship, submissions, drawings, documentation, instrumentation control system, electrical appurtenances and wiring/cabling, etc

11.1 Radial Gates

*11.1.1 **Design, Manufacture, Supply and Delivery to site**:*

Design, Manufacture Supply and delivery to site of radial gate as follows**:** ……Unit: Number (No)

- Description/ location,
- To suit Clear opening [Specify] m Length by [Specify] m Height:
- Gate material [Specify] or as specified in GIBB 007 and min thickness [Specify] mm:
- Sleeve Material: [Specify]
- Backing plate material: [Specify]
- Seal faces and guide material: [Specify]
- Design pressure head: [Specify] m

- Seating and sill position: [Specify] masl
- Hydraulic cylinder(s)
- List all switches (position/limit/pressure)
- All coatings described in GIBB 007.

The unit of measurement shall be the number of units of each size, as specified or shown on the Drawings or as designated by the Engineer.

The rate tendered shall include full compensation for the design of the complete installation including full design calculations; detail working Drawings for all items; Specifications; schematic diagrams; electrical Drawings and wiring diagrams; layout Drawings; delivery including, supply of raw materials and bought-out items; fabrication/manufacture/assembly; quality assurance and quality control; inspection and testing (including attendance on inspection/tests witnessed by the *Employer's Agent*); type and routine tests; application of finishes (paint/corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. The rates shall also include payment for supply and delivery to Site of all specified or agreed upon spare parts, including permanent packing for long-term storage.

A Separate rate for designing, supplying, delivering, manufacturing, installing, erecting, and commissioning for the lifting and or hoisting equipment is described elsewhere.

11.1.2 ***Installation / Erection and Commissioning of Radial Gate listed above****:*

Installation / Erection, testing, Commissioning preparation of O&M manuals of radial gate as listed above	……Unit: Number (No)

The unit of measurement shall be the number of units of each size, as specified or shown on the Drawings or as designated by the Engineer.

The rates tendered shall include full compensation for the installation including the provision of all labour, equipment, transport, materials, lifting equipment and temporary works necessary to install the complete works; on-site quality assurance and quality control, inspection and testing (including attendance at tests witnessed by the *Employer's Agent*); the installation of all auxiliary equipment, electrical panels, cabling, pipe work, etc., to complete a workable installation; supply of all consumables (electricity, fuel, oil and lubricants etc.) necessary for the operation of the installation until taken over by the *Employer*; the putting into service of the complete installation; and any other work as specified. The rates tendered shall include for full compensation of all costs incurred in preparing and submitting to the *Employer's Agent* of the specified Operating and Maintenance Manuals and record Drawings.

A Separate rate for designing, supplying, delivering, manufacturing, installing, erecting, and commissioning for the lifting and or hoisting equipment is described elsewhere.

11.1.3 ***Design, manufacture, supply and deliver of HPP conveyance components and control panels (excl. HPP)***

Design, Manufacture Supply and delivery to site of HPP conveyance components and control panels (excl. HPP)**.**	……Unit: Number (No)
HPP conveyance system described as follows [provide description of system to include particular features which must be considered in the contractors pricing]	

System to include components as follows**:**

- Piping, tubing, connection and fixtures of material specified in GIBB 006 or unless specified otherwise in GIBB 007.
- Supply Hydraulic oil for testing and commissioning
- All special tools and components for installing and commissioning.
- Radial Gate local control panels
- All electrical and instrumentation cabling required between HPPs, local panels, master control panel, and to the local RIO module.
- Local control panel (mounted at gate)
- Electrical Cabinets and appurtenances
- Supports, stands and mountings
- Cables trays
- [Specify further components where necessary]

The rate tendered shall include full compensation for the design of the complete installation including full design calculations; detail working Drawings for all items; Specifications; schematic diagrams; electrical Drawings and wiring diagrams; layout Drawings; delivery including, supply of raw materials and bought-out items; fabrication/manufacture/assembly; quality assurance and quality control; inspection and testing (including attendance on inspection/tests witnessed by the *Employer's Agent*); type and routine tests; application of finishes (paint/corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. The rates shall also include payment for supply and delivery to Site of all specified or agreed upon spare parts, including permanent packing for long-term storage.

11.1.4 Install and commission HPP conveyance components listed above

Installation / Erection, testing, Commissioning preparation of O&M manuals of HPP conveyance components as listed above	……Unit: Number (No)

The rates tendered shall include full compensation for the installation including the provision of all labour, equipment, transport, materials, lifting equipment and temporary works necessary to install the complete works; on-site quality assurance and quality control, inspection and testing (including attendance at tests witnessed by the *Employer's Agent*); the installation of all auxiliary equipment, electrical panels, cabling, pipe work, etc., to complete a workable installation; supply of all consumables (electricity, fuel, oil and lubricants etc.) necessary for the operation of the installation until taken over by the *Employer*; the putting into service of the complete installation; and any other work as specified. The rates tendered shall include for full compensation of all costs incurred in preparing and submitting to the *Employer's Agent* of the specified Operating and Maintenance Manuals and record Drawings.

11.2 Screens

*11.2.1 **Design, Manufacture, Supply and Delivery to site**:*

Design, Manufacture Supply and delivery to site of screens as follows**:** ……Unit: Number (No)

- Description/location:
- To suit Clear opening Length by Height. [Specify] m x [Specify] m
- Frame material [Specify] or as specified in GIBB 007 and min thickness [Specify] mm:
- Slat or Grid type stated
- Slat material: [Specify] or as specified in GIBB 007 and min thickness [Specify] mm
- Slat/Grid pattern [Specify] and aperture width: [Specify] mm breadth [Specify] mm
- Seal faces and guide material: [Specify]
- Integration with Lifting Equipment as specified in GIBB 008, inclusive of control panel, cabling, wiring, sleeves (where specified)
- Screen hoisting integration to sand trap control panel

The unit of measurement shall be the number of units of each size, as specified or shown on the Drawings or as designated by the Engineer.

The rate tendered shall include full compensation for the design of the complete installation including full design calculations; detail working Drawings for all items; Specifications; schematic diagrams; electrical Drawings and wiring diagrams; layout Drawings; delivery including, supply of raw materials and bought-out items; fabrication/manufacture/assembly; quality assurance and quality control; inspection and testing (including attendance on inspection/tests witnessed by the *Employer's Agent*); type and routine tests; application of finishes (paint/corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. The rates shall also include payment for supply and delivery to Site of all specified or agreed upon spare parts, including permanent packing for long-term storage.

A Separate rate for designing, supplying, delivering, manufacturing, installing, erecting, and commissioning for the lifting and or hoisting equipment is described elsewhere.

*11.2.2 **Installation / Erection and Commissioning of screens listed above**:*

Installation / Erection, testing, Commissioning preparation of O&M manuals of screens as listed above ……Unit: Number (No)

The unit of measurement shall be the number of units of each size, as specified or shown on the Drawings or as designated by the Engineer.

The rates tendered shall include full compensation for the installation including the provision of all labour, equipment, transport, materials, lifting equipment and temporary works necessary to install the complete works; on-site quality assurance and quality control, inspection and testing

(including attendance at tests witnessed by the *Employer's Agent*); the installation of all auxiliary equipment, electrical panels, cabling, pipe work, etc., to complete a workable installation; supply of all consumables (electricity, fuel, oil and lubricants etc.) necessary for the operation of the installation until taken over by the *Employer*; the putting into service of the complete installation; and any other work as specified. The rates tendered shall include for full compensation of all costs incurred in preparing and submitting to the *Employer's Agent* of the specified Operating and Maintenance Manuals and record Drawings.

A Separate rate for designing, supplying, delivering, manufacturing, installing, erecting, and commissioning for the lifting and or hoisting equipment is described elsewhere.

11.3 Sluice Gates

11.3.1 ***Design, Manufacture, Supply and Delivery to site****:*

Design, Manufacture Supply and delivery to site of Sluice gate as follows**:** ……Unit: Number (No)

- Description/ location,
- To suit clear opening Length by Height. [Specify]m x [Specify]m
- Frame and slide disc designed to suit pressure head of [Specify] m
- [Surface or Channel] mounted
- [Headstock and hand wheel or Yoke] mounted at operating level [Specify] masl
- All material as per GIBB 006
- Seals as per GIBB 006
- [Type of actuation manual/HPP/Electric]]
- All coatings as described in GIBB 007.
- [Specify further requirements where necessary]

The unit of measurement shall be the number of units of each size, as specified or shown on the Drawings or as designated by the Engineer.

The rate tendered shall include full compensation for the design of the complete installation including full design calculations; detail working Drawings for all items; Specifications; schematic diagrams; electrical Drawings and wiring diagrams; layout Drawings; delivery including, supply of raw materials and bought-out items; fabrication/manufacture/assembly; quality assurance and quality control; inspection and testing (including attendance on inspection/tests witnessed by the *Employer's Agent*); type and routine tests; application of finishes (paint/corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. The rates shall also include payment for supply and delivery to Site of all specified or agreed upon spare parts, including permanent packing for long-term storage.

A Separate rate for designing, supplying, delivering, manufacturing , installing, erecting, and commissioning for the lifting and or hoisting equipment is described elsewhere.

11.3.2 ***Installation / Erection and Commissioning of sluice gates listed above****:*

Installation / Erection, testing, Commissioning preparation of O&M manuals of sluice gate as listed above	……Unit: Number (No)

The unit of measurement shall be the number of units of each size, as specified or shown on the Drawings or as designated by the Engineer.

The rates tendered shall include full compensation for the installation including the provision of all labour, equipment, transport, materials, lifting equipment and temporary works necessary to install the complete works; on-site quality assurance and quality control, inspection and testing (including attendance at tests witnessed by the *Employer's Agent*); the installation of all auxiliary equipment, electrical panels, cabling, pipe work, etc., to complete a workable installation; supply of all consumables (electricity, fuel, oil and lubricants etc.) necessary for the operation of the installation until taken over by the *Employer*; the putting into service of the complete installation; and any other work as specified. The rates tendered shall include for full compensation of all costs incurred in preparing and submitting to the *Employer's Agent* of the specified Operating and Maintenance Manuals and record Drawings.

A Separate rate for designing, supplying, delivering, manufacturing, installing, erecting, and commissioning for the lifting and or hoisting equipment is described elsewhere.

11.3.3 ***Design, manufacture, supply and deliver HPP conveyance components and control panels (excl. HPP)***

Design, Manufacture Supply and delivery to site of HPP conveyance components and local control panels. HPP conveyance system described as follows [provide description of system to include particular features which must be considered in the contractors pricing] System to include components as follows**:** • Piping, tubing, connection and fixtures of material specified in GIBB 006 or unless specified otherwise in GIBB 007. • Supply Hydraulic oil for testing and commissioning • All special tools and components for installing and commissioning. • Sluice Gate local control panel • All electrical and instrumentation cabling required between HPPs, local panels, master control panel, and to the local RIO module. • Local control panel (mounted at gate) • Electrical Cabinets and appurtenances • Supports, stands and mountings • Cables trays • [Specify further components where necessary]	……Unit: Number (No)

The rate tendered shall include full compensation for the design of the complete installation including full design calculations; detail working Drawings for all items; Specifications; schematic diagrams; electrical Drawings and wiring diagrams; layout Drawings; delivery including, supply of raw materials and bought-out items; fabrication/manufacture/assembly; quality assurance and quality control; inspection and testing (including attendance on inspection/tests witnessed by the *Employer's Agent*); type and routine tests; application of finishes (paint/corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. The rates shall also include payment for supply and delivery to Site of all specified or agreed upon spare parts, including permanent packing for long-term storage.

11.3.4 Install and commission HPP conveyance components and control panel (excl. HPP)

Installation / Erection, testing, Commissioning preparation of O&M manuals of HPP conveyance components and control panel as listed above	……Unit: Number (No)

The rates tendered shall include full compensation for the installation including the provision of all labour, equipment, transport, materials, lifting equipment and temporary works necessary to install the complete works; on-site quality assurance and quality control, inspection and testing (including attendance at tests witnessed by the *Employer's Agent*); the installation of all auxiliary equipment, electrical panels, cabling, pipe work, etc., to complete a workable installation; supply of all consumables (electricity, fuel, oil and lubricants etc.) necessary for the operation of the installation until taken over by the *Employer*; the putting into service of the complete installation; and any other work as specified. The rates tendered shall include for full compensation of all costs incurred in preparing and submitting to the *Employer's Agent* of the specified Operating and Maintenance Manuals and record Drawings.

11.4 Stop logs

11.4.1 Design, Manufacture, Supply and Delivery to site:

Design, Manufacture Supply and delivery to site of Stop logs as follows: • Description/ location, • To suit Clear opening [Specify]m Length by [Specify] m Height: • Design pressure head: [Specify] m • Material type [Specify], and thickness [Specify] mm • Seating and sill position: [Specify] masl • Seal faces and guide material: [Specify] • Integration with Lifting Equipment as specified in GIBB 008 and GIBB 006	……Unit: Number (No)

The unit of measurement shall be the number of units of each size, as specified or shown on the Drawings or as designated by the Engineer.

The rate tendered shall include full compensation for the design of the complete installation including full design calculations; detail working Drawings for all items; Specifications; schematic diagrams; electrical Drawings and wiring diagrams; layout Drawings; delivery including, supply of raw materials and bought-out items; fabrication/manufacture/assembly; quality assurance and quality control; inspection and testing (including attendance on

inspection/tests witnessed by the *Employer's Agent*); type and routine tests; application of finishes (paint/corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. The rates shall also include payment for supply and delivery to Site of all specified or agreed upon spare parts, including permanent packing for long-term storage.

A Separate rate for designing, supplying, delivering, manufacturing , installing, erecting, and commissioning for the lifting and or hoisting equipment is described elsewhere.

11.4.2 ***Installation / Erection and Commissioning****:*

Installation / Erection, testing, Commissioning preparation of O&M manuals of stop logs as listed above	……Unit: Number (No)

The unit of measurement shall be the number of units of each size, as specified or shown on the Drawings or as designated by the Engineer.

The rates tendered shall include full compensation for the installation including the provision of all labour, equipment, transport, materials, lifting equipment and temporary works necessary to install the complete works; on-site quality assurance and quality control, inspection and testing (including attendance at tests witnessed by the *Employer's Agent*); the installation of all auxiliary equipment, electrical panels, cabling, pipe work, etc., to complete a workable installation; supply of all consumables (electricity, fuel, oil and lubricants etc.) necessary for the operation of the installation until taken over by the *Employer*; the putting into service of the complete installation; and any other work as specified. The rates tendered shall include for full compensation of all costs incurred in preparing and submitting to the *Employer's Agent* of the specified Operating and Maintenance Manuals and record Drawings.

A Separate rate for designing, supplying, delivering, manufacturing, installing, erecting, and commissioning for the lifting and or hoisting equipment is described elsewhere.

11.4.3 ***Design, Manufacture, Supply, and install/erect Stop Log Storage****:*

Design, Manufacture, Supply, and install/erect Stop Log Storage for [Specify] individual storage location (with size and number of applicable stop logs to be stored), or with size of stop logs to be stored Integration with Lifting Equipment as specified in GIBB 008	……Unit: Lump Sum (Sum)

11.5 Hydraulic Power Packs

11.5.1 ***Design, Manufacture, Supply and Delivery to site****:*

Design, Manufacture Supply and delivery to site of HPP as follows**:** • Description [provide description of HPPs to include particular features which must be considered in the contractors pricing] • List of hydraulic actuated equipment: • Pump and motor to provide sufficient pressure for hydro-mechanical equipment : List Equipment [Specify]	……Unit: Number (No)

- Reservoir, valves, control valve equipment, solenoid drives
- Control Panel complete with controller (micro-PLC) to manage HPP system components and conveyance system.
- Hydraulic oil
- Piping and tubing
    - Instrumentation for level, position, pressure, temperature
- Electrical and instrumentation wiring
- Supports, stands and mountings
- Electrical Cabinets and appurtenances (where applicable)
- Cable trays (where applicable)
- All materials and coatings described in GIBB 006 or unless specified otherwise in GIBB 007.
- [Specify further components where necessary]

The unit of measurement shall be the number of units of each size, as specified or shown on the Drawings or as designated by the Engineer.

The rate tendered shall include full compensation for the design of the complete installation including full design calculations; detail working Drawings for all items; Specifications; schematic diagrams; electrical Drawings and wiring diagrams; layout Drawings; delivery including, supply of raw materials and bought-out items; fabrication/manufacture/assembly; quality assurance and quality control; inspection and testing (including attendance on inspection/tests witnessed by the *Employer's Agent*); type and routine tests; application of finishes (paint/corrosion protection); trial erection and dismantling; preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. The rates shall also include payment for supply and delivery to Site of all specified or agreed upon spare parts, including permanent packing for long-term storage.

11.5.2 ***Installation / Erection and Commissioning of HPP as listed above****:*

Installation / Erection, testing, Commissioning preparation of O&M manuals of HPP as listed above	……Unit: Number (No)

The unit of measurement shall be the number of units of each size, as specified or shown on the Drawings or as designated by the Engineer.

The rates tendered shall include full compensation for the installation including the provision of all labour, equipment, transport, materials, lifting equipment and temporary works necessary to install the complete works; on-site quality assurance and quality control, inspection and testing (including attendance at tests witnessed by the *Employer's Agent*); the installation of all auxiliary equipment, electrical panels, cabling, pipe work, etc., to complete a workable installation; supply of all consumables (electricity, fuel, oil and lubricants etc.) necessary for the operation of the installation until taken over by the *Employer*; the putting into service of the complete installation; and any other work as specified. The rates tendered shall include for full compensation of all costs incurred in preparing and submitting to the *Employer's Agent* of the specified Operating and Maintenance Manuals and record Drawings.

11.6 Spares

11.6.1 ***Design, Manufacture, Supply, Delivery and store at/near site****:*

Design, Manufacture, Supply, Delivery and store to site spares the mentioned equipment:	……Unit: Lump Sum (Sum)

The *Contractor* shall price in his Tender Schedules the spare parts considered necessary as required in terms of the GIBB 002 - General Mechanical Specification.

The rate tendered shall provide for the manufacture, supply and delivery to Site of the spares ordered and shall include permanent packing for long-term storage. The spares shall be as listed or described in the relevant payment items

HARRY GWALA DISTRICT MUNICIPALITY

CONTRACT NO: HGDM748/HGM/2021

CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM: CIVIL, MECHANICAL & ELECTRICAL

PARTICULAR SPECIFICATION

GIBB 007 – PAINTING AND CORROSION PROTECTION

Table of Contents

Table of Revisions

Revision	Date	Change Detail	Editor
1.0	December 2020	Initial Release	M. Funnell
1.1	June 2021	Editied HDG deiscriptions	M. Holmes

1 SCOPE

This Specification covers the painting and corrosion protection of plant, equipment in pump stations and water and wastewater treatment works and above ground pipelines exposed to environments with variable corrosive tendencies.

Plant and equipment shall be manufactured and corrosion protected in accordance with the requirements specified in this Specification. No deviation from the Specification will be allowed without the written approval of the *Employer's Agent*. In the case of there being conflict between Specifications, this Specification will take preference

2 DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

In this document the word or words:

(a) **Abrasive blast cleaning:** The process of projecting a stream of abrasive particles at high velocity towards a surface for the purpose of removing contaminants from that surface and to produce a textured surface which will increase the surface area and thus increase adhesion of the coating.

(b) **"Coating"** shall refer to the application of a uniform protective layer of material in the specified manner to the outside of equipment or piping.

(c) **Coat:** A single uniform film of corrosion protection material applied to a substrate for corrosion protection purposes.

(d) **"Lining"** shall refer to the application of a uniform protective layer of material in the specified manner to the inside of equipment or piping.

(e) **Layer:** A uniform protective film of corrosion protection material applied to plant, equipment and piping in a specified manner consisting out of multiple coats.

(f) **Holiday:** A discontinuity in a coating or lining which exhibits electrical conductivity when exposed to a specific voltage.

(g) **"Dis-bonded area"** shall refer to an area of coating that initially did adhere to the steel substrate after application, but which subsequently became loose from the substrate as a result of mechanical, chemical or other action.

(h) **"Un-bonded area"** shall refer to an area of coating which at no stage adhered to the steel substrate.

(i) **"Water path"** shall refer to the distance along the surface of a material embedded in concrete but exposed to water measured from the concrete surface.

(j) **"Dry"** shall refer to atmospheric conditions only and includes periodic wetting by spray or rain.

(k) **"Wet"** shall refer to permanently or usually "submerged", "submersed" or "immersed" conditions and shall include dry but normally very humid conditions.

(l) **"Wet/dry"** shall refer to conditions that are intermittently dry and wet as defined above.

(m) **"SC"** shall refer to Section in this specification i.e. SC 7 is section 7

(n) **System:** A corrosion protection coating or lining consisting of multiple coats and/or layers, the type of coat, the number of coats and their thickness, the method of application and the requirements of the complete system.

(o) **Electrical insulation defect (EID)**: Defects in a coating or lining that impair the protective properties of the coating or lining and that are detected instrumentally by either:

a) A low-voltage, wet-sponge detector
b) A high-voltage, sparking detector
c) Operated in each case within the parameters specified

Note: EID's include such defects as steel projections from the substrate, conductive particles embedded in the coatings or linings, voids and those defects commonly known as pinholes and holidays.

(p) **Fusion bonded epoxy (FBE)**: A thermoset epoxy powder coat. (The powder is normally applied by electrostatic spray to a preheated surface. The powder normally melts, fuses and cures at a temperature of 220ºC to 250ºC.)

(q) **Inspector**: A person authorised by the Employer's Agent to act as his representative in examining the work and materials and drawing such samples and carrying out such tests as may be necessary to ensure compliance with the specification.

(r) **Lot**: A number of similar or related items submitted for inspection at one time by the Contractor and of such size that the inspector can reasonably be expected to examine adequately in not more than one working day.

(s) **Paint**: A liquid material that, when applied as a thin film to a suitably prepared surface by an appropriate method, undergoes a physical or chemical change (or both) that converts it to a solid coating or lining bonded to the surface to which it is applied.

(t) **Pinhole**: An electric insulation defect detected by the use of a wet sponge detector (see EID).

(u) **Pot life**: The period, after the contents of the packs of a two-pack paint have been mixed together, during which the paint remains suitable for use without the addition of further solvent.

(v) **Powder coat**: A material in the form of a dry, free flowing powder that, when applied to a suitably prepared steel surface by an appropriate method, can be fused by application of heat and subsequent cooling to form a continuous coating or lining that is bonded to the surface. A powder coat is classified as thermoplastic, when the applied coat may be re melted by heating, or thermoset, when it cannot be re melted by heat. Low or medium density polyethylene powder is thermoplastic whilst FBE is a thermoset material.

(w) **Significant surface**: The part of the article covered or to be covered by the coating or lining and for which the coating or lining is essential for serviceability and/or appearance.

(x) **Steel**: This term embraces carbon steels, 3CR12 and all grades of stainless steels.

(y) **Water break free**: A surface which, when wetted all over with plain potable water, maintains a continuously wet surface and the water does not break up into islands surrounded by unwetted surfaces.

(z) **Wet film thickness (WFT)**: The thickness of a coating or lining immediately after application and before any volatile matter has evaporated.

(aa) **Quality control**: The operational techniques and activities that are employed by the Contractor to sustain the required quality of a product, process or service.

(bb) **SAHDGA**: South African Hot Dip Galvanisers Association.

(cc) **Sa**: Followed by a number refers to a photographic illustration of the standard of blast cleaning required, as shown in ISO 8501-1

(dd) **St**: Followed by a number refers to a photographic illustration of the standard of mechanical cleaning required, as shown in ISO 8501 1.

(ee) **Dry film thickness (DFT**): The thickness of a coating or lining after it is hard dry.

2.2 Abbreviations

CI	:	Cast iron - grade 220
CS	:	Cast steel
DCA	:	Die Cast Aluminium
DFT	:	Dry film thickness
FBE	:	Fusion-bonded Epoxy
FBP	:	Fusion-bonded Polyester
HDG	:	Hot-dip galvanized
PVC	:	Polyvinylchloride
MIO	:	Micaceous Iron Oxide
MS	:	Mild steel – grade 300WA
SB	:	Solvent borne
SG	:	Spheroidal graphite cast iron – grade 420
304 SS	:	Stainless steel – EN Grade 1.4301
304 L SS	:	Stainless steel – EN Grade 1.4306/7
316 SS	:	Stainless steel – EN Grade 1.4401
316 L SS	:	Stainless steel – EN Grade 1.4404
UV	:	Ultra Violet
3Cr12	:	Corrosion resistant steel
µm	:	Micrometer
WB	:	Water borne
3LPE	:	Three Layer high density polyethylene
QCP	:	Quality control plan
GRP	:	Glass fibre reinforced polyester
FBPE	:	Fusion bonded polyethylene
Al	:	Aluminium
PVC	:	Polyinyl chloride

3. GENERAL REQUIREMENTS

3.1 Contractors Obligation

The requirements, material, surface preparation and corrosion protection systems prescribed in this Specification is regarded as a minimum requirement for the specific application. No deviation from this Specification shall be allowed without the written approval of the Employer's Agent.

The Contractor is responsible for the design of the corrosion protection system and shall provide the Employer's Agent with details of the material selection, surface preparation method and corrosion protection system he intends using as part of his design, including the Manufacturer's Instructions for each product and shall only proceed with the purchase of the corrosion protection materials/paints upon receipt of written approval from the Employer's Agent.

The corrosion protection material selection, surface preparation method and corrosion protection system shall be approved by the material manufacturer/supplier. The Contractor shall obtain a written assurance from the chosen material manufacturer/supplier that the proposed materials, surface preparation method and corrosion protection system comply with the specified requirements and are suitable for the intended purposes under the specified Environmental Conditions (refer to SC 3.3). The Contractor shall also obtain the Manufacturer's Instructions (refer to SC 3.2). The written assurance and Manufacturer's Instructions shall be submitted to the Employer's Agent for approval before commencement of the work.

Plant, equipment and pipes shall be manufactured and corrosion protected in accordance with the requirements specified in the Specification and Drawings. In the event that no corrosion protection is specified for any Plant, equipment or pipes within the Specifications or Drawings, this Specifications shall be used to agree the specific application.

3.2 Manufacturer Instructions

The manufacturer's instructions shall be regarded as the recommendations supplied by the manufacturer in the form of the latest edition of printed data sheets, or given in writing on the manufacturer's letterhead.

The following details shall be made available to the Employer's Agent and the applicator:

- Brand and type of corrosion protection material
- Mixing and thinning instructions
- Recommended type and quantity of solvent required for thinning during application
- Pot life of mixed product
- Minimum and maximum recommended dry film thickness per coat
- Minimum and maximum recommended dry film thickness per layer
- Recommended time intervals between coats
- Recommended minimum and maximum steel surface temperatures during application
- Time for complete drying and curing on applicable surfaces
- Substrate surface preparation requirements
- Recommended primers for substrate
- Recommended method of coating and lining application
- Repair procedures for damaged coatings and/or linings and field joints on pipelines

- Toxicity if in contact with water
- All relevant information the Supplier wishes to submit on his product

Verbal instructions by the manufacturer's representative will not be accepted unless confirmed in writing by the Contractor.

3.3 Environmental Conditions

Environmental conditions shall be classified according to SANS 1200 HC: Part 3. The corrosion protection system design and applied by the Contractor shall be suitable for the Environmental Conditions specified.

Unless otherwise specified in the Amendment of this Specification the Environmental Conditions shall be classified as follows:

Mildly-corrosive	Dry, indoor/internal, above ground and ventilated conditions, not within 5km from the coastline or polluted industrial area. Relative humidity below 70%.
Severely corrosive	Submerged, splash-zone, underground, very moist conditions, or within 5km from coastline or polluted industrial area, or in waste water works, or close to electrical power lines. Relative humidity above 85%.
Medium Corrosive	All other conditions not included in the abovementioned definitions

Notwithstanding the abovementioned information the Contractor shall satisfy himself of the environmental conditions on site and design the final corrosion protection systems accordingly.

3.4 Workmanship

A high standard of workmanship is required. Only experienced personnel shall be used to carry out corrosion protection work. All work shall be carried out under the constant supervision of a qualified supervisor.

Similarly all repair work at Site shall be done by competent personnel under the supervision of a qualified supervisor.

3.5 Compatibility of Materials

3.5.1 Design Precautions

All equipment shall be designed to suppress corrosion in an exposed environment with special reference to galvanic corrosion.

The Contractor shall ensure that metals or alloys are compatible or are adequately protected if, in the galvanic series, there is more than a 0,3 volt difference in the galvanic potential.

3.5.2 Galvanic Corrosion Prevention

The Contractor shall ensure that the following steps are taken to minimise corrosion:

a) If dissimilar metals are used: Coat all surfaces of the whole assembly including the more noble member of the galvanic series

b) If the noble member of the assembly cannot be entirely covered:
   - Keep the anode/cathode ratio as large as possible in the particular component

- Use electrical insulators between two metals. Insulation must be complete, a bolt requires a sleeve as well as washers of an insulating material

c) Joints and crevices between metals shall be sealed

d) Where fastening is unavoidable, the fasteners shall be more noble (cathodic) than the base material. Fasteners shall be coated where possible and/or adequately electrically insulated between fasteners and the base material.

3.6 Handling of Clean Items

After cleaning, surface shall not be contaminated in any way. Operators shall wear clean gloves and all surfaces shall be clean and free from oil, grease, grit, dirt and other contamination

3.7 Machined and Matching Services

Mating surfaces of joints shall be coated with primer (where specified) or first coat only. The coating or lining shall be uniform in thickness and shall not interfere with the mechanical tolerances. After assembly the outside surface of the joints shall be fully coated.

3.8 Special Areas

Areas that are inaccessible after assembly shall be prepared and fully coated with the specified system to the specified requirements before assembly. The coats shall be fully cured before assembly.

Steel edges to be welded after coating shall not be coated for a distance of 50 mm from the welding edge. The unlined strip of grit blasted surface shall be temporarily protected with a coat of (red or a different colour to the lining/coating) weldable primer between coating and/or lining application and installation.

Friction grip areas shall be left un-coated unless otherwise specified.

3.9 Supports

During coating and/or lining application, the items shall be so supported to prevent damage to the wet coatings or linings until the coatings or linings have hardened adequately. Items shall remain supported during curing, storing and handling.

3.10 Water Retention Areas

Pockets, recesses and crevices in which water and dirt may collect shall be avoided. Water retention areas shall be properly drained by holes as large as possible.

Surfaces of corrodible metals, such as the insides of tanks or hollow Specifications that cannot be protected by any method (e.g. painting or dipping), shall be avoided, or where not possible, be fully sealed against ingress of air and moisture.

3.11 Stripe Coats and Crevices

All complex surfaces including metal edges, up stands, welds, bolts and nuts shall be adequately coated to ensure complete corrosion protection. Additional stripe coats shall be applied after initial priming, if required or ordered by the Employer's Agent.

Special attention shall be given to crevices and edges to ensure complete coverage and uniform paint thickness.

3.12 Repair of Damaged Coats

Repair procedures shall be approved by the Employer's Agent and repairs will be subject to inspections as set out in SC 11.2. Where the damage is extensive the particular remedial procedures for each such instance shall be agreed with the Employer's Agent in writing.

All repairs shall comply with the requirements of the repair-product Manufacturer's Instructions. The Employer's Agent may at his discretion request that repaired areas undergo adhesion tests.

Any damage occurring during transit from the Contractor's premises to the Site shall be the responsibility of the Contractor. The Contractor shall repair any damage occurring on Site during handling, assembly, storage, transport and erection.

A repaired area shall be tested in accordance with Sub-Clauses 8.4 and 8.12 of SANS 1217 for compliance with the relevant requirements for thickness and electrical insulation defects respectively.

Any item showing electrical insulation defects exceeding an average of five per square metre (a cluster of pinholes within a radius of 25 mm being regarded as a single defective area), or flaking or other signs of loss of adhesion, shall not be repaired. The item shall be blast cleaned and re-coated in accordance with the relevant requirements of this Specification.

Paint surfaces which become streaky because paint has run, will be rejected.

Touching up of damage to the final paint coat will NOT be permitted. If final paint coat is damaged the item shall completely repainted with the finishing coat in accordance with the specifications.

3.12.1 Repair Methods for Minor Defects

The repair of areas showing electrical insulation defects or low film thickness shall, if approved by the Employer's Agent, be carried out as follows:

- Degrease in accordance with SC 9.3.3
- Thoroughly abrade the area, including an adjacent surrounding area of at least 25 mm wide, with a medium grade 220 abrasive paper
- Vacuum-clean the surface to remove dust and debris in accordance with SANS 5769 and SC 9.4.1
- Wipe the abraded paint surface with methyl ethyl ketone and allow to dry
- Apply as many coats of repair material as necessary to achieve the specified electrical insulation thickness and finish as to conform to the adjoining corrosion protection system's requirements
- Apply a final top coat over the repaired area to achieve a pleasing, uniform finish of the item

3.12.2 Repair Methods for Major Defects

The repair of areas showing damage down to the steel surface shall, if approved by the Employer's Agent, be carried out as follows:

- Degrease in accordance with SC .9.3.3
- Blast-clean area to Sa 3 (ISO 8501-1)
- Feather the surrounding paint for a distance of 25 mm beyond the damaged areas with a medium grade 220 abrasive paper

- Vacuum-clean the surface to remove dust and debris in accordance with SANS 5769 and SC 9.4.1
- Wipe only the abraded paint surface with methyl ethyl ketone and allow to dry
- Apply as many coats of repair material as necessary to conform to the specified adjoining corrosion protection system's requirements
- Apply a final top coat over the repaired area to achieve a pleasing, uniform finish of the item

4 MATERIALS

The material requirements for each corrosion protections system is specified in the relevant SC 13- SC 20 and shall be read in conjunction with this clause.

4.1 General

All materials in a corrosion protection system shall be purchased from the same manufacturer unless approved by the Employer's Agent.

Materials offered and subsequently approved shall not be changed without written approval of the Employer's Agent.

All corrosion protection materials shall be delivered in the manufacturer's original containers clearly marked with the following:

- Manufacturer's name
- Product Brand and Reference Number
- Batch Number which may incorporate the date of manufacture
- Abbreviated instructions for storage and use of material, which shall include mixing ratios of the components of multi-component materials, minimum and maximum temperature of application and the method of application
- The SANS mark where applicable

Any conflict between the manufacturer's data sheet and the specification shall be referred to the Employer's Agent for adjudication.

4.2 Toxicity of Lining Material

Materials used for the lining of equipment that will be in contact with water shall be non-toxic and shall not impart any odour, taste, or colour to the water.

4.3 Storage

All corrosion protection materials shall be kept in an approved dry and enclosed store. The temperature shall not drop below 0°C nor exceed 40°C.

Usage of materials shall be on a first in, first out basis and no materials shall be used that have exceeded the shelf life recommended by the manufacturer.

5 PLANT/ EQUIPMENT

5.1 Handling and Transportation

The plant and equipment used by the Contractor for handling of pipes, valves, pumps and other equipment, for the purpose of corrosion protection shall be such that no pipe shell, valve or pump casing or any other piece of equipment is over stressed during any operations covered by this Specification.

5.2 Surface Preparation Equipment

The Contractor shall provide all the equipment required for abrasive blast cleaning, preparation and cleaning of all surfaces to be coated.

5.3 Compressor

Compressors used for abrasive blast cleaning shall be fitted with an after cooler and oil and water traps such that the air delivered at the nozzle is completely free from oil and water. The volume displacement of the compressors shall be adequate for the number and bore of blast nozzles, the spray equipment and flame spray equipment that may be necessary to carry out the specified coating operations.

5.4 Application Equipment

The Contractor shall provide all the equipment required for airless spray painting, two component hot airless spray painting, electrostatic powder coating, fluidised bed powder coating, or any other approved method of applying the corrosion protection system in the shop or required for site application and repairs to coats. All equipment shall be thoroughly cleaned on completion of each day's work and maintained in clean working order.

5.5 Inspection of Equipment

All facilities and equipment shall be subject to inspection by the Employer's Agent or the independent inspectorate and defects in the equipment shall be rectified when so required.

The Contractor shall supply all facilities and equipment for inspecting and testing the specified preparation and corrosion protection of all items supplied under the Contract. Recent calibration certificates shall be available for all equipment requiring calibration. This equipment shall be made available to the Employer's Agent or his independent inspectorate for the purpose of testing the specified corrosion protection systems and verifying the accuracy of the test equipment.

5.6 Inspection Procedure

Corrosion damage must be exposed by manual, mechanical or abrasive blast-cleaning for inspection. The refurbishment procedures shall then be specified by the *Employer's Agent.*

5.7 Measuring Equipment

a) The *Contract*or shall have the following measuring equipment at his paint shop or site at all times:

- Ambient temperature gauge
- Blast profile gauge
- Dew point instrument
- Dry film thickness gauge
- Electric insulation defect detector
- Wet film comb

5.9 Mixer

A low speed mixer, which does not introduce air into the coating material being mixed, shall be utilised.

6 QUALITY

6.1 Quality Control

6.1.1 Quality Assurance and Procedures

a) Quality procedures as specified in GIBB 002 - General Mechanical Specification shall be adhered

b) The production and application shall be in accordance with SANS 9000, Quality System

c) The Contractor shall ensure that he is fully conversant with the requirements of this Specification and the relevant coating systems

6.1.2 Responsibility for Quality

The Contractor shall accept full responsibility for the quality of his workmanship and material used, irrespective of any quality surveillance that may be carried out by the Employer's Agent or his assistants.

The Contractor and all approved Subcontractor(s) shall:

(a) Be responsible for compliance with all the Clauses of this Specification and shall carry out all inspections and tests called for in this Specification in the presence of the Employer's Agent or his assistant. The cost of these inspections and tests shall be included in the Rates.

(b) Abide by the approved Project Quality Plan (PQP) throughout all the intended stages of testing during manufacture, cleaning, preparation and application as well as hold points for independent quality surveillance.

6.1.3 Contractor Qualification

The Contractor and Subcontractor(s) shall satisfy the Employer's Agent that they have the management, facilities and equipment, skilled staff, a quality control procedure and required test methods and standards to carry out the quality control committed to in the approved PQP during manufacture and corrosion protection application. In this regard, the Contractor and his Subcontractors shall be subject to quality audits.

6.1.4 Submission for Approval

The Contractor shall submit the following to the Employer's Agent, including data sheets where applicable, for approval:

6.1.4.1 Corrosion Protection

- A programme
- The Quality Control Plan (QCP) for corrosion protection indicating hold points
- Process Method Statement
- Blast material
- Proposed corrosion protection systems
- Proposed pickling and passivating products.

6.1.4.2 Manufacture and Corrosion Protection Programmes

The manufacture and corrosion protection programmes shall state the time and place when the following will be conducted:

- Inspection of material

- Hydrostatic testing of uncoated castings, pipes and fittings
- Manufacture of components
- Fettling or dressing
- Degreasing
- Water soluble salts test
- Blast cleaning and application of the first coat
- Application of intermediate and final coats
- The commencement of Site repairs

6.1.5 Inspection by the Employer's Agent and Notice of Inspection

Inspection of Plant shall be carried out by the Employer's Agent, his appointed representative or a nominated and Approved Inspection Authority at the manufacturer's and corrosion applicator's works.

The Employer's Agent shall be notified at least seven days in advance, or as otherwise agreed, of impending inspections or when cleaning and first coat application are to be carried out as well as for witnessing the points in terms of the agreed Quality Control Plans (QCP's).

The Employer's Agent's inspection shall in no way relieve the Contractor or his Subcontractors of any of their obligations with respect to design, manufacture and supply Plant of superior quality and workmanship in accordance with the Specification.

6.1.6 Substandard Quality Control

All material, certification and records of the Contractor will be subject to examination by the Employer's Agent. This shall include the checking and testing of the Plant. If any deviation to the approved QCP or product quality is found, additional testing and quality surveillance shall be carried out at no additional cost to the Employer.

If the additional testing confirms inaccurate quality control by the Contractor, all work on that particular Plant item shall be stopped and shall only proceed after remedial action has been implemented to the satisfaction of the Employer's Agent.

6.2. Quality Plan

A detailed quality plan shall be submitted for approval and completion by the *Employer's Agent* before manufacture/coating is initiated – refer to GIBB 002 – General Mechanical Specification. The *Employer's Agent* reserves the right to approve the specific paint used before coating is initiated.

6.3 Qualified Staff

6.3.1 Application

A high standard of workmanship is required. Only experienced personnel shall be used to carry out corrosion protection work. All work shall be carried out under the constant supervision of a qualified Employer's Agent.

6.3.2 Repair Work at Site

All repair work shall be done by competent personnel of the approved applicator under the supervision of a qualified *Employer's Agent*.

7 RECOMMENDED COATING SYSTEMS (WHERE APPLICABLE)

7.1 Proprietary Items

Components that are supplied painted or protected e.g. hoists, gearboxes, actuators etc., shall only be accepted provided that they meet the corrosion protection requirements of this Specification. If this Specification cannot be adhered to the *Contracto*r shall submit full details of the equivalent paint systems at Tender stage for approval by the *Employer's Agent*.

7.2 Gates, Screens and Built-in Parts

Selection of all corrosion protection systems shall be submitted to the *Employer's Agent* for approval before application.

The following tables are abbreviated guidelines and the systems are not listed in order of preference.

The highlighted (Orange) rows shall be the minimum material and coating used for the Works.

7.2.1 Radial Gates

ENVIRONMENT	MATERIAL	*COATING PRODUCT	NO. COATS	DFT PER COAT (µM)	TOTAL DFT (µM)
Wet Only Non Corrosive	MS	Carboline 891 Cross Linked Epoxy	3	125	400
Wet Only Moderate Corrosive	3Cr12	Two Pack Epoxy	2	200	400
Immersible Conditions Moderate Corrosive	3Cr12	Two Pack Epoxy – plus Re-coatable Polyurethane	2 1	125 40	250 40
Immersible Conditions Moderate - High Corrosion	304 SS	SigmaCover 280 Universal Primer plus	1	100	100
		Sigmacover 300 Coal Tar Epoxy	2	200	400

7.2.2 Screens

*OR SIMILAR APPROVED COATING **ENVIRONMENT**	MATERIAL	*COATING PRODUCT	NO. COATS	DFT PER COAT (µM)	TOTAL DFT (µM)
Wet Only Non corrosive	MS	Carboline 891 Cross Linked Epoxy	3	125	400
Immersible Conditions Moderate – High Corrosion	316 SS	Picked and Passivated Slats and Frames			

*Or similar approved coating

7.2.3 Stop Logs

ENVIRONMENT	MATERIAL	*COATING PRODUCT	NO. COATS	DFT PER COAT (µM)	TOTAL DFT (µM)
Wet Only Non Corrosive	MS	Hot Dipped Galvanised		100	100
Wet Only Non Corrosive	MS	Carboguard 891 Cross Linked Epoxy or Similar Approved	3	125	375
Wet Only Moderate Corrosive	3CR12	Two Pack Epoxy	2	200	400
Immersible Conditions Moderate Corrosive	3CR12	Two Pack Epoxy – Plus Re-coatable Polyurethane	2 1	125 40	250 40
Immersible Conditions Moderate - High Corrosion	304 SS	Pickled and Passivate			
Immersible Conditions High Corrosion	316 SS	Picked and Passivated			

*Or similar approved coating

7.2.4 Guides, Built-In Parts and General Built-In Steelwork

ENVIRONMENT		MATERIAL	SYSTEM	MINIMUM DFT (µM)
Water Path	>150 mm	MS 304	Un-Coated	
	<150 mm	316 SS	Pickle and Passivate	
Concrete Cover	>75 mm	MS	Un-Coated	
	<75 mm	316 SS	Pickle and Passivate	
		MS	Two Pack Epoxy	250

7.2.5 Wire Ropes

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Dry	MS	Rope Dressing - Penetrating, Water Resistant with a Non-Sticky Surface	Refer to 7.14.1
Dry/Wet	MS	HDG to ISO 1461 Plus Penetrating and Water Resistant Rope Dressing with a Non-Sticky Surface	85 Refer to 7.14.1
	SS	Pickle and Passivate	

7.2.5 Chains

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Dry/Wet	MS	HDG TO ISO 1461	85
	SS	Pickle and Passivate	

7.2.6 Lashing Strips

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Wet	304 SS	SigmaCover 280 Universal Primer Plus Sigmacover 300 Coal Tar Epoxy	100 400

7.3 Hydraulic Oil Equipment

7.3.1 Hydraulic Cylinders

ENVIRONMENT	MATERIAL	SURFACE	SYSTEM	MINIMUM DFT (µM)
Dry	MS	Coating	Two Pack Epoxy Plus Top Coat of Re-coatable Polyurethane	250 40
Wet	316 SS	Coating	Two Pack Epoxy	125

7.3.2 Pipes

ENVIRON MENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Dry/Wet	316 SS	Pickle and Passivate (avoid MS contact and contamination)	N/A

7.3.3 Fluid Reservoirs

ENVIRONMENT	MATERIAL	SURFACE	SYSTEM	MINIMUM DFT (µM)
Dry	MS	Lining	Two Pack Epoxy	200
		Coating	Two Pack Epoxy Plus Top Coat of Re-coatable Polyurethane	250 40
Immersible	304 SS	Coating	Pickle and Passivate Enamel Paint	 25-50

7.3.5 Pumps (hydraulic oil pumps only)

ENVIRONMENT	MATERIAL	SURFACE	SYSTEM	MINIMUM DFT (µM)
Wet	SG CI	Lining and Coating	Two Pack Epoxy Plus Top Coat of Pure Aliphatic Polyurethane	400 25
Dry	SG CI	Coating	Two Pack Epoxy plus Top Coat of Re-coatable Polyurethane	250 40
Wet	SG	Machined close tolerance	Long Life Molybdenum Disulphide Lubricant	10-15
Abrasive Conditions	SG CS	Lining	Abrasion Resistant Coating – To be approved by *Employer's Agent*	
Submerged	SG	Coating	Two Pack Epoxy	400

7.3.6 Motors (hydraulic oil pumps only)

ENVIRONMENT	MATERIAL	SURFACE	SYSTEM	MINIMUM DFT (µM)
Dry	MS	Lining	Two Pack Epoxy	250
		Coating	Two Pack Epoxy Plus Coat of Re-coatable Polyurethane	250 40
	SG CI	Coating	Two Pack Epoxy Plus Coat of Re-coatable Polyurethane	125 40
	DCA	Coating	Two Pack Epoxy Plus Coat of Re-coatable Polyurethane	75 40
Immersible	SG CI	Coating	Two Pack Epoxy Plus of Pure Aliphatic Polyurethane	400 25

7.4 Pipes and Specials

7.4.1 Above Ground (refer to PSL)

ENVIRONMENT	MATERIAL	SURFACE	SYSTEM	MINIMUM DFT (µM)
Above Ground (outside UV exposure – Dry/wet)	MS Pipes Larger than 150 dia	Lining	Two Pack Epoxy	400
		Coating	Multi-purpose Epoxy Plus Top Coat of Re-coatable Polyurethane	250 40
		Lining	HDG to ISO 1461	700 g/m² or 80
		Coating	HDG to ISO 1461	700 g/m² or 80
	MS Pipes Smaller than 150 dia	Lining	FBE	350
		Coating	FBE	350
		Lining	HDG to ISO 1461	700 g/m² or 80
		Coating	HDG to ISO 1461	700 g/m² or 80
Heavy Corrosive Environment	MS	Coating	Tape Wrap	
Above Ground (outside UV exposure – Dry/wet)	304 SS	Lining Coating		

7.4.2 Through Concrete Walls

ENVIRONMENT	MATERIAL	SURFACE	SYSTEM	MINIMUM DFT (µM)
In Walls (Above Ground - Dry)	MS	Lining	As per 7.4.1	
		Coating	As per 7.4.1 and Tape Wrap	Tape=1250
In Walls (Above Ground Dry-Wet Conditions)	304 SS		As per 7.4.1	
	304 SS	Lining Coating	As per 7.4.1	
In Walls (Below Ground – Dry and Wet)	MS	Lining	As per 7.4.1	
		Coating	As per 7.4.1 and Tape Wrap	Tape=1250

7.4.3 In Water

ENVIRONMENT	MATERIAL	SURFACE	SYSTEM	MINIMUM DFT (µM)
Only Wet	MS	Lining	Two Pack Epoxy	400
		Coating	Two Pack Epoxy Plus Pure Aliphatic Polyurethane	400 25
Wet and Dry (Immersible)	316 SS	Lining	Pickled and Passivate	
		Coating		

7.4.5 Internal Pipework (e.g. Pump Stations, etc)

ENVIRONMENT	MATERIAL	SURFACE	SYSTEM	MINIMUM DFT (µM)
Moderate – Mild Conditions	MS	Lining	Two Pack Epoxy	400
		Coating	Two Pack Epoxy Plus Pure Aliphatic Polyurethane	400 25
Moderate – Mild Conditions	MS Pipes Larger than 150 dia	Lining	Two Pack Epoxy	400
		Coating	Multi-purpose Epoxy Plus Top Coat of Re-coatable Polyurethane	250 40
		Lining	HDG to ISO 1461	700 g/m² or 80
		Coating	HDG to ISO 1461	700 g/m² or 80
	MS Pipes Smaller than 150 dia	Lining	FBE	350
		Coating	FBE	350
		Lining	HDG to ISO 1461	700 g/m² or 80
		Coating	HDG to ISO 1461	700 g/m² or 80
Severe Corrosion Conditions	304 SS	Lining	Pickled and Passivate	
		Coating	Pickled and Passivate and Enamel Overcoat	

7.4.6 Fuel Conveyance (Schedule 40 as per ANSI)

If applicable, refer to GIBB 018 - Fuel Management Specification

7.6 Valves

7.6.1 Valves and Flowmeters, including Handwheels

ENVIRONMENT	MATERIAL	SURFACE	SYSTEM	MINIMUM DFT (µM)

	MS SG	Lining	Two Pack Epoxy	400
	316 SS	Lining	Two Pack Epoxy	150
			Pickle and Passivate – See SC 7.14.1	
Dry	MS SG	Coating	Two Pack Epoxy plus Top Coat of Re-coatable Polyurethane	250 40
Wet	MS SG	Coating	Two Pack Epoxy plus Top Coat of Pure Aliphatic Polyurethane – where specified	400 25
	316 SS	Coating	Pickle and Passivate	
Refer to Clients spec or elsewhere				

7.6.2 Gearboxes

As per manufacturer's details and based on the corrosive environment grade.

7.6.3 Actuators

As per manufacturer's details and based on the corrosive environment grade.

7.7 Couplings, Flange Adaptors and Joints

Refer to PSL.

7.8 Ancillary

7.8.1 Nuts and Bolts

ENVIRONMENT	MATERIAL	SYSTEM	DFT
In Water (Only Wet)	316 SS		
Buried	MS	HDG TO ISO 1461 Plus Wrapped (discussed elsewhere)	75
Buried	316 SS		
Outdoors – Dry Only	MS	HDG TO ISO 1461	75
immersed	316 SS		
Internal (Dry Only)	MS	HDG TO ISO 1461	75
Internal (Wet/Dry)	316 SS	Pickled and Passivated	

7.9 Electrical Equipment

7.9.1 Electrical Panels and Enclosures

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor	3Cr12 304 SS	FBE	100
	DCA	FBE	75
	PVC	Un-coated	
	GRP	Polyester Gelcoat	250
Outdoor	3Cr12	FBE	125
Outdoor	3Cr12	Pickled and Passivate	
Outdoor	304 SS	Pickled and Passivate	

7.11.4 Industrial Switched Socket Outlets and Light Switch Housings

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor	PVC	Un-coated	
	DCA	FBE	75
Outdoor	DCA	FBP	75

7.11.5 Cable Support Systems

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Dry	MS	HDG to ISO 1461	700 g/m² or 80
	3Cr12	Pickle and Passivate	
Wet	3Cr12	FBE	100
	304 SS 316 SS	Pickle and Passivate	

7.11.6 Industrial Light Fittings

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor – Dry	MS	FBE	50
	DCA	FBE	50
Indoor – Wet	DCA	FBE	75
	GRP	Polyester Gelcoat	250
Outdoor	DCA	FBP	75
	GRP	Polyester Gelcoat	250

7.11.7 Conduit

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor - Dry	MS	HDG TO ISO 1461	65
	PVC	Un-coated	
Indoor - Wet	304 SS	Pickle and Passivate	
	PVC	Un-coated	
Outdoor (Above ground)	MS	HDG to ISO 1461	700 g/m² or 80
	304 SS	Pickle and Passivate	
Underground	HDPE PVC	Un-coated	
	304 SS	Pickle and Passivate	

7.11.8 Junction Boxes

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor	DCA	FBE	75
	PVC	Un-coated	
	GRP	Polyester Gelcoat	250
Outdoor	DCA	FBP	75

7.11.9. Light Poles and Masts

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor	GRP	Polyester Gelcoat	250
	304 SS	Pickle and Passivate	
	MS	HDG to ISO 1461	700 g/m² or 80
Outdoor	MS	HDG to ISO 1461	700 g/m² or 80
	GRP	Polyester Gelcoat	250
	3Cr12 304 SS	Pickle and Passivate	

7.11.10 Cable Mounting Straps and Clamps

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor - Dry	MS	HDG TO ISO 1461	45
	PVC	Un-coated	
	304 SS	Un-coated	
Indoor - Dry and Wet	MS	HDG to ISO 1461	700 g/m² or 80

	304 SS	Un-coated	
Outdoor	304 SS	Un-coated	

7.12. Platforms, Ladders, Handrails and Flooring

7.12.1 Platforms, Walkways, Flooring and Kick Plates

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor	3Cr12	Pickle and Passivate	
	304 SS	Pickle and Passivate	
	MS	HDG to ISO 1461	700 g/m² or 80
Outdoor	3Cr12	Pickle and Passivate	
Outdoor - Wet	304 SS	Pickle and Passivate	
Outdoor - Dry	MS	HDG to ISO 1461	700 g/m² or 80
Immersed	304 SS	Pickle and Passivate	
Immersed	316 SS	Pickle and Passivate	
Immersed	MS	HDG to ISO 1461	700 g/m² or 80

7.12.2 Ladders

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor - Wet	304 SS	Pickle and Passivate	
Indoor - Dry	MS	HDG to ISO 1461	700 g/m² or 80
Outdoor - Wet Outdoor	304 SS	Pickle and Passivate	
Outdoor - Dry	MS	HDG to ISO 1461	700 g/m² or 80
Immersed	304 SS	Pickle and Passivate	
Immersed	316 SS	Pickle and Passivate	
Immersed	MS	HDG to ISO 1461	700 g/m² or 80

7.12.3 Handrails and Balustrades

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor - Dry	MS	HDG to ISO 1461	700 g/m² or 80
Indoor - Wet	304 SS	Pickle and Passivate	
Outdoor	3Cr12	Two Pack Epoxy plus Re-coatable Polyurethane	250
Outdoor - Dry	MS	HDG to ISO 1461	700 g/m² or 80
Immersed	304 SS	Pickle and Passivate	
Immersed	316 SS	Pickle and Passivate	
immersed	MS	HDG to ISO 1461	700 g/m² or 80

7.12.4 Doors, Door Frames and Steel Covers

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor – Dry	3Cr12	Multi-purpose Epoxy	125-150
Indoor – Wet	3Cr12	Two Pack Epoxy 2 Coats	250
	304 SS	Pickle and Passivate	
Outdoor	3Cr12	Multi-Purpose Epoxy	125-150
	304 SS	Pickle and Passivate	
	MS	HDG to ISO 1461	700 g/m² or 80
Indoor and Outdoor	MS	Primer One Coat Red Oxide Zinc Chromate Multipurpose Epoxy Plus Top Coat of Polyurethane	250 40
OR			
Architectural	Alum	Prime Coat Zinc Chromate Plus Polyurethane Acrylic Enamel	500

7.12.5. Louvers

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor and Outdoor	Alum	Prime Coat Zinc Chromate Plus Polyurethane Acrylic Enamel	1500
	MS	Primer One Coat Red Oxide Zinc Chromate Multipurpose Epoxy Plus Top Coat of Polyurethane Acrylic Enamel	250 40
	DCA	FBP	75

7.13 Steel Structures

7.13.1 Portal Frames

ENVIRONMENT	MATERIAL	SYSTEM*	MINIMUM DFT (µM)
Indoor	MS	Red Oxide Zinc Chromate Primer Coat, Plus Universal Undercoat Top Coat Of Polyurethane	40 40
Outdoor	MS	**Portal Frame Beams and Connections**	
		Primer: One Coat with a Polyamide Cured Epoxy Primer (Sigmacover 280)	75
		Stripe Coat: One Coat with A High Build Micaceous Iron Oxide Pigmented Polyamide Cured Epoxy Coating (Sigmacover 435)	75

ENVIRONMENT	MATERIAL	SYSTEM*	MINIMUM DFT (µM)
		Intermediate Coat: One Coat with a High Build Micaceous Iron Oxide Pigmented Polyamide Cured Epoxy Coating (Sigmacover 435)	125
		Finish: One Coat High Solid Containing Polymeric Urethane (Sigmadur 1800)	75
		OR	
		Primer: One Coat with an Inorganic Zinc Silicate Primer	100
		Intermediate Coat: One Coat with a High Build Micaceous Iron Oxide Pigmented Polyamide Cured Epoxy Coating (Sigmacover 435)	150
		Finish: One Coat with a High Build Aliphatic Acrylic Polyurethane (Sigmadur 520 Aluminium)	75
		OR	
Indoor/outdoor - dry	MS	HDG	100

* or similar approved supplier

7.13.2. Pipe Supports and Base Plates

ENVIRONMENT	MATERIAL	SYSTEM*	MINIMUM DFT (µM)
Indoor and outdoor	MS	Primer One Coat Red Oxide Zinc Chromate Multipurpose Epoxy Plus Top Coat of Polyurethane	250 40
		OR	
Indoor and outdoor	MS	Carboline 891 cross linked epoxy x 2 coat Plus Carboline 134 polyurethane	200 40
		AND	
Indoor	MS	Multi-purpose Epoxy Plus Polyurethane Sealant	250 40
Indoor	MS	HDG To ISO 1461	700 g/m² or 80
		AND	
Outdoor - Wet	3Cr12	Multi-Purpose Epoxy plus Grout Under Base pus Polyurethane Sealant	250
Indoor and Outdoor - Dry	MS	HDG To ISO 1461	100
Outdoor	MS	HDG To ISO 1461	700 g/m² or 80
Outdoor -Severe	304		

*or similar approved supplier

7.14 Overhead Travelling Crane

In conjunction with GIBB 008 – Cranes, gantries, hoists and winches specification.

7.14.1 Crane Structures

ENVIRONMENT	MATERIAL	SYSTEM*	MINIMUM DFT (µM)
Indoor and Outdoor	MS	Primer One Coat Red Oxide Zinc Chromate Multipurpose Epoxy Plus Top Coat Of Polyurethane	250 40
		OR	
Indoor and Outdoor	MS	Carboline 891 Cross Linked Epoxy X 2 Coat Plus Carboline 134 Polyurethane	200 40
		AND	
Indoor	MS	Multi-purpose Epoxy plus Polyurethane Sealant	250
		AND	
Outdoor	3Cr12	Multi-purpose Epoxy plus Grout Under BasePlus Polyurethane Sealant	250

*or similar approved supplier

7.14.2 Crane Structures Fixed to Concrete

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Outdoor	3Cr12	Multi-Purpose Epoxy Plus Grout Under Base plus Polyurethane Sealant	250
Indoor	MS	Multi-Purpose Epoxy Plus Grout Under Base plus Polyurethane Sealant	250

7.14.3 Rails Bolted To Concrete/Steel Girders

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor – Dry	MS	Two Pack Epoxy: Sides and Bottom Rolling surface	250 60-90
Indoor – Wet	MS	Two Pack Epoxy: Sides and Bottom Rolling Surface	250 60-90
Outdoor	MS	Multi-purpose Epoxy: Sides and Bottom Rolling Surface	250 60-90

7.14.4 Steel Girders/ Steel Support Beams

ENVIRONMENT	MATERIAL	SYSTEM*	MINIMUM DFT (µM)
Indoor and Outdoor	MS	Primer One Coat Red Oxide Zinc Chromate Multipurpose Epoxy Plus Top Coat of Polyurethane	250 40
OR			
Indoor and Outdoor	MS	Carboline 891 Cross Linked Epoxy x 2 Coat Plus Carboline 134 polyurethane	200 40
AND			
Indoor	MS	Multi-purpose Epoxy Plus Polyurethane Sealant	250 40
AND			
Outdoor - Wet	3Cr12	Multi-purpose Epoxy Plus Grout Under Base Plus Polyurethane Sealant	250
Indoor and Outdoor - Dry	MS	HDG TO ISO 1461	100

*or similar approved supplier

7.15 Goliath Crane

In conjunction with GIBB 008 – Cranes, gantries, hoists and winches specification.

7.15.1 Crane Structures

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor and Outdoor	MS	Primer One Coat Red Oxide Zinc Chromate Multipurpose Epoxy Plus Top Coat of Polyurethane	250 40
OR			
Indoor	MS	Multi-Purpose Epoxy plus Polyurethane Sealant	250
OR			
Outdoor	3Cr12	Multi-Purpose Epoxy plus Grout Under Base Plus Polyurethane Sealant	250

7.15.2 Rails Bolted To Concrete

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Environment	Material	System	Minimum DFT (µM)
Indoor – Dry	MS	Two Pack Epoxy: Sides and bottom	 250

		Rolling surface	60-90
Indoor – Wet	MS	Two Pack Epoxy: Sides and Bottom Rolling Surface	 250 60-90
Outdoor	MS	Multi-purpose Epoxy: Sides and Bottom Rolling Surface	 250 60-90

7.16 Fixed Gantries and Crawl Beams for Hoists and Winches

In conjunction with GIBB 008 – Cranes, Gantries, Hoists and Winches Specification.

7.16.1 Structural Steel Girders

ENVIRONMENT	MATERIAL	SYSTEM*	MINIMUM DFT (µM)
Indoor and Outdoor	MS	Primer One Coat Red Oxide Zinc Chromate Multipurpose Epoxy Plus Top Coat of Polyurethane	250 40
		OR	
Indoor and Outdoor	MS	Carboline 891 Cross Linked Epoxy x 2 Coat Plus Carboline 134 Polyurethane	200 40
		AND	
Indoor	MS	Multi-purpose Epoxy Plus Polyurethane Sealant	250
		AND	
Outdoor - Wet	3Cr12	Multi-purpose Epoxy Plus Grout Under Base Plus Polyurethane Sealant	250
Indoor and Outdoor - Dry	MS	HDG TO ISO 1461	100

*or similar approved supplier

7.16.2 Rails Bolted to Concrete/Steel Girders

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor – Dry	MS	Two Pack Epoxy: Sides and Bottom Rolling Surface	 250 60-90
Indoor – Wet	MS	Two Pack Epoxy: Sides and Bottom Rolling Surface	 250 60-90
Outdoor	MS	Multi-purpose Epoxy: Sides and Bottom Rolling Surface	 250 60-90

7.16.3 Steel Girders/ Steel Support Beams

ENVIRONMENT	MATERIAL	SYSTEM*	MINIMUM DFT (µM)
Indoor – Dry	MS	Two Pack Epoxy	250
Indoor – Wet	MS	Two Pack Epoxy	250
Indoor/outdoor - Dry	MS	HDG TO ISO 1461	100
Outdoor	3Cr12	Multi-purpose Epoxy	250
OR			
Outdoor	MS	*Primer:* One Coat with a Polyamide Cured Epoxy Primer (Sigmacover 280)	75
		Stripe Coat: One Coat with a High Build Micaceous Iron Oxide Pigmented Polyamide Cured Epoxy Coating (Sigmacover 435)	75
		Intermediate Coat: One Coat with a High Build Micaceous Iron Oxide Pigmented Polyamide Cured Epoxy Coating (Sigmacover 435)	125
		Finish: One Coat High Solid Containing Polymeric Urethane (Sigmadur 1800)	75
Or			
Indoor	MS	Red Oxide Zinc Chromate Primer Coat, Then Universal Undercoat. Top Coat of Polyurethane	40 40
OR			
Outdoor	MS	*Primer:* One Coat with an Inorganic Zinc Silicate Primer	100
		Intermediate Coat: One Coat with a High Build Micaceous Iron Oxide Pigmented Polyamide Cured Epoxy Coating (Sigmacover 435)	150
		Finish: One Coat with a High Build Aliphatic Acrylic Polyurethane (Sigmadur 520 Aluminium)	75

*Or similar approved supplier

7.16.4 Crawl Beams

ENVIRONMENT	MATERIAL	SYSTEM	MINIMUM DFT (µM)
Indoor - Dry	3Cr12	Pickle and Passivate	
Indoor - Wet	3Cr12	Multi-purpose Epoxy	250
Outdoor	3Cr12	Multi-purpose Epoxy	250

Indoor/outdoor - dry	MS	HDG TO ISO 1461	100
Indoor – Dry/wet	MS	Two Pack Epoxy	250
Indoor and Qutdoor	MS	Primer One Coat Red Oxide Zinc Chromate Multipurpose Epoxy Plus Top Coat of Polyurethane	250 40

7.17 Notes

The following items shall be approved by the *Employer's Agent*:

Hot-Dip Galvanizing:	Only for pipes up to 150 mm diameter maximum and flow less than 2 m/s. Pipes shall not be embedded in concrete. Water analysis shall be provided. Pipes over 150 mm diameter to be coated with a duplex system.
Sealant:	Interfaces Of Different Environments Shall Be Sealed With A Polyurethane Or Polysulphide Flexible Sealant To Be Applied In Accordance With The Manufacturer's Data Sheets
Un-Coated Stainless Steel:	Only To Be Used If No Galvanic Reaction And Anaerobic Conditions Are Present.
Pickle And Passivated:	If Not In Contact With Less Noble Material. If Exposed To Anaerobic Conditions Seal-Coat All Crevices With Elastoplastic Epoxy. Shall Be Done By The Dipping Process.
Galvanic Cells	Where A Galvanic Cell Is Situated Within A Water Path <150 Mm And Concrete Cover <75 Mm, The Ms, 3cr12 Or SS Shall Be Coated.
Anaerobic Conditions	SS Grade 316l Shall Be Used Under Anaerobic And Aggressive Water Conditions.
Polyurethane For	Re-Coatable Or Pure Aliphatic Polyurethane Where Required For Colour Coding. Only UV Resistant Polyurethane Shall Be Used.
Primers	Primers Shall Only Be Used In Special Cases I.E. Over-Coating Of Galvanized Surfaces.
3cr12:	In View Of Superior Corrosion Resistance, Coated 3cr12 Material Is Preferred.
Mild Steel:	Mild Steel May Only Be Used Where The Pipe Lining Can Be Refurbished In-Situ.
Items Subjected To High Temperatures	Items To Be Manufactured Out Of Stainless Steel Or Coated With Heat Resistant Paint.
Epoxy Primer:	Epoxy Primer May Not Be Required If Appropriate Two Pack Epoxy/ Re-Coatable Or Pure Aliphatic Polyurethane Is Being Used.
Rope Dressing	Shall Be Applied Using A High Pressure Impregnation System. Minimum Pressure Of 5 MPA Shall Be Used.

8 SURFACE PREPERATION METHODS

The requirements as specified below shall be read in conjunction with the requirements of SC 9: Preparation of Surfaces to be Coated. Each preparation method specified below shall also conform to the relevant requirements of SC 9 and its sub-clauses. Where in in conflict with SC 9 and its sub-clauses the requirements hereunder shall take precedence.

Unless otherwise specified in the Amendments of this Specifications and subject to the approval of the Employer's Agent, the surfaces of all items to be coated and/or lined shall be prepared in accordance with one or more of the following Methods.

8.1 Method 1: Mild Steel

Components manufactured from mild steel shall be degreased and blast clean before the corrosion protection system is applied. Oil and grease contamination, when present, shall be removed to a water break free surface by degreasing (Refer to SC 9.3.3) before blast cleaning (refer to SC 9.3.4 - 9.3.5).

Steel items less than 2 mm thick may distort when blast cleaned. Sheet steel items less than 2 mm in thickness shall be degreased, acid pickled and phosphated with an approved proprietary 7 or 9 stage process to produce a fine grain zinc phosphate surface complying with SANS 10064 Table 2 Lightweight or by a proprietary process approved by the Employer's Agent for the standard of cleaning specified.

All surfaces of steel 2 mm or more in thickness shall be abrasive blast cleaned in accordance with SANS 10064 Section 4.3 and cleaned to achieve the requirements given in Table 4.1 for the standard of abrasive blast cleaning specified.

8.2 Method 2: Cast Iron and Cast Alloys

Cast iron shall be abrasive blast cleaned until all sand particles, residual burnt-on sand and casting skin have been completely removed. Cast iron surfaces shall be abrasive blast cleaned in accordance with SANS 10064 Section 4.3 to achieve the requirements given in SC 9.4.1 for the standard of abrasive blast cleaning specified.

Blowholes and omegas in cast surfaces shall be opened up where necessary and filled with a two component solvent free epoxy filler. When the filler has set hard, the surface shall be abraded to be flush with the surrounding metal.

8.3 Method 3: Stainless and Corrosion-Resistant Steel

Components manufactured from stainless or corrosion-resistant steel shall be supplied in the fully passivated condition. Sheared edges, welds or surfaces subjected to any form of heat treatment or contamination with iron or mild steel, shall be pickled and passivated in terms of SC 9.5.

Surfaces shall thereafter be thoroughly degreased in terms of SC 9.3.3, then rinsed with potable water to obtain a water-break-free surface.

When it is required to paint stainless steel exceeding 2 mm thickness, the surface shall be blast cleaned in accordance with the parameters given in SC 9.4.1, using non-metallic abrasives such as iron slag, copper slag or platinum slag. The use of steel shot, steel grit or cast-iron grit is strictly prohibited. Any contamination with iron or mild steel is prohibited.

Where blasting is impractical, the surface shall be cleaned with detergent solution and roughened manually by the use of non-metallic abrasive pads, followed by washing with clean potable water to a water-break-free surface. If a water-break-free surface is not obtained, detergent cleaning shall be repeated until the surface is water-break-free. Allow the surface to dry before coating.

8.4 Method 4: Aluminium

Generally, aluminium surfaces will be anodized or powder coated and will require no further treatment. Where painting is required, the aluminium surface shall be thoroughly degreased

then rinsed with clean potable water. If the surface is not water break free, repeat the degreasing process until a water-break-free surface is obtained. Allow to dry completely, then apply a thin coat (8 to 13 micrometres dry film thickness) of wash primer which complies with SABS 723, mixed and applied in accordance with the manufacturer's instructions. Note that the “wash primer” is an adhesion promoter and does not replace the primer specified in the paint system.

8.5 Method 5: Hot-Dip Galvanized Surfaces

Hot-dip galvanized surfaces shall be thoroughly degreased by scrubbing with water rinsable solvent degreaser, followed by thorough washing with clean, potable water. If the water breaks up into islands of non wetted surface, the degreasing shall be repeated until a water break free surface is obtained. Small areas may be abraded with a non metallic abrasive paper prior to painting. Large surfaces may be sweep blast cleaned, using ultra fine abrasive (particle size 0,2 to 0,8 mm) and a nozzle pressure not exceeding 300 kPa. A uniform matt surface shall be obtained. Loss of zinc thickness shall not exceed 10 µm. Cracking and flaking of the galvanized layer is indicative of excessive blast cleaning by using too coarse abrasive or too high blast pressure. Such surfaces will be rejected. The article shall then be stripped and re-galvanized.

8.6 Method 6: Painted Surfaces

8.6.1 Primer Only

Where the surface has been contaminated it shall be washed and dried to remove dust and deposits before overcoating.

The succeeding coats shall be compatible with the primer. Where the type of primer is unknown, a test patch shall be applied. There shall be no loss of adhesion or other defects of the primer or between primer and undercoat. If defects or adhesion loss occur, the primer shall be completely removed, feather blasted and replaced by a primer which is compatible with the specified system.

8.6.2 Recoatable Materials

Surfaces painted with recoatable paints shall be abraded with abrasive paper grade 220 to a uniform matt finish, washed and dried to remove dust and deposits before overcoating.

8.6.3 Fully Cured Non-Recoatable Materials

Surfaces painted with fully cured non-recoatable paints that have exceeded their overcoating time shall be thoroughly abraded with abrasive paper grade 220 to a uniform matt finish, washed and dried before overcoating. The edges of any damage shall be smoothly feathered into the sound paint. Repairs to damaged areas shall extend 25 mm beyond the damage.

8.6.4 Two Component Paints within the Overcoating Time

Surfaces painted with two component paints where the paint is still within the overcoating time specified by the manufacturer shall be recoated without special surface preparation. Where the surface has become contaminated, it shall be cleaned.

8.7. Method 7: Plastic Surfaces such as PVC and GRP

Where the surface has been contaminated it shall be washed and dried to remove dust and deposits before overcoating.

8.8. Method 8: Concrete and Plaster Surfaces

Concrete and plaster surfaces to be painted shall be clean, dry and free from laitance, dust or similar friable surface layers and from mould oil or similar contaminants that will interfere with the adhesion of the coating or lining.

Mould oil shall be removed by the use of a water-based detergent followed by high pressure water washing. When all contaminants have been removed, the surface shall be allowed to dry either to a damp condition or to a completely dry condition, depending on the coating or lining to be applied.

For immersion or other heavy duty applications, laitance shall be totally removed by water blast cleaning, with abrasive injection, or by mechanical scabbling of the surface, or by acid pickling, followed by very thorough washing with potable water.

Off shutter concrete usually shows surface blowholes or omegas. Omegas shall be drilled or chipped open to the full hole diameter. Blowholes and opened omegas shall be filled with a suitable filler such as acrylic or solvent-free epoxy. The use of gypsum or cellulose-based fillers is not permitted for underwater or humid conditions. Shutter kicks and similar projections shall be removed by grinding to a smooth surface.

For coatings or linings of low water permeability, such as solvent-borne epoxies, vinyls and chlorinated rubber, the moisture content of the concrete or plaster shall be not more than an indicated 5% when tested with an approved electrical conductivity meter, designed for use on concrete or plaster (such as the Delmhorst meter). The pins of the meter shall penetrate the concrete or plaster to a depth of not less than 5 mm.

The first coat of the coating or lining system may require thinning with the manufacturer's recommended solvent to assist in penetration of the substrate.

9 SURFACE PREPERATION OF STEEL

9.1 Standards

Reference is made to the latest issues of the following Standards:

SANS 1344	Medium duty solvent detergent
SANS10064	The preparation of surfaces for coating
ISO8501-1	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of un-coated steel substrates and of steel substrates after overall removal of previous coatings
ISO8504-2	Preparation of steel substrates before application of paints and related products – Surface preparation methods – Part 2: Abrasive blast cleaning
SANS 5770	Cleanliness of blast-cleaned steel surfaces for painting (freedom of soluble salts)
SANS 5772	Profile of blast-cleaned steel surfaces for painting (profile gauge)

SANS 5769	Cleanliness of blast-cleaned steel surfaces for painting (freedom from dust and debris)
ISO11125	Preparation of steel substrates before application of paints – Metallic blast-cleaning abrasives
ISO11127	Preparation of steel substrates before application of paints – Non-metallic blast–cleaning abrasives

9.2. Responsibility

9.2.1 Surface Preparation

a) The Subcontractor carrying out the corrosion protection shall be responsible for preparation of all surfaces to be coated.

b) On completion of the *Contract*, all plant, equipment, temporary structures and materials shall be removed from the site.

9.2.2 Personnel

a) The Subcontractor carrying out the surface preparation shall have competent personnel with the necessary technical knowledge of the processes involved.

b) All work shall be carried out under the supervision of an experienced *Employer's Agent*.

9.2.3 Equipment

a) Plant and equipment shall, to achieve the specified surface preparation, comply with the following:

i) Equipment and air supply free of oil and moisture

ii) Compressors shall have a capacity and pressure output to achieve the required nozzle pressures

iii) Worn nozzles shall be replaced

b) If the correct surface preparation is not achieved due to inadequate plant and equipment, the *Employer's Agent* may order the *Contract*or to obtain such plant and equipment as may be necessary to achieve the specified results.

c) All plant, equipment and temporary structures shall at all times be maintained in good and safe working order.

9.2.4 Working Conditions

a) Surface preparation shall not take place when conditions are likely to affect the corrosion protection processes adversely.

b) The Subcontractor shall provide screens, covers, trestles or any other equipment necessary to avoid contamination of surfaces and to minimise time delays caused by inclement weather.

9.2.5 Health and Safety

The *Contract*or's shall at all times enforce health and safety measures necessary to comply with the Occupational Health and Safety Act No. 85 of 1993 and the manufacturer's requirements.

9.3 Procedure and Preparation of Items

Prior to the application of any coat, each item shall comply with the following:

- Weld splatter shall have been removed by chipping or grinding to a smooth surface flush with the surrounding steel.
- Weld seams shall have a smooth contour, free from sharp edges, protrusions and undercuts.
- Sharp edges and protrusions shall have been removed by grinding to a smooth radius. The radius shall be a minimum of 3 mm for steel of thickness 6 mm or greater, or a minimum of 50% of the steel thickness for steel of thickness less than 6 mm.
- Laminations, scabs or occluded scale shall be ground out. If such grinding penetrates deeper than 3.5% of the metal thickness, the area shall be repaired by welding or the metal shall be rejected at the discretion of the Employer's Agent.
- Articles for hot-dip galvanizing shall not have any overlapping joints. Closed sections shall be suitably vented.

9.3.1 Approval of Works and Programme

The *Contract*or programme, plant and equipment and works shall be approved by the *Employer's Agent* prior to commencement of surface preparation.

9.3.2 Initial Inspection

Before accepting items from the Fabricator, the corrosion protection Subcontractor shall check the initial condition of the surface for:

- Visible surface defects
- Corrosion or contamination
- Any required metal dressing
- Elimination of burrs and radiusing of edges
- Removing of weld spatter and weld imperfections such as blowholes
- Suitable lifting lugs

9.3.3 Degreasing

(a) All surfaces to be coated shall be tested for oil and grease contamination by the water break free test.

(b) In the event that degreasing is required, items shall be degreased by the use of a water based solvent degreaser such as that complying with SANS 1344 or, for use in enclosed systems, with SANS 1365.

(c) Oil and grease contamination shall be removed by:

- Steam-cleaning
- An emulsifiable or aqueous detergent applied in accordance with SANS 1344
- An alkaline cleaning solution

(d) Allow to react, and then rinse off with clean, potable water to remove all residues prior to surface preparation, all in accordance with Clauses 3.3 and 3.4 of SANS 10064.

(e) Items shall be thoroughly washed with clean potable water to remove all residues. The items shall then be allowed to dry.

(f) The surfaces shall be tested after degreasing and show no oil, grease and chemical contamination after degreasing.

(g) Care shall be taken to avoid entrapment of cleaning agents in recesses or other retention areas.

9.3.4 Blast Cleaning (Rough-Blast)

Blast-cleaning shall be done in accordance with the code of practice SANS 10064 to achieve a cleanliness of Sa 2. (ISO 8501-1). Any abrasive used for blast cleaning shall composed of clean, non-recycled, sound hard particles free from foreign substances such as dirt, oil, grease, toxic substances, organic matter, water soluble salts and foreign metals.

The surface of the items to be coated or lined shall be blast cleaned by centrifugal or air blast cleaning methods, then vacuum cleaned or blown off to achieve the following requirements:

1. The surface condition shall be in accordance with Swedish Standard SIS 05 5900 (or ISO 8501-1) as stipulated in Clause 4.2 and specified in the Amendments and Additions of the Specification, when tested in accordance with SANS Method 767.or SANS Method 772.
2. Any laminations revealed by blast cleaning shall be ground out and re-blast cleaned to meet the above requirements. If grinding penetrates the steel to a depth greater than 3.5% of the nominal wall thickness, the item will be rejected.
3. The time interval between abrasive blast cleaning and paint application shall not exceed those given in SC 12.

The following applies to **Rough Blasting** requirements.

a) All rust, mill scale, old coating or marking paint shall be removed by rough-blasting.

b) Laminations, scabs and occluded scale which becomes visible after cleaning shall be ground out and the area re-cleaned.

c) The *Employer's Agent* shall be advised when blast-cleaning of the appropriate section will be completed so that an inspection can be carried out to determine if repairs are required.

d) The surfaces to be coated shall be tested for water soluble salts after blast-cleaning. The maximum level of salts allowable on the surfaces shall not exceed the values given in SC 9.4.2.

e) Should these values be exceeded, the surfaces shall be cleaned by:

- A liquid soluble salt remover approved by the *Employer's Agent* or
- Washing with a high pressure jet of clean potable water or
- Water injected blast-cleaning or
- Flash blast-cleaning until the soluble salts are within the specified limits.

g) Should immediate lining/coating not be possible, or should any atmospheric oxidisation take place between the completion of blast cleaning and commencement of lining/coating, such oxidisation shall be removed by flash blasting to restore the specified surface finish.

9.3.5. Final-Blast

(a) Final Blast

- Humidity and Temperature:

  All blast-cleaned surfaces shall be coated within:

  - Six (6) hours when humidity is below 50% or

- Four (4) hours when humidity is below 70% or
- Two (2) hours when humidity is between 70% and 85%.

Over 85% Coating not permitted- reblast and coat when rel. humidity below 85%

Final-blasting shall not be carried out if the steel temperature is less than 3°C above dew point.

- Blasting-Material:

  Final blast-cleaning shall be carried out using clean, uncontaminated blast-medium in accordance with SC 9.4.2.

- Cleanliness:

  All surfaces for “wet/submerged conditions” and for “dry conditions” shall be blast-cleaned to Sa 3 and Sa 2½ respectively.

- Profile:

  The required surface profile specified in SC 9.4.1 shall be achieved by final-blasting in accordance with SANS 10064 and ISO 8504-2.

- Residual Dust and Debris:

  Prior to coating, dust and debris shall be removed by vacuum-cleaning in accordance with SANS 5769. Dust and debris may only be removed by blowing with clean uncontaminated compressed air, with prior approval of the *Employer’s Agent*.

- Contamination:

  After final blasting uncoated steel shall not be touched with bare hands. All applicators shall wear white gloves and shoe covers where applicable.

(b) Flash- Blast

Flash blast-cleaning shall be carried out to reinstate the surfaces specified in SC 9.4.1, in accordance with SC 9.3.5(c).

(c) Sweep-Blasting

Sweep blast-cleaning is used to create a fine, even profile on soft materials and to remove portions of a coating.

The parameters for sweep blast-cleaning are as follows:

Table 9-1: Parameters for sweep blast-cleaning

Equipment and air supply	Free of oil and moisture
Nozzle pressure	Not greater than 300 kPa
Nozzle angle to the surface being cleaned	30 to 60°
Sweeping distance	450 to 600 mm
Abrasive – ultra fine non-metallic grit	Minimum 0.2 mm – maximum 0.8 mm
Grit	Only new grit shall be used

9.3.6 Mechanical Surface Preparation

Cleaning by hand or by means of power tools (e.g. wire brushing) shall be carried out in accordance with the methods described in SANS 10064 to the standards specified in the Amendments of this Specifications and as shown in SIS 055900 and SC 9.2.

9.4 Surface Preparation Requirements

9.4.1 Surface Conditions

Before surface preparation all items to receive a coating or lining shall be in rust condition A to C of Swedish Standard SIS 05 5900. Items in rust condition D will be rejected.

Prepared surfaces shall conform to Table 9.2 below. If only surface cleanliness to ISO 8501-1 is specified in the Specifications then the corresponding values of Table 9.2 for degreasing, surface profile and soluble salts shall apply.

Table 9-2: Surface Conditions

PROPERTY **Cleanliness to ISO 8501-1 (min)** **(SIS 055900)**	**FOR DRY CONDITIONS** **Sa 2½**	**FOR WET/SUBMERGED CONDITIONS** **Sa 3**	**TAPE WRAPPING** **Sa 2**
Residual Dust and Debris (SANS 5769)	0.5%	0.3%	0.5%
Oil, Grease and Perspiration	Nil	Nil	Nil
Surface Profile (min) Coats up to 200 µm (max)	30 µm 50 µm	30 µm 50 µm	- -
Surface Profile (min) Coats up to 300 µm (max)	50 µm 80 µm	50 µm 80 µm	- -
Surface Profile (min) Coats up to 500 µm (max)	60 µm 100 µm	60 µm 100 µm	- -
Water soluble Salts: Maximum at any point. Average of any 250 cm.	500 mg/m^2 100 mg/m^2	100 mg/m^2 100 mg/m^2	500 mg/m^2 100 mg/m^2

Note: The maximum surface profile shall be less than ⅓ of the coat thickness.

Unless otherwise specified in the Amendments to this Specifications the surface condition shall conform to the following requirements:

- Sa 3 for the environmental condition classified as severely corrosive,
- Sa 2 for Tape Wrapping, and
- For all other environmental conditions, the surface condition shall be Sa 2½.

9.4.2 Abrasive Material

a) Material:

The blast-cleaning abrasive shall be composed of clean, non-recycled, sound hard particles free from foreign substances such as dirt, oil, grease, toxic substances, organic matter, water-soluble salts and foreign metals.

b) Certification:

The abrasive material supplier shall certify that all products supplied conform to all the requirements specified.

c) Shape and Size:

The individual abrasive particles shall be angular in shape and within the following sizes:

- Non-metallic material - 0.2 to 0.8 mm or 0.4 to 1.4 mm
- Metallic material - 0.3 to 0.9 mm

d) Hardness:

The minimum hardness of abrasive material shall be as follows:

- For non-metallic material - 6 on the Moh's scale
- For metallic material - 390 HV

e) Ph:

The pH of the prepared slurry mixture shall not be below 6.2.

f) Water Soluble Salts:

The conductivity of slurry shall be less than 25 mS/m in accordance with ISO 11127.

g) Moisture Content:

The moisture content for abrasive material shall not exceed 0.2%.

h) Re-cycling:

Re-cycled blasting-material shall only be used if:

(i) Blasting-materials were only used on degreased surfaces;

(ii) Dust and debris is removed from the blasting-material; and

(iii) Particles are kept angular and within specified sizes.

9.4.3 Air Supply

a) The air pressure at the nozzle shall be a minimum of 600 to 700 kPa.

b) Air supply equipment shall be fitted with efficient oil and water traps to avoid contamination of the surface.

9.5 Pickling And Passivation

Where specified the following areas shall be pickled and passivated:

- All un-coated areas
- Ground and sheared edges
- Heat affected zones caused by welding or cutting.

Where possible, pickling and passivation shall be done by the dipping process.

Proprietary pickling and passivation chemicals (as supplied by approved suppliers) shall only be used in accordance with the manufacturer's recommendations. Pickling formulations made up of 15 to 20% nitric acid (HNO3) and 1 to 2% hydrofluoric acid (HF) by volume with potable

water are considered suitable. Care shall be taken not to exceed the maximum contact time recommended.

After pickling and passivation, surfaces shall be very thoroughly washed with clean potable water to remove all traces of acid. Repeat the process, if necessary to remove all discolouration. Surfaces shall be allowed to dry, then polished where necessary, using polishing compounds recommended by the stainless steel manufacturer.

10 SURFACE PREPERATION OF OTHER MATERIALS

10.1 Corrosion Resistant and Stainless Steel

Components fabricated from stainless steel shall not be contaminated with iron or mild steel.

10.1.1 Un-Coated Surfaces

a) Stainless steel surfaces shall not be contaminated with carbon steel, scratched or stressed.

b) The following areas shall be pickled ad passivated:

- All un-coated areas
- Ground and sheared edges
- Heat affected zones caused by welding or cutting.

c) It is recommended that, if possible, pickling and passivation be done by the dipping process.

d) Proprietary pickling and passivation chemicals (as supplied by approved suppliers) shall only be used in accordance with the manufacturer's recommendations. Care shall be taken not to exceed the maximum contact time recommended.

e) After pickling and passivation, surfaces shall be very thoroughly washed with clean potable water to remove all traces of acid. Surfaces shall be allowed to dry, then polished where necessary, using polishing compounds recommended by the stainless steel manufacturer.

10.1.2 Surfaces to be Coated

a) Degreasing:

Surfaces shall be degreased in accordance with SC 9.3.3

b) Profile:

- Corrosion resistant steel surfaces shall be blast-cleaned with stainless steel grit or non-metallic abrasive to create a profile in accordance with the table in SC 9.4.1. The use of steel shot and steel or cast iron grit is strictly prohibited.
- Where blasting is impractical, the surface shall be roughened manually with abrasive paper grade 220, disc grinders or flapper wheel abrasive pads. In all instances, clean, uncontaminated equipment must be used.
- Surface profile shall be in the range of 30 to 50 µm.

c) Dust and debris shall be removed by vacuum-cleaning SC 9.3.4.

10.2 Synthetic Materials to be Coated

10.2.1 Degreasing

Surfaces shall be degreased in accordance with SC 9.3.3

10.2.2 Profile

Abrade the surface with abrasive paper grade 220 to achieve a uniform matt finish.

10.2.3. Dust and Debris

Dust and debris shall be removed by vacuum-cleaning.

10.3 Coated Surfaces

10.3.1 Primed Surfaces to be Over-coated

a) Degreasing:

Surfaces shall be degreased in accordance with SC 9.3.3

b) Profile:

- Primers to be over coated outside the over-coating period shall be abraded with abrasive paper grade 220 to a uniform matt finish.
- All un-coated areas and all areas with micro rust shall be re-blasted to the original surface finish as specified.

c) Dust and Debris:

Dust and debris shall be removed by vacuum-cleaning.

10.3.2 Coated Surfaces to be Repaired

Spot repairs shall be carried out in accordance with the Specification or as specified by the *Employer's Agent*. Repairs shall overlap the undamaged area by a minimum of 25 mm. Repairs shall be built up to the original undamaged coating thickness.

a) Preparation of Bare Areas:

Bare areas shall be prepared by spot-blasting to Sa 3 in accordance with SC9.1. If spot-blasting is not possible, clean with abrasive paper grade 220 to a bright metal surface.

b) Soluble Salts:

The surfaces shall be tested for water soluble salts in accordance with SC 11.2.

10.3.3 Feathering of Coated Surfaces

The surrounding paint, which must be intact, shall be feathered for a minimum distance of 25 mm beyond the damaged areas.

a) Dust and Debris:

Dust and debris shall be removed by vacuum-cleaning as per SANS 5769.

10.3.4 Coated Surfaces to be Over Coated

a) Degreasing:

Surfaces shall be cleared of all contamination and degreased in accordance with SC 9.3.3.

b) Profile:

Coated surfaces to be over-coated outside the over-coating period shall be abraded with abrasive paper grade 220 to a uniform matt finish.

c) Dust and Debris:

Dust and debris shall be removed by vacuum-cleaning as per SANS 5769.

d) Solvent-wiping:

- The surfaces to be coated shall be wiped with the solvent specified by the coating manufacturer and approved by the *Employer's Agent*.
- Further coats shall then be applied as specified in the Specification.

11 COMPLIANCE WITH REQUIREMENTS

Tests, instruments, methods and criteria shall be as specified below or in the Specification.

11.1 Test Methods

11.1.1 Free of Oil and Grease

11.1.1.1 Wetting with Water

All surfaces cleaned of oil and grease shall be tested using the "water-break-free" method. The surface shall be wetted with water and the entire surface shall be covered by an unbroken film.

11.1.1.2 Solvent-wiping

Where water soluble lubricants may be present the surface shall be further tested by wiping with a clean cotton wool swab soaked in solvent. No stain shall be evident on the swab after solvent-wiping.

11.1.2 Water Soluble Salt Contaminants

Substrate surfaces shall be tested for the presence of water soluble salt contaminants in accordance with SANS 5770 or by means of the Weber Reilly Test.

11.1.3 Standard of Mechanical Surface Preparation

Mechanical surface preparation shall be visually compared to the standard shown in ISO 8501-1.

11.1.4 Blast Profile

The blast profile of the substrate surfaces shall be determined in accordance with SANS 5772.

11.1.5 Residual Dust and Debris

Substrate surfaces shall be tested for the presence of residual dust and debris in accordance with SANS 5769.

11.1.6. Blasting Material

All blasting-materials shall be approved by the Employer's Agent.

11.1.6.1 Metallic Abrasive

Abrasive shall be tested in accordance with ISO 11125 for particle size, hardness, density, foreign matter and moisture.

11.1.6.2 Non-Metallic Abrasive

Abrasive shall be tested in accordance with ISO 11127 for particle size, hardness, density, moisture and water soluble contaminants.

11.1.7. Protection of Works during Painting Operations

The Contractor shall protect all parts of the structure against disfigurement by spatters, splashes and smirches of paint or of paint materials. The Contractor shall be responsible for any damage, paint or dirt caused by his operations to vehicles, persons or property, including plants and animals, and he will be required to provide protective measures at his expense to prevent such damage.

Any paint stains which may result in any unsightly appearance shall be removed or obliterated by the Contractor at his expense.

If passing traffic creates so much dust that it will harm or spoil the appearance of painted surfaces, the Contractor shall, at his expense, sprinkle the adjacent roads and shoulders with water for a sufficient distance, in order to keep dust away from freshly painted surfaces. The Contractor shall also furnish and post "DRIVE SLOWLY" signs at his own expense and take other necessary precautions to prevent dust and dirt from adhering to freshly painted surfaces.

11.2 Testing

Tests, instruments, methods and criteria shall be as specified below or in the Amendments of this Specification.

The requirements of SC 6 shall apply.

11.2.1 Visual Inspection

All surfaces shall be inspected visually and shall be free from tears, runs, sags, wrinkles, blisters, change in colour or gloss, orange peel, dirt, visible pinholes, dust or fluff occlusions or any other visible defects.

11.2.2 Holiday Inspection

100% of all coated surfaces shall be tested and there shall be no electrical insulation defects on any area inspected.

For films exceeding 500 µm thickness, a high voltage, electrical insulation defects detector shall be used in accordance with SABS 1217.

Except on system containing conductive pigment (Zn, Al), low-voltage wet sponge electrical insulation defects inspection shall be carried out in accordance with SANS 1217 for coatings and linings of thickness not exceeding 500 µm.

For sytems exceeding 500 µm thickness, the high voltage, sparking electrical insulation defects detector shall be used in accordance with SANS 1217.

During the inspection procedure the Contractor shall ensure that sufficient moisture is present at all times on the surfaces to be tested.

11.2.3 Dry Film Thickness

The dry film thickness (DFT) shall also conform to the requirements of SC 12.9:

(a) Measurements shall be taken in accordance with ISO 2808.

(b) 100% of all system thicknesses measured shall comply with the minimum requirements of this Specification.

(c) Film thickness in excess of the prescribed maxima shall not necessarily constitute reason for rejection if the system is demonstrated to be sound in all respects.

(d) The method used to measure film thickness, and the significance of the readings for each particular project, shall be agreed upon by all parties prior to commencement of the work.

11.2.4 Degree of Cure of Fusion-Bonded Materials

The degree of cure of corrosion protection material shall be assessed by solvent wiping in accordance with the method given in SABS 1217 (methyl ethyl ketone resistance test)

11.2.5 Free of Oil and Grease

11.2.5.1 Wetting with Water

All surfaces cleaned of oil and grease shall be tested using the “water-break-free” method. The surface shall be wetted with water and the entire surface shall be covered by an unbroken film.

11.2.5.2 Solvent-Wiping

Where water soluble lubricants may be present the surface shall be further tested by wiping with a clean cotton wool swab soaked in solvent. No stain shall be evident on the swab after solvent-wiping.

11.2.6 Water Soluble Salt Contaminants

Substrate surfaces shall be tested for the presence of water soluble salt contaminants in accordance with SABS Method 770 or by means of the Weber Reilly Test.

11.2.7 Standard of Mechanical Surface Preparation

Mechanical surface preparation shall be visually compared to the standard shown in

SABS ISO 8501-1.

11.2.8 Blast Profile

The blast profile of the substrate surfaces shall be determined in accordance with SABS

Method 772.

11.2.9 Residual Dust and Debris

Substrate surfaces shall be tested for the presence of residual dust and debris in accordance with SABS Method 769.

11.2.10 Blasting Material

All blasting-materials shall be approved by the Employer’s Agent.

11.2.10.1 Metallic Abrasive

Abrasive shall be tested in accordance with ISO 11125 for particle size, hardness, density, foreign matter and moisture.

11.2.10.2 Non-Metallic Abrasive

Abrasive shall be tested in accordance with ISO 11127 for particle size, hardness, density, moisture and water soluble contaminants.

11.3 PIPE AND SPECIALS SPECIFIC TESTING

11.3.1 Dry Film Thickness (DFT)

Measurements shall be taken in accordance with ISO 2808.

100% of all system thicknesses measured shall comply with the minimum requirements of this Specification.

In the case of coats applied after the erection of steel work on Site, the frequency at which measurements of the DFT are taken shall be at the discretion of the Employer's Agent, and may be dictated by accessibility.

DFT in excess of the prescribed maxima shall not necessarily constitute reason for rejection if the paint film is demonstrated to be sound in all respects.

DFT shall be tested within 7 days of application.

The method used to measure DFT, and the significance of the readings for each particular item, shall be agreed upon by all parties prior to commencement of the coating work.

11.3.1.1 Automated Shop Applied Lining and Coating

The film thickness on the first pipe of a production run and thereafter on at least one pipe selected at random from every day's production, but not less than one pipe out of every ten pipes, shall be measured non-destructively by an approved eddy current instrument. At least four readings at equally spaced intervals around the circumference, approximately 300 mm from each end of the pipe, shall be taken. The first reading shall be over the weld bead. When practicable an additional four readings at equally spaced intervals around the circumference in the centre of the pipe shall be taken. The thickness shall not be less than the minimum specified over 100% of the area including weld beads. The Employer's Agent may at his discretion supplement the above test by checking wet film thickness on any or all pipes during application of the coats.

11.3.1.2 Hand and In-situ Applied Lining and Coating

All the hand applied lining and coating thicknesses shall be tested by means of an approved eddy current or magnetic instrument. At least four readings shall be taken at equally spaced intervals around the pipe circumference at any test point. The first reading shall be over the weld bead. The thickness shall not be less than the minimum specified over 100% of the area including weld beads.

12 APPLICATION OF CORROSION PROTECTION SYSTEM

All coatings and/or linings, irrespective of the surface preparation method or corrosion protection system used, shall be applied in accordance with the relevant following requirements.

12.1 Conditions during Application

If in the opinion of the Employer's Agent adverse weather conditions are such as to interfere with the successful application of an efficient corrosion protective system, he shall order a stoppage of work. The Contractor will be deemed to have accepted this risk and made provision for it in his rates.

12.1.1 Dusty Conditions

Coats shall not be applied in dusty or contaminated conditions.

12.1.2 Surface Temperature

Coats shall not be applied if the surface temperature of the base metal is less than 3°C above dew point or outside the range 5 - 40°C, unless otherwise recommended in the manufacturer's instructions.

12.1.3 Ambient Temperature

Coats shall not be applied when the ambient temperature is less than the minimum or greater than the maximum recommended by the manufacturer's instructions of the corrosion protection material.

12.1.4 Relative Humidity and Time Interval

The time interval between abrasive blast cleaning and paint application shall not exceed those given in SC 9.3.5.

12.2 Paints

12.2.1 Application Method

The recommendations of the paint manufacturer as per the manufacturer's instruction (refer to SC 3.2) as shown on his data sheets or given in writing on his letterhead and approved by the Employer's Agent shall be followed.

Apart from touch up, all liquid paints applied in the shop shall be applied by means of airless spray machines. Before use all paints shall be thoroughly stirred so as to be completely homogeneous. Two component paints shall be thoroughly mixed in the correct proportions as specified in the manufacturer's data sheet.

Painting on site shall be carried out to the Employer's Agent's written approval. Significant surfaces to be painted on site shall be those specified in the Specification or shown on the drawings. Site application methods shall comply with the paint manufacturer's recommendations.

12.2.2 Colour

Successive coats shall have distinctively different shades to facilitate coverage of each coat. Unless otherwise specified in the Amendments to this Specification, or directed by the Employer's Agent, the final paint colour shall be that given in SC 21 of this specification and shall be a commercial match to the appropriate colour in SANS 1091 - National Colour Standards for Paint.

12.2.3 Wet Film Thickness

The Contractor shall regularly and frequently monitor wet film thickness and shall calculate the dry film thickness from the volume solids of the paint.

12.2.4 Mixing

The Contractor shall ensure that all paints are mixed in accordance with the requirements of

BS 5493.

All paint components, particularly two- or multi-component materials, shall be thoroughly mixed until a homogeneous mixture is achieved.

12.2.5 Degree of Cure

The degree of cure of paint will vary with time, temperature and ventilation and shall be assessed by solvent wiping in accordance with the method given in SANS 1217 (Methyl Ethyl Ketone Resistance Test).

12.2.6 Overcoating

12.2.6.1 Compatibility of Coats

All primer, intermediate, finishing coats and layers shall be mutually compatible and re-coatable paints shall be used where applicable. There shall be not loss of adhesion between the consecutive coats or other defects.

12.2.6.2 Overcoating Intervals

The minimum and maximum overcoating intervals provided in the manufacturer's data instructions shall be strictly observed. Times and dates of application shall be recorded for each separate item and coat in the quality control records.

Since overcoating times are frequently quoted at 20 °C or 25 °C, longer overcoating times shall be allowed at lower temperatures. As a rough guide, increase time by 50% for a 5° decrease (or by 100% for a 10° decrease) in the ambient temperature below the temperature quoted in the data sheet.

12.2.6.3 Thickness of Consecutive Coats

Generally a corrosion protection system will be build-up with multiple coats. The thickness of all coats, primer, intermediate or finish coats shall be strictly according to the manufacturer's instructions. For solvent-base paints it is imperative that the applicator does not exceed the maximum film thickness per coat applied in order to prevent entrapment of the solvent and the formation of pinholes.

12.3 Powder Coats

Powder shall be applied in the shop by electrostatic spray or by fluidised bed as applicable. Items for powder coating shall after surface preparation, be pre heated to the required temperature, usually in the range 200 to 250ºC, coated by electrostatic spray or by fluidised bed, then post cured if necessary to obtain complete fusion and cure. For surfaces to be immersed the applied coating shall be tested for defects by high voltage spark testing. No defects will be permitted. Thermoset materials such as FBE shall be fully cured.

12.4 Hot-Dip Galvanizing

Hot-dip galvanizing shall be carried out in accordance with SANS 121. The coating of lining thickness shall comply with the values specified for General Applications or Heavy Duty Applications as specified in the Clause 10.8.

Galvanized surfaces which are to be painted shall NOT be passivated by the galvanizer.

Repairs to damaged galvanizing shall be carried out in accordance with the procedures specified in SANS 121 by hot metallic zinc spraying unless the use of an appropriate solder is approved. Conventional solder shall NOT be used. Solder composition shall have been approved in writing by the SANS (Metallurgy Division) or by the SAHDGA.

12.5 Cement Mortar Lining

12.5.1 Mixing of Mortar

Components of the mix shall be accurately weighed. Each batch shall be identical. Mixing shall be carried out in a suitable mechanical mixer. Aggregate and cement shall be measured in correct proportions, then dry mixed in the mixer. When homogeneous, water shall be added from a measuring vessel to achieve the correct consistency but shall not exceed the amount stated previously. When correctly mixed, the material shall be used as soon as possible and

not later than 1 hour after the first addition of water. Re tempering of the mix by further addition of water or other material shall not be permitted.

From a random batch of each day's production prepare three 150 mm test cubes, in accordance with SANS 5863. After 28 days curing, the compressive strength shall not be less than 30 MPa.

12.5.2 Placing of Cement Mortar

Cement mortar shall be placed to the specified thickness by spin casting (preferred method) or by mechanical drag trowel. In either case, sufficient centrifugal force shall be used to ensure optimum bonding to the pipe wall and optimum compaction of the cement mortar, with minimum segregation of different sizes of aggregate. The finished lining shall be smooth and uniform. Hand application is not permitted except on specials or by prior agreement of the Employer's Agent.

12.5.3 Curing of Lining

After completion of placing, spinning, trowelling an end finish, the lining shall not be disturbed until set. The pipe ends shall be closed with waterproof end covers or caps and the pipe shall be left undisturbed for at least 40 hours. After 48 hours the lining shall be sprayed with a fine mist of water and the covers and caps replaced or shall be steam cured by an approved method. The lining shall be kept wet for not less than 7 days. Pipes shall not be transported within 21 days from the date of applying the lining.

During placing of the cement mortar and the whole of the curing period, the pipes shall be kept constantly in the shade or under cover. Pipes shall not be exposed to direct sunlight.

12.6 Plastic Tape Wrapping

Pipes shall be helically wrapped on site with minimum 50% overlap, using a tape wrapping machine to ensure uniform tension. Wrinkling, bubbling or other visible defects are not permitted. The tape manufacturer shall approve the tape wrapping procedure and equipment and the application shall comply with SANS 10129.

12.7 Duplex or Multi-Layer Systems

Duplex or Multi-layer systems consist of more than one corrosion protection system applied consecutively e.g. a Hot-Dip Galvanizing and Polyurethane system.

The specifications for each of the corrosion protection systems shall be strictly followed. Special attention shall be given to adhesion between the systems.

12.8 Finishing on Site

Repairs, finish painting and cleaning on the site are regarded as inherent parts of the installation. On completion of erection, all pipework, control gear and indicating gear shall be thoroughly cleaned.

After erection, paint work shall be washed down, using nylon brushes and detergent to remove all adhering contamination. It shall then be washed with clean water to remove all traces of detergent and allowed to dry. The finishing coat shall then be applied as specified in the Amendments to this Specification.

All surfaces which cannot be painted after erection shall be painted as specified before erection. The painting system so applied shall be allowed to become fully hard dry (for at least two weeks for epoxy type paints) before erection.

For coatings such as epoxies, having a limited overcoating interval as specified in the manufacturer's data sheets, the surface shall be washed and thoroughly abraded to a matt finish before application of the finishing coats in accordance with the manufacturer's instructions.

12.9 Tolerances

12.9.1 Individual Coats Film Thickness

At least 90% of all thicknesses measured shall comply with the minimum thickness of the system specification. Up to 10% of all readings may be below the specific minimum thickness, but no reading shall be less than 70% of the specified minimum thickness.

12.9.2 Total Dry Film Thickness

Not more than 10% of readings shall be less than the minimum specified and no reading shall be less than 90% of the specified minimum. For severely corrosive conditions, no reading shall exceed the mean specified thickness by greater than 60% of the minimum.

12.10 Corrosion Protection Systems

The requirements as specified in the following sections as listed below shall be read in conjunction with the requirements of SC 12: Application of Corrosion Protection Systems. Each system specified below shall also conform to the relevant requirements of SC 12 and its sub-clauses. Where in in conflict with SC 12 and its sub-clauses the requirements in the following sections listed below shall take precedence.

- Epoxy Coating System
- Fusion Bonded Epoxy Coating System (Heavy Duty)
- Hot-Dip Galvanizing Systems (Heavy Duty)
- Bitumen Coating Systems
- Alkyd resin based systems
- Vinyl Resin Based Systems
- Elastic Polyurethane Systems

Unless otherwise specified in the Amendments to this Specification and subject to the approval by the Employer’s Agent, Plant, equipment and pipework in pump stations and water and wastewater treatment works and pipelines shall be corrosion protected with one or more of the corrosion protection systems described in the following paragraphs of this Specification.

13 TWO PACK EPOXY COATING SYSTEM

13.1 Standards

a) Equipment, materials and operational methods shall comply with the relevant SANS, ISO, BS, DIN or equivalent American Standard.

b) The *Contract*or shall ensure that he is in possession of the latest editions of all the relevant National Specifications, Codes of Practice or Standards referred to in this Specification.

c) Reference is made to the latest issues of the following Standard Specifications:

SANS 1091	National colour standards for paint
SANS 1217	The production of painted and powder coated steel pipes

SANS 5769	Cleanliness of blast-cleaned steel surfaces for painting (dust and debris)
SANS 5772	Profile of blast-cleaned steel surfaces for painting
SANS 2808	Determination of film thickness
ISO 8501-1	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of un-coated steel substrates and of steel substrates after removal of previous coatings
BSS 5493	Protective coating of iron and steel structures against corrosion
SANS 9000	Model for quality assurance in production and installation

13.2 Material

a) The *Contract*or shall have the Manufacturer's data sheets of materials to be used available.

b) Two Pack Epoxies shall be in accordance with SANS 1217. Solvent free Epoxies shall be used.

c) Two Pack Epoxies offered shall be polyamine cured.

d) Multi-purpose Epoxy shall be of the high build, modified aluminium Epoxy mastic type, containing at least 90% solids.

e) Materials and procedures shall comply with the relevant SANS Specifications and Codes of Practice.

f) All materials in a coating system shall be purchased from the same manufacturer unless approved by the *Employer's Agent*.

g) Details of coating materials to be supplied and approved.

h) The *Contract*or shall only proceed with the purchase of coating materials upon receipt of written approval from the *Employer's Agent*.

i) Materials offered and subsequently approved shall not be changed without written approval of the *Employer's Agent*.

j) Coating material selection shall also be approved by the material manufacturer/supplier. The *Contract*or shall receive a written assurance from the material suppliers that the materials comply with the specified requirements.

k) All coating materials shall be delivered in the manufacturer's original containers, clearly marked with the following:

- Manufacturer's name
- Product Brand and Reference Number
- Batch Number which may incorporate the date of manufacture
- Abbreviated instructions for storage and use of material, which shall include mixing ratios of the components of multi-component materials, minimum and maximum temperature of application and the method of application
- The SANS mark where applicable.

l) All coating materials shall be kept in an approved dry and enclosed store. The temperature shall not drop below 0°C nor exceed 40°C.

m) Usage of materials shall be on a first in, first out basis and no materials shall be used that have exceeded the shelf life recommended by the manufacturer.

13.3 Special Coating Areas

a) Areas that are inaccessible after assembly shall be prepared and fully coated with the specified system to the specified requirements before assembly. The coating shall be fully cured before assembly.

b) Mating surfaces of joints shall be coated with primer (where specified) or first coat only. The coating shall be uniform in thickness and shall not interfere with the mechanical tolerances. After assembly the outside surface of the joints shall be fully coated.

c) Steel edges to be welded after coating shall not be coated for a distance of 50 mm from the welding edge. The unlined strip of grit blasted surface shall be temporarily protected with a coat of (red or a different colour to the lining/coating) weldable primer between coating application and installation.

d) Friction grip areas shall be left un-coated unless otherwise specified.

13.4 Acceptability of Items to be Coated

Items to be coated shall conform to Sub-Clause 4.1.1 of SANS 1217, with the proviso that “pipes” shall read “items to be coated”.

13.5 Surface Preparation

a) The *Contract*or shall satisfy himself that the condition of each item to be coated is such that it is fit for coating or lining, or both, as relevant. Immediately after surface preparation each item or special shall be examined, including the inside surface, where possible, for compliance with the relevant requirements of this sub-clause.

b) Pre- and surface preparation shall conform to GIBB 002 – General Mechanical Specification and SC 9 respectively.

c) For pipes and specials intended for butt welding the prepared surfaces shall extend to the pipe ends.

13.6 Coating Thicknesses

Coating thicknesses shall conform to SC7.

13.7 Manufacturer’s Instructions

a) Recommendations supplied by the manufacturer in the form of the latest edition of printed data sheets, or given in writing on the manufacturer’s letterhead, shall be followed.

b) The following details shall be made available to the applicator:

- Brand and type of epoxy resin
- Mixing and thinning instructions
- Recommended type and quantity of solvent required for thinning during application
- Pot life of mixed product
- Minimum and maximum recommended dry film thickness per coat
- Recommended time intervals between coats
- Recommended minimum and maximum steel surface temperatures during application
- Time for complete drying and curing on steel surfaces

- All relevant information the Supplier wishes to submit on his product
- Recommended method of coating application

c) Verbal information by the Manufacturer's representative will not be accepted unless confirmed in writing by the Company.

13.8 Coating Application

13.8.1 Environmental Conditions

a) Dusty Conditions:

Coatings shall not be applied in dusty or contaminated conditions.

b) Surface Temperature:

Coatings shall not be applied if the surface temperature of the steelwork is less than 3°C above dew point or outside the range 5-40°C, unless otherwise specified by the coating manufacturer.

c) Relative Humidity and Time of Application:

Refer to SC 9.3.5.

d) Ambient Temperature:

Coatings shall not be applied when the ambient temperature is less than the minimum or greater than the maximum specified by the manufacturer of the coating material.

13.8.2 Mixing

a) The *Contracto*r shall ensure that all paints are mixed in accordance with the requirements of Specification BS 5493.

b) All coating components, particularly two- or multi-component materials, shall be thoroughly mixed until a homogeneous mixture is achieved.

c) In the case of two-Pack materials, each component containing pigments shall be thoroughly mixed. The two components shall then be mixed together in the proportions supplied by the Manufacturer until the mixture is completely homogeneous. For two Pack materials, the use of part of the contents (split Packs) is strictly forbidden.

d) In the case of solvent based Epoxy materials, it is recommended that the mixed material be allowed to stand for an induction period, as recommended by the manufacturer, before use.

e) During application, coating materials shall be agitated regularly to keep the solids in suspension. The preparation time, induction time and pot life of these materials shall be closely adhered to.

13.8.3 Application Requirements

a) Equipment:

Application equipment shall be maintained in a clean condition and in good working order. The use of equipment not maintained in good condition may lead to rejection of the coating.

b) Compatibility of Coats:

All primer, intermediate and finishing coats shall be mutually compatible.

c) Surface Restoration:

Should immediate lining/coating not be possible, or should any atmospheric

oxidisation take place between the completion of blast cleaning and commencement of lining/coating, such oxidisation shall be removed by flash blasting to restore the specified surface finish. Removal of dust and debris shall be in accordance with

SC 9.3.5(a).

d) Supports:

During coating application, the items shall be so supported to prevent damage to the wet coatings until the coatings have hardened adequately. Items shall remain supported during curing, storing and handling.

13.8.4 Method of Application

a) Application:

Epoxy coatings shall be applied by any appropriate method recommended by the manufacturer thereof, and approved by the *Employer's Agent*.

b) First Coat:

The first coat shall be applied to a minimum dry film thickness of 40 µm above the peaks of the blast profile.

c) Cleanliness:

- During application and curing of the layers, the items shall be protected against contamination by dust or other foreign matter and shall be kept dry and shaded from direct sunlight.
- All coats shall be clean and free from dust, oil, moisture and perspiration before over-coating.
- Operators handling blast-cleaned or partially painted surfaces shall wear clean gloves to avoid contamination of the surface.

d) Stripe Coat and Crevices:

- All metal edges, up stands, welds, bolts and nuts shall be adequately coated. Additional stripe coatings shall be applied after initial priming, if ordered by the *Employer's Agent*.
- Special attention shall be given to crevices and edges to ensure complete coverage and uniform paint thickness.

e) Second and Subsequent Coats:

The second and subsequent layers shall then be applied within the recommended over-coating periods.

13.8.5 Coat Colours

The colour of each subsequent coat shall be different from that of the previous coat except where two finishing coats of the same colour are necessary to achieve colour uniformity.

13.8.6 Over-coating Times

Over-coating times shall be not less than the minimum nor greater than the maximum specified by the manufacturer relevant to the ambient temperature.

Strict adherence to over-coating times is particularly important for coatings which are subsequently immersed.

13.8.7. Pipe Ends

a) Extension of Lining:

For flanged pipes or specials and pipes or specials intended for joining with flexible couplings or for site welding by means of double sleeve weld-on couplings, the lining shall extend to the ends of pipes and specials including edges and shall overlap by at least 300 mm on the outside of the pipe. Coatings shall overlap epoxy surfaces on the outside by at least 25 mm.

b) Butt Weld Edges:

For pipes and specials intended for site butt-welding, lining and coating shall extend up to a distance of 50 mm from pipe ends. The unlined circumferential strip of grit blasted surface shall be temporarily protected between the works and Site with a coat of weldable primer (different colour to the lining/coating).

13.8.8 In-situ Applied Epoxy Lining

In-situ application shall only be used to make good defects. No welding whatsoever shall be performed on any pipe or special on which the lining or coating has been completed, without the approval in writing of the *Employer's Agent*. The temporary protected surfaces shall be blast cleaned before coating with the specified system. The approval shall only be considered by the *Employer's Agent* after submission by the *Contract*or of acceptable proposals for making good un-coated and damaged areas.

13.9. Over-Coating with Polyurethane

13.9.1 Wet, Submerged or High Humidity Conditions

a) Pure Aliphatic Polyurethane:

- The area to be over-coated shall be abraded with abrasive paper grade 220 to a uniform matt finish;
- The surface shall be vacuum-cleaned to remove dust and debris – refer to SC9.3.5(a);
- Contaminants shall be removed and surfaces prepared by wiping with an organic solvent
- Over-coat with a 25 to 35 µm layer of pure Aliphatic Polyurethane in accordance with the Colour Code, SC 21.

13.9.2. Dry or UV Conditions

a) Re-coatable Polyurethane:

- The area to be over-coated shall be abraded with abrasive paper grade 220 to a uniform matt finish;
- The surface shall be vacuum-cleaned to remove dust and debris – refer SC.9.3.5(a); and
- Over-coat with a 40 µm minimum layer of Re-coatable Polyurethane in accordance with the Colour Code, SC 21

13.10 Quality of Coating

13.10.1 Finish

The fully cured coating shall have a uniform, smooth, gloss finish with proper adhesion.

13.10.2 Dry Film Thickness (DFT)

The Epoxy coating shall be evenly applied to the minimum final film thickness as specified in SC 13.6 and shall be tested in accordance with SC 13.11

13.10.3 Electrical Insulation Defects

All coated surfaces intended for water immersion or where likely to be frequently wetted under normal service conditions shall show no electrical insulation defects when tested in accordance with SC 0.

13.10.4 Finishing Coat Colours

a) The finishing coat colours shall be as specified in the Colour Code, SC 21.

b) Colours shall be in accordance with SANS 1091.

c) Where not specified, the selection of final colours shall be approved by the *Employer's Agent*.

13.10.5 Solvent Entrapment

(a) Coatings showing evidence of entrapped solvents after full cure will be rejected. No inter-coat de-lamination shall be allowed.

(b) The *Contract*or shall be hthield responsible for blistering of coatings, when shown to be caused by solvent retention.

13.11 Testing

To be read in conjunction with SC 6

13.11.1 Contractor's and Employer's Agent's Inspections

Refer to GIBB 002 - General Mechanical Specification

13.11.2 Visual Inspection

All surfaces shall be inspected visually and shall be free from tears, runs, sags, wrinkles, blisters, change in colour or gloss, orange peel, dirt, visible pinholes, dust or fluff occlusions or any other visible defects.

13.11.3 Holiday Inspection (Electrical Insulation Defects Inspection)

(a) 100% of the lining and coating of all pipes shall be tested and there shall be no electrical insulation defects on any area inspected.

(b) Except for coating containing conductive pigment (Zn, Al), low-voltage wet sponge electrical insulation defects inspection shall be carried out in accordance with SANS 1217 for coatings and linings of thickness not exceeding 500 µm.

(c) For films exceeding 500 µm thickness, the high voltage, sparking electrical insulation defects detector shall be used in accordance with SANS 1217

(d) Inspection procedure shall ensure that sufficient moisture is present at all times on the surfaces to be tested.

13.11.4 Dry Film Thickness (Dft)

a) Measurements shall be taken in accordance with SANS 2808.

b) 100% of all coating thicknesses measured shall comply with the minimum requirements of this Specification.

c) In the case of coats applied after the erection of steel work on Site, the frequency at which measurements of the DFT are taken shall be at the discretion of the *Employer's Agent*, and may be dictated by accessibility.

d) DFT in excess of the prescribed maxima shall not necessarily constitute reason for rejection if the paint film is demonstrated to be sound in all respects.

e) DFT shall be tested within 7 days of application.

f) DFT measurements taken at times beyond seven days after application shall not constitute a valid claim against the original satisfactory and documented execution of the work.

g) The method used to measure DFT, and the significance of the readings for each particular item, shall be agreed upon by all parties prior to commencement of the work.

13.11.5 Automated Shop Applied Lining and Coating

The film thickness on the first pipe and thereafter on at least one pipe selected at random from every day's production, but not less than one pipe out of every ten pipes, shall be measured non-destructively by an approved eddy current instrument. At least four readings at equally spaced intervals around the circumference, approximately 300 mm from each end of the pipe, shall be taken. The first reading shall be over the weld bead. When practicable an additional four readings at equally spaced intervals around the circumference in the centre of the pipe shall be taken. The thickness shall not be less than the minimum specified over 100% of the area including weld beads. The *Employer's Agent* may at his discretion supplement the above test by checking wet film thickness on any or all pipes during application of the epoxy resin.

13.11.6 Hand and In-situ Applied Lining and Coating

All the applied lining and coating thicknesses shall be tested by means of an approved eddy current or magnetic instrument. At least four readings shall be taken at equally spaced intervals around the pipe circumference at any test point. The first reading shall be over the weld bead. The thickness shall not be less than the minimum specified over 100% of the area including weld beads.

13.11.7 Degree of Cure of Two-Component Materials

The degree of cure of a two-component material will vary with time, temperature and ventilation and shall be assessed by solvent wiping in accordance with the method given in SANS 1217 (methyl ethyl ketone resistance test).

13.12 Damaged Coatings

a) All repairs and procedures shall be approved by the *Employer's Agent* and subject to inspection procedures as set out in SC 13.11.

b) Where the damage is extensive the remedial procedures shall be agreed with the *Employer's Agent* in writing.

c) All repairs shall comply with the requirements of the repair-product manufacturer's data sheet. The *Employer's Agent* may at his discretion request that repaired coating areas undergo adhesion tests.

d) Any damage occurring during transit from the *Contract*or's premises to the site shall be the responsibility of the *Contract*or. The *Contract*or responsible for installation of equipment at site shall repair any damage occurring on site during handling, assembly, storage, transport and erection.

e) The repaired area shall be tested in accordance with Sub Clauses 8.4 and 8.12 of SANS 1217 for compliance with the relevant requirements for thickness and electrical insulation defects respectively.

f) Any item showing electrical insulation defects exceeding an average of five per square metre (a cluster of pinholes within a radius of 25 mm being regarded as a single defective area), or flaking or other signs of loss of adhesion, shall not be repaired. The item shall be blast cleaned and re-coated in accordance with the relevant requirements of the Specification.

13.12.1 Repair Methods for Minor Defects

The repair of areas showing electrical insulation defects or low film thickness shall, if approved by the *Employer's Agent*, be carried out as follows:

a) Degrease in accordance with SC 9.3.3.

b) Thoroughly abrade the damaged area, including an adjacent surrounding area of at least 25 mm wide, with a medium grade 220 abrasive paper.

c) Vacuum-clean the surface to remove dust and debris in accordance with SANS 5769 and SC 9.3.5(a).

d) Wipe the abraded paint surface with methyl ethyl ketone and allow to dry.

e) Apply as many coats of repair material as necessary to achieve the specified thickness and finish.

NOTE: 1. When solvent borne materials are used, curing time between coats, as specified by the coating material manufacturer, shall be adhered to.

2. Apply a final top coat over the repaired area to achieve a pleasing, uniform finish of the item.

13.12.2 Repair Methods for Major Defects

The repair of areas showing damage down to the steel surface shall, if approved by the *Employer's Agent*, be carried out as follows:

a) Degrease in accordance with SC9.3.3.

b) Blast-clean all damaged areas to Sa 3 OR Sa 2 1/2 (ISO 8501-1).

c) Feather the surrounding paint for a distance of 25 mm beyond the damaged areas with a medium grade 220 abrasive paper.

d) Vacuum-clean the surface to remove dust and debris in accordance with SANS 5769 and
SC 9.3.5(a).

e) Wipe only the abraded paint surface with methyl ethyl ketone and allow to dry.

f) Apply as many coats of repair material as necessary to achieve the specified thickness and finish.

NOTE: 1. When solvent borne materials are used, curing time between coats, as specified by the coating material manufacturer, shall be adhered to.

2. Apply a final top coat over the repaired area to achieve a pleasing, uniform finish of the item.

14 FUSION BONDED EPOXY COATING SYSTEM (HEAVY DUTY)

14.1 Standards

a) Equipment, materials and operational methods shall comply with the relevant SANS, ISO, BS, DIN or equivalent American Standard.

b) The *Contract*or shall ensure that he is in possession of the latest editions of all the relevant National Specifications, Codes of Practice or Standards referred to in this Specification.

c) Reference is made to the latest issues of the following Standard Specifications:

SANS 1217	The production of painted and powder coated steel pipes.
SANS 5769	Cleanliness of blast-cleaned steel surfaces for painting (dust and debris).
SANS 5772	Profile of blast-cleaned steel surfaces for painting.
SANS 2808	Determination of film thickness.
ISO8501-1	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of un-coated steel substrates and of steel substrates after removal of previous coatings.
BSS 5493	Protective coating of iron and steel structures against corrosion.
SANS ISO 9000	Model for quality assurance in production and installation.

14.2 Material

Shall conform to SANS 1217, Type 2, powder coating.

14.3 Application

14.3.1 Surface Preparation

Pre- and surface preparation shall conform to GIBB 002 – General mechanical specification and SC 9 respectively.

14.3.2 Coating Thicknesses

Coating thicknesses shall conform to SC 7 or as specified in the Specification.

14.3.3 Coating Application

a) Items shall be heated to a temperature of 200°C (only applicable to heavy items) and coated with Fusion-bonded Epoxy by means of an electrostatic powder gun.

b) The normal procedures pertaining to powder application shall apply.

c) On completion of the coating, items shall be cured for 60 minutes at 200°C (mean temperature).

14.4 Quality of Coating

Refer to SC 13.10.1.

14.5 Testing

To be read in conjunction with SC6 and SANS 1217.

14.5.1 Contractor's and Employer's Agent's Inspections

Refer to GIBB 0012 - General Mechanical Specification.

14.5.2 Visual Inspection

All surfaces shall be inspected visually and shall be free from tears, runs, sags, wrinkles, blisters, change in colour or gloss, orange peel, dirt, visible pinholes, dust or fluff occlusions or any other visible defects.

14.5.3 Holiday Inspection (Electrical Insulation Defects Inspection)

a) 100% of all coated surfaces shall be tested and there shall be no electrical insulation defects on any area inspected.

b) Inspection procedure shall ensure that sufficient moisture is present at all times.

c) For films exceeding 500 µm thickness, a high voltage, electrical insulation defects detector shall be used in accordance with SANS 1217.

14.5.4 Film Thickness

a) Measurements shall be taken in accordance with SANS 2808.

b) 100% of all coating thicknesses measured shall comply with the minimum requirements of this Specification.

c) Film thickness in excess of the prescribed maxima shall not necessarily constitute reason for rejection if the coating is demonstrated to be sound in all respects.

d) The method used to measure film thickness, and the significance of the readings for each particular item, shall be agreed upon by all parties prior to commencement of the work.

14.5.5 Degree of Cure of Fusion-Bonded Materials

The degree of cure of fusion-bonded material shall be assessed by solvent wiping in accordance with the method given in SANS 1217 (methyl ethyl ketone resistance test).

14.6 Damaged Coatings

a) All repairs and procedures shall be approved by the Employer's Agent and subject to inspection procedures as set out in SC 13.11

b) Where the damage is extensive the remedial procedures shall be agreed in writing with the Employer's Agent.

c) All repairs shall comply with the requirements of the repair-product manufacturer's data sheet. The Employer's Agent may at his discretion request that repaired coating areas undergo adhesion tests.

d) Any damage occurring during transit from the Contractor's premises to site shall be the responsibility of the Contractor. The Contractor responsible for installation of equipment on site shall repair any damage occurring on site during handling, assembly, storage, transport and erection.

e) The repaired area shall be tested in accordance with Sub-Clauses 8.4 and 8.12 of SANS 1217 for compliance with the relevant requirements for thickness and electrical insulation defects respectively.

f) Any item showing electrical insulation defects exceeding an average of five per square metre (a cluster of pinholes within a radius of 25 mm being regarded as a single defective area), or flaking or other signs of loss of adhesion, shall not be repaired. The item shall be blast cleaned and re-coated in accordance with the relevant requirements of the Specification.

14.7 Repair Methods for Minor Defects

The repair of areas showing electrical insulation defects or low film thickness shall, if approved by the *Employer's Agent*, be carried out as follows:

a) Degrease in accordance with SC 9.3.3.

b) Thoroughly abrade the damaged area, including an adjacent surrounding area of at least 25 mm wide, with a medium grade 220 abrasive paper.

c) Vacuum-clean the surface to remove dust and debris in accordance with SC 9.3.5(a).

d) Wipe the abraded paint surface with methyl ethyl ketone and allow to dry.

e) Apply as many coats of the following repair material as necessary to achieve the specified thickness and finish.

- Solvent free Epoxy or
- Fusion-bonded Epoxy powder repair kit.

NOTE: Apply a final top coat over the repaired area to achieve a pleasing, uniform finish of the item.

14.8 Repair Methods for Major Defects

The total un-coated areas for renovation by the applicator shall not exceed 0.5 percent of the total surface area of a component. Each un-coated area for renovation shall not exceed 2 500 mm^2. If damaged areas are larger, the items containing such areas shall be re-coated.

The repair of areas showing damage down to the steel surface shall, if approved by the *Employer's Agent*, be carried out as follows:

a) Degrease in accordance with SC 9.3.3.

b) Blast-clean all damaged areas to Sa 3 (ISO 8501-1).

c) Feather the surrounding paint for a distance of 25 mm beyond the damaged areas with a medium grade 220 abrasive paper.

d) Vacuum-clean the surface to remove dust and debris in accordance with SANS 5769 and
SC 9.3.5(e).

e) Wipe only the abraded paint surface with methyl ethyl ketone and allow to dry.

f) Apply as many coats of the following repair material as necessary to achieve the specified thickness and finish.

- Solvent free Epoxy or
- Fusion-bonded Epoxy powder repair kit.

NOTE: Apply a final top coat over the repaired area to achieve a pleasing, uniform finish of the item.

15 HOT-DIP GALVANIZING SYSTEMS (HEAVY DUTY)

15.1 Standards

Reference is made to the latest issues of the following Standard Specifications:

SANS 14713	Protection against corrosion of iron and steel in structures - guidelines.
SANS 32	Internal/external protective coatings for steel tubes.
SANS 121	Hot-dip galvanized coatings on fabricated iron and steel articles.
SANS SM 5772	Profile of blast-cleaned steel surfaces for painting.
SANS 2063	Metallic and other inorganic coatings – Thermal spraying.
SANS 2808	Determination of film thickness.
ISO 8501-1	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of un-coated steel substrates and of steel substrates after removal of previous coatings.
SANS 10374-1	The suitability of hot-dip galvanized steel piping for the transportation of water.
SANS 1344	Medium duty solvent detergent.
ISO 752	Zinc ingots.
EN 1179	Zinc and zinc alloys – primary zinc.
SANS 9000	Model for quality assurance in production and installation.

15.2 Material

a) The impurities in the molten zinc, as defined in ISO 752 and EN 1179, shall not exceed a total of 1.5%.

b) Steel to be hot-dip galvanized shall be:

   i) For aesthetic appearance

      - Aluminium-killed steel or
      - Silicon-killed steel with a Silicon content not exceeding 0.04% and a Phosphorus content not exceeding 0.02%.

      NOTE: Material certification shall be supplied.

   ii) For general corrosion protection

      - Aluminium killed steel or
      - Silicon killed steel with a Silicon content not exceeding 0.25% and a Phosphorus content not exceeding 0.02%.

c) The condition of articles to be hot-dip galvanized shall comply with “Annexure C” of SANS 121.

d) The condition of tubes to be hot-dip galvanized on a continuous line shall comply with “Annexure A” of SANS 32.

15.3 Application

a) Shall only be done by members of the Hot Dip Galvanizers Association of Southern Africa (HDGASA) in accordance with SANS 9000.

b) Shall be in accordance with SANS 121 and SANS 32 for tubes.

15.4 Tolerances

15.4.1 Steel Specials

Shall be in accordance with Clause 6 of SANS 121.

a) Surface

- The surfaces shall be free from nodules, blisters, roughness and sharp points. Un-coated areas, flux residues, lumps and zinc ash shall not be permitted.
- Notwithstanding Clause 6.1 of SANS 121, in the case of handrails etc. a high quality surface finish is required and a bright smooth surface shall be achieved. Only materials specified in the Scope of works, drawings, specification shall be utilised unless otherwise approved by the Employer's Agent.
- Double dipping shall not be allowed.

b) Thickness

The thickness of hot-dip galvanizing shall comply with the requirements of the table below.

Minimum coating thicknesses on items that are not centrifuged.

Table 15-1: Minimum coating thickness

ARTICLES AND ITS THICKNESS	HEAVY DUTY COATING	LIGHT DUTY COATING	
	COATING THICKNESS µM (MIN)	LOCAL COATING THICKNESS µM (MIN)	MEAN COATING THICKNESS µM (MIN)
Steel ≥ 6 mm	105	70	85
3.0 mm ≤ Steel < 6.0 mm	80	55	70
1.5 mm ≤ Steel < 3.0 mm	65	45	55
Steel < 1.5 mm	55	35	45
Castings ≥ 6.0 mm	105	70	80
Castings < 6.0 mm	-	60	70

Heavy duty coatings are required except in the following cases:

- Where a high surface finish is required
- Where otherwise specified in this Specification

15.4.2 Steel Tubes

Shall be in accordance with Clause 7 of SANS 32.

a) Surface:

The surface of the coating shall be continuous, smooth and free from flux residues.

b) Thickness:

The thickness shall comply with the requirements of the coating quality A1, in accordance with Clause 8, Table 1 of SANS 32, as specified below.

Minimum local coating thickness requirements for coating quality A1:

Table 15-2: Minimum coating requirements

REQUIREMENTS	COATING QUALITY A1
Minimum Local Coating Thickness on the Inside Surface except at the Weld Bead	55 µm
Minimum Local Coating Thickness on the Inside Surface at the Weld Bead	28 µm
Minimum Local Coating Thickness on the Outside Surface	55 µm

c) Adhesion:

The coating shall show no evidence of flaking or cracking when tested in accordance with Clause 11.4 of SANS 32.

d) Coating Qualities:

- Coating qualities shall be A1 for water installations – see Sub-Clause 8.2 of SANS 32.
- The surface of the coating on the inside shall be as smooth as can be achieved by steam blowing.

15.5 Testing

15.5.1 Steel Items

To be read in conjunction with SC 6.

a) Visual Examination:

Where a superior aesthetic appearance of hot-dip galvanizing is requested, a bright mirror surface finish shall be achieved by the galvanizer.

b) Thickness:

Thicknesses shall be in accordance with SC 15.4.1(b) and shall be tested in accordance with Sub-Clause 6.2 of SANS 121.

15.5.2. Steel Tubes

To be read in conjunction with SC 6.

a) **Visual Examination** - Where a superior aesthetic appearance of hot-dip galvanizing is requested, a bright mirror surface finish shall be achieved by the galvanizer

b) **Thickness** -Shall be tested in accordance with Sub-Clause 11.3 of SANS 32

c) **Adhesion** - Shall be tested in accordance with Sub-Clause 11.4 of SANS 32

d) **Chemical Analysis** - Shall be tested in accordance with Sub-Clause 11.5 of SANS 32

15.6. Repair Methods

15.6.1 Steel Items

a) The total un-coated areas for renovation by the galvanizer shall not exceed 0.5% of the total surface area of a component. Each un-coated area for renovation shall not exceed 400 mm². If un-coated areas are larger, the item containing such areas shall be re-galvanized.

b) The repair method shall be approved by the Employer's Agent before repairs are initiated.

c) Repairs shall be by zinc thermal spray in accordance with SANS 2063 or three component zinc solvent free Epoxy repair system. The repair shall include removal of any scale, cleaning and any necessary pre-treatment to ensure adhesion – refer to SC 9

d) The coating thickness on the renovated areas shall be a minimum of 30 µm more than the local coating thickness specified in SC 15.4.1(b) for the relevant hot-dip galvanized coating unless otherwise specified by the Employer's Agent. The coating on the renovated areas shall be capable of giving sacrificial protection to the steel to which it is applied.

15.6.2. Steel Tubes

a) Repairs shall not be allowed on internal surfaces of tubes. Tubes shall be re-galvanized.

b) Repairs on external surfaces shall be in accordance with SC 15.6.1

16 BITUMEN COATING SYSTEMS

Bitumen coating systems are used for corrosion protection of structural steel elements and piping, specifically focused on elements that are subject to hard sliding type abrasion and for repairs.

16.1 Standards

Reference is made to the latest issues of the following Standard Specifications:

SANS 1130	Glass fibre reinforcing material for pipe wrapping.
SABS 1136	Cold-applied bitumen primer for steel pipeline protection. (as withdrawn in 2000
SABS 1137	Hot-applied bitumen for steel pipeline protection. (as withdrawn in 1999).
SANS 1178	The production of lined and coated steel pipes using bitumen or coal tar enamel.
ISO 8501-1	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of un-coated steel substrates and of steel substrates after removal of previous coatings.
SANS 9000	Model for quality assurance in production and installation.

16.2 Material

16.2.1 Hot Applied Bitumen and Primer

Shall conform to SABS 1137 (as withdrawn in 1999) and SANS 1178. In all cases where

bitumen or primer is to be stored in open tanks at elevated temperatures, or the storage temperature of the bitumen in enclosed tanks exceeds 180°C, the supplier shall be consulted and certificates obtained from him indicating recommended maximum temperatures and temperature/time relationships for storage. These certificates shall be made available to the *Employer's Agent* or the Inspectorate on request.

NOTE: Bitumen that has been heated to a temperature in excess of 230°C shall be discarded.

16.2.2 Cold Applied Bitumen Primer

Shall conform to SABS 1136 (as withdrawn in 2000).

15.2.3 Glass Fibre Tissue and Woven Wrap

Shall conform to SANS 1130.

16.3 Application

16.3.1 Acceptability of Pipes

Shall conform to Sub-Clause 3.3.1 of SANS 1178.

16.3.2 Surface Preparation

Surfaces shall be prepared in accordance with SC 9 and shall conform to Sub-Clause 3.3.2 of SANS 1178 with preparation grade Sa 2½ of ISO 8501-1 and surface profile amplitude 75 micrometers (µm).

16.3.3 Lining

a) Primers shall be applied in accordance with Clause 3.5 of SANS 1178. The lining shall then be applied in accordance with Clause 3.6 of SANS 1178, except that the maximum lining thickness shall be 5 mm.

b) Where pipe ends are intended for jointing by butt welding, the lining shall be cut back 100 mm from each end of the pipe. The primer shall however extend over the full length of the pipe.

16.3.4 Coating

a) Coating Procedure:

The coating procedure shall conform to sub-clauses 3.5.2, 3.7.2 and 3.7.3 of SANS 1178 and as specified hereunder.

b) Reinforced Coating:

The reinforced wrapping shall be of glass fibre tissue and shall have a fifty (50) percent overlap from one end of the pipe to the other. On completion of the first wrap a further coat of hot bitumen shall be applied at a temperature not exceeding 230°C, whilst a second wrap shall be applied in the same manner as the first, but in the reverse direction. On no account shall the bitumen layer between two wraps be less than 1 mm thick.

The minimum cover of bitumen over the second glass fibre tissue wrap shall not be less than 1 mm. The nominal thickness of the completed coating shall be 5.5 mm. The coating surface shall be free of surface craters, crazing, laminations, and pinholes and shall have an acceptable smooth surface.

c) Armoured Coating:

Armoured coated pipes shall, where specified in the Schedule of Quantities and in the Specification, be "armoured" against mechanical damage as follows:

Immediately after completion of the second glass fibre tissue (to SANS 1130, Type 1) wrap, a further coat of hot bitumen, not exceeding 230°C, shall be applied with bitumen impregnated woven glass fibre reinforcement, (to SANS 1130, Type 2 or Type 3) as in the above paragraphs (a) and (b).

It shall be helically wound around the pipe as a single wrap from end to end, applied under tension with a minimum overlap of 35 mm.

On no account shall the minimum thickness of the bitumen layer between the outer wrap and the second tissue wrap be less than 1.5 mm.

The minimum cover of bitumen over the woven glass fibre outer wrap shall not be less than 1.0 mm.

The nominal thickness of "armoured" coatings shall be 7 mm.

d) Pipe Ends:

Treatment of pipe ends shall conform to Sub-Clause 3.7.11 of SANS 1178.

Where pipe ends are intended for jointing by slip couplings, the coating shall be cut back 250 mm from the end of the pipe.

e) Reflective Finish:

Reflective finishes shall conform to SC 16.3.7 and Sub-Clause 3.7.10 of SANS 1178.

16.3.5 Bitumen Coating of Pipes with Linings other than Bitumen

Bitumen and glass fibre reinforcement shall comply with SC 16.2.1 and SC 16.2.3. respectively. Cold applied bitumen primer shall conform to SABS 1136 (as withdrawn in 2000).

Application of Coating:

- Within four (4) hours of having been grit blasted, and provided the pipes and specials are kept dry and free of dust, cold applied bitumen primer shall be applied by brush, spray, roller or mechanical equipment. The pipe or special shall be supported on skids or in any other suitable manner to avoid damage to and contamination of the primed surface. Primer shall be applied in a uniform manner and at the coverage rate specified or as recommended by the manufacturer, but at a rate of not less than 0.8 litres per square metre of pipe surface. Particular care is required to ensure complete penetration and coverage of welds and sharp edges. All defects in priming shall be immediately touched up by brush, care being taken to overlap the joint with the correctly primed area. Care shall be taken not to contaminate the inside of the pipes or specials with the primer.

  All equipment used for priming shall be maintained in a clean condition. Primer shall be stored in sealed containers and before material is drawn from containers, the contents shall be agitated or stirred to ensure uniformity. After sufficient material for application is withdrawn, containers shall be sealed immediately to prevent contamination or loss of solvent. Material shall not be kept in open containers overnight, nor shall it be exposed to the sun. Primer which has become fouled with foreign substances shall be discarded. Primer shall be maintained at the correct consistency by mechanical agitation during application. Thinners may be used as recommended by the manufacturer, provided the thinners are uniformly mixed with the primer before use.

- As soon as the primer is dry to the touch, but not later than three (3) days after application of the primer and provided primed surfaces are kept clean, dry, free from

dust and shaded from sunlight, the primed pipes shall be transferred to a lathe-like coating machine. Coating shall further proceed strictly in accordance with SC 16.3.4.

Reflective finishes shall only be applied and the specified inspections and non-destructive tests shall only be carried out after the lining, if applicable, has been completed and fully cured.

16.3.6 Lining and Coating of Specials

In the case of specials, where length and/or shape preclude the application of lining and coating by the mechanical processes as described for pipes, the lining and coating shall be applied by hand. The lining and coating shall not be inferior to that applied by machine. The standards of pre-cleaning of specials and linings and coatings applied to specials shall comply with all the requirements of this Specification.

16.3.7 Reflective Finish

Bitumen coated pipes shall be given a temporary reflective finish of white wash to minimise heat absorption in transit and prior to laying and back filling on site.

16.4 Tolerances

The minimum acceptable lining thickness shall be 2.5 mm and the maximum acceptable thickness 5 mm.

The nominal coating thickness shall be 5.5 mm with a tolerance of -0.5 mm and +0.5 mm.

The nominal thickness of "armoured" coatings shall be 7.0 mm with a tolerance of –0.5 mm and +0.5 mm.

16.5 Spare Pipes

Spare pipes shall be lined and coated in accordance with SC 7.

16.6 Testing

To be read in conjunction with GIBB 002 - General Mechanical Specification.

16.6.1 Visual Inspection

a) Linings shall have a smooth glossy finish and shall be free from ripples, runs, pinholes, craters, bubbles, laminations and visible impurities.

b) Coatings shall be free of surface craters, crazing lamination, dis-bonding, un-bonded areas, pinholes and shall have an acceptable smooth surface. No hollow sounds shall be detected when the coating is tapped. The glass fibre reinforcement of the fibre pattern thereof shall not be discernible on the bitumen surface.

16.6.2 Non-Destructive Tests

a) Holiday Testing:

Shall conform to Sub-Clause 7.2.2 of SANS 1178.

b) Thickness Testing:

On each pipe in the sample, taken in accordance with SC 16.6.4(b), the thickness of lining and coating shall be measured by means of a suitable magnetic or eddy current instrument. The instrument must be designed for non-destructive measurement of the thickness of non-metallic films on a magnetic base and be suitable for use on curved surfaces. Set zero and calibrate the instrument on steel similar to that used in the manufacture of the pipe, using a suitable shim of which the thickness is

approximately equivalent to the thickness of the coating/lining under test. Take readings as specified in Sub-Clause 7.2.1 (a) and (b) of SANS 1178.

16.6.3 Destructive Tests

a) Peel Test on Lining:

Shall conform to Sub-Clause 7.3.2 of SANS 1178. Three tests shall be carried out, one of which shall be over the longitudinal or spiral weld seam, the test areas being approximately 120° apart. The lining shall not be accepted as having passed the test if the average of the three peel length readings is greater than 3 mm.

b) Condition of Bitumen:

Shall conform to sub-clause 7.3.3 (a) and (b) of SANS 1178, to the following standards:

- Fraas breaking point : no failure to +10°C
- Softening point : 100 - 125°C
- Penetration : 1.0 – 2.2 mm
- Resistance to cracking : no cracking down to –10°C.

In the event of the condition of bitumen test results not satisfying all these requirements, a series of three (3) other tests shall be carried out by the *Contract*or, and witnessed by the *Employer's Agent*. The average of the three (3) results for each test shall be determined. If the average does not comply with the requirements, then the day's production, from which lining and coating samples were obtained, shall be rejected.

16.6.4 Test Samples

a) Visual:

All pipes to be inspected.

b) Non-Destructive Testing:

(i) Holiday testing:

All pipes to be inspected.

(ii) Thickness:

On the first pipe and thereafter on at least 10 percent of the number of pipes and specials in each day's production.

c) Destructive Testing:

Sufficient lining and coating material shall be removed from the ends of at least one pipe selected at random from that day's production for the purpose of carrying out the tests. The peel test shall be carried out the next day on the same pipe.

16.7 Repair Methods

16.7.1 Damage to Substrate

Areas dis-bonded or damaged through to the substrate shall be repaired as follows:

a) The problem areas shall be stripped back to the substrate and the edges feathered back for 100 mm minimum to achieve Sa2 of ISO 8501.

b) The repair shall be effected by firstly applying a coat of primer.

c) (i) Using liquid bitumen and cut pieces of glass fibre tissue or a blanket, rebuild the coating to the original Specification. Gas heated repair irons shall be used to blend in the various layers or

(ii) Apply a layer of the "torch on" bitumen tape with 50 mm overlap by heating the side of the tape with a gas torch until the compound is glossy and just molten. Then smooth firmly onto the surface to eliminate air pockets and voids.

Overlaps and seams shall be smoothed and sealed by tooling with a heated bullnose trowel.

16.7.2 Partially Damaged

Areas partially de-laminated or damaged through the thickness shall be repaired as follows:

The de-laminated or damaged areas shall be stripped back to the lamination or bottom of the damage and using liquid bitumen and cut pieces of glass fibre tissue, the coating shall be rebuilt to the original Specification. Gas heated repair irons shall be used to blend in the various layers.

16.7.3 Electrical Insulation Defects

Electrical insulation defects (holidays) shall be repaired by hot ironing.

16.7.4 Top Coat

Completed repairs shall be protected as per SC 16.3.7.

17 ALKYD RESIN BASED SYSTEMS

Alkyd systems are intended for use in environments of low corrosiveness, where a good decorative finish is required. Materials shall therefore be applied with due cognisance of appearance and protection. Defects such as runs, sags, curtaining, shrivelling or wrinkling will not be permitted.

17.1 Standards

Reference is made to the latest issues of the following Standard Specifications:

SANS 630: Ecorative high gloss enamel paints.

SANS 681: Undercoats for paints

SANS 1319: Zinc phosphate primer for steel.

17.2 Material

- Alkyd zinc phosphate primer for steel shall comply with the requirements of SANS 1319.
- General purpose alkyd undercoat shall comply with the requirements of SANS 681 Type 2.
- Alkyd enamel shall comply with the requirements of SANS 630.

17.3 Surface Preparation

The substrate surface preparation shall conform to the Manufacturer's Instructions or as specified in the Amendments of this Specification as approved by the Employer's Agent. In the event of it being omitted the surface preparation shall confirm to the requirements Sa 2½ (ISO 8501-1) and the corresponding requirements as specified in SC 9.4 and Table 9.2 and the applicable Method as specified in SC 8.

17.4 Repair of Damaged Coats

Repair procedures shall be approved by the Employer's Agent and in Clause 3.12.

17.5 Testing

Testing shall conform to the requirements of Clause 11.1 and SANS 1217.

18 VINYL RESIN BASED SYSTEMS

Vinyl copolymer (PVC) paints are a single component vinyl resin-based paints have excellent resistance to water, chemicals, dilute acids and hypochlorites. Their resistance to heat is poor and they must never be used on surfaces continually subjected to a temperature of 70 °C or higher. They are not resistant to solvents and should not be used where there may be contact with oils, grease, kerosene, petrol etc.

The main advantage of vinyls is their easy maintainability. Whereas epoxies are difficult to recoat after about one month's exposure, vinyls may be recoated after any period of time.

Vinyls are recommended for use above water and for interior and exterior use where and could be subject to chemical fumes, as in chlorination rooms.

18.1 Material

Vinyl copolymer (PVC) paints shall have a solids content of 50% by mass and 32% by volume with a viscosity of 4,5 poise +_ 0,5 poise. The paint shall be stabilised against UV radiation.

18.2 Surface Preparation

The substrate surface preparation shall conform to the Manufacturer's Instructions or as specified in the Amendments of this Specification as approved by the Employer's Agent. In the event of it being omitted the surface preparation shall confirm to the requirements Sa 2½ (ISO 8501-1) and the corresponding requirements as specified in Table 9.2.

18.3 Repair of Damaged Coats

Repair procedures shall be approved by the Employer's Agent and in SC 3.12.

18.4 Testing

Testing shall conform to the requirements of Clause 11.1 and SANS 1217.

19 ELASTOPLASTIC POLYURETHANE SYSTEMS

This part of the Specification applies to two component solvent free elastoplastic polyurethane. This system shall only be used in limited approved applications.

19.1 Standards

Reference is made to the latest issues of the following Standards:

SANS1217: Internal and external organic coating protection for buried steel pipelines.

19.2 Material

The paint material shall be a solvent free two-component polyurethane hybrid based on a polyester type polyol and aromatic isocyanate. The cured paint shall comply with the following requirements:

- Tensile strength at 3 mm thickness - ASTM D 638 - not less than 15 MPa
- Adhesion to primed steel - SANS Method 776 - not less than 10 MPa
- Impact resistance (direct) - ASTM G 14 - not less than 9 Joules

- Dielectric Strength - not less than 10 kV/mm
- Elongation at break - not less than 25%
- Compressibility - not less than 25 MPa
- Surface hardness of 5 mm thick sample - not less than 60 nor greater than 80 Shore 'D'
- Water Vapour Permeability - not greater than 0.5 g/24 h/m²/mm²
- Cathodic disbonding - when tested in accordance with ASTM GB Method A, for 60 days, the dis-bonded area shall not exceed 500 mm²

19.2.1 Adhesive

Adhesive shall be a two component polyurethane adhesive designed to maximise adhesion between used polyurethane and freshly mixed polyurethane.

19.3 Application

19.3.1 Dry Film Thicknesses

Dry film thicknesses shall be at least as follows unless otherwise specified in the Amendments of this Specification

- Overcoating as duplex system
  - The dry film thickness shall be 40 µm minimum
- For corrosive/abrasive environmental conditions:
  - The dry film thickness shall be 1.0 mm minimum
- For highly corrosive/abrasive environmental conditions:
- The dry film thickness shall be 3.0 mm minimum

19.4 Repair of Damaged Coats

Repair procedures shall be approved by the Employer's Agent and conform to the requirements of SC 3.12.

19.5 Testing

Testing shall conform to the requirements of Clause 11.1 and SANS 1217.

20. TAPE WRAPPING SYSTEM

20.1 Standards

Reference is made to the latest issues of the following Standard Specifications:

SANS 1117	Plastic wrappings for the protection of steel pipelines.
SANS 10129	Plastics tape wrapping of steel pipelines.
ISO 8501-1	Preparation of steel substrates before application of paints and related products – Visual assessment of surface cleanliness – Part 1: Rust grades and preparation grades of un-coated steel substrates and of steel substrates after removal of previous coatings.
SANS 9000	Model for quality assurance in production and installation.

20.2 Material

Polyethylene pressure-sensitive or polyethylene laminated to an elastomeric layer of butyl rubber tapes shall conform to SANS 1117, types A, B or C.

20.3 Application

20.3.1 General

Steel pipes, fittings and specials, protected by means of tapes, shall be wrapped in accordance with SANS 10129 as amended and extended by this Specification. All pipes shall be wrapped outside the trench in accordance with acceptable factory applications. Tape wrapping may be carried out in an "over the trench" operation for pipe diameters up to 450 mm.

If in the opinion of the Employer's Agent adverse weather conditions are such as to interfere with the successful application of an efficient corrosion protective wrapping, he shall order a stoppage of work. It shall be regarded that the Contractor has accepted this risk and made provision for it in his Tender.

The production and application of the tapes shall be controlled by SANS 9000, Quality System.

20.3.2 Surface Preparation

Shall conform to Clause 3.2 of SANS 10129.

20.3.3 Priming

Immediately after cleaning but not later than 4 hours after cleaning, provided the pipe surfaces are kept dry and free from dust, a primer shall be applied according to Sub-Clause 4.2.1 of SANS 10129.

20.3.4 Normal Wrapping

Tape wrapping shall be applied with sufficient pre-tensioning immediately after priming, in accordance with sub-clause 4.2.2 of SANS 10129, and shall ensure a smooth wrap free from wrinkles, blisters, frayed or torn edges, cracks or other defects even at temperatures up to 65°C.

For normal wrapping, tape shall be applied in two layers with a minimum overlap of 50% on both the inner and outer wraps.

Tape joints and repairs shall be done in accordance with sub-clause 4.2.3 of SANS 10129.

Hand wrapping shall only be allowed for short lengths that are inaccessible to a wrapping machine, specials, joints, small diameter pipes and small repairs – refer SC 20.6

20.3.5 Armouring

Where armour wrapping is specified, two layers of tape wrapping shall first be applied with sufficient pre-tensioning immediately after priming, in accordance with Sub-Clause 4.2.2 of SANS 10129, and shall ensure a smooth wrap free from wrinkles, blisters, frayed or torn edges, cracks or other defects even at temperatures up to 65°C.

The first layer of wrap shall overlap by half the tape width plus 25 mm and the second wrap shall overlap by not less than 50 mm.

The above-mentioned layers of tape shall be armoured by the application of a third layer of pressure-sensitive polyethylene tape with a carrier thickness of 750 micrometers and a minimum overlap of 50%.

Armoured wrappings shall generally be applied at the following positions:

- All road crossings through sleeves and culverts;
- All railway crossings through sleeves or culverts; and

- Wherever the *Employer's Agent* may consider that special conditions warrant such measures.

20.3.6 Wrapping of Specials

In the case of specials or pipe lengths where length and/or shape preclude the application of a protective wrapping system by any means, the protection shall be carried out either by bitumen-fibre glass or epoxy coating in accordance with SC's 16 or 14 respectively. In the case of access, scour, air valve and farmers off-take tees the special shall be deemed to incorporate at least two (2) diameter lengths either side of the main tee barrel.

20.3.7 Armour Wrapping of Coated Pipes

Where armour wrapping of coated pipes is specified, a single layer of pressure-sensitive polyethylene tape with a carrier thickness of 750 micrometers and a minimum overlap of 50% shall be applied.

20.4 Tolerances

20.4.1 Pressure Sensitive Tape Wrapping

The minimum thickness of the inner low-density polyethylene tape carrier component shall be 300 µm and the maximum thickness of the outer high-density tape carrier shall be 1000 µm. Total minimum polyethylene thickness of 1450 µm.

The adhesive part of the inner layer shall be a minimum thickness of 1.5 times the polyethylene tape carrier thickness. For the outer layer the adhesive layer shall be at least equal to the thickness of the polyethylene tape carrier thickness.

20.4.2 Butyl Rubber Laminates

The minimum thickness of the completed wrapping shall be 750 µm. The inner layer shall be a butyl rubber laminate of 450 µm minimum thickness of which the butyl rubber film shall not be less than 200 µm thick and the polyethylene film shall not be less than 200 µm thick.

The outer layer shall be high density pressure tape of 300 µm minimum thickness.

20.5 TESTING

To be read in conjunction with GIBB 002 - General Mechanical.

20.5.1 Visual Inspection

The wrapping shall have a smooth appearance, free from wrinkles, blisters, bridging across weld beads, frayed edges, cracks, dis-bonding and any signs of physical damage.

20.5.2 Non-Destructive Testing

a) Electrical Insulation Defect (Holiday) Testing

The entire wrapping of the pipeline shall be tested with an approved holiday detector equipped with a rolling ring detector around the pipe by the *Contract*or to the *Employer's Agent* satisfaction. The ring shall be in close contact with the surface of the wrapping along the pipe circumference. The test shall be carried out immediately prior to lowering the pipe into the trench. The wrapping on specials or short pipe lengths shall be tested with an approved holiday detector fitted with a copper bristle brush detector of suitable form. The wrapping shall exhibit no holidays when tested with an effective voltage of 12 kV at a nominal pulse frequency of not less than 30 Hz.

The *Employer's Agent* may instruct any length of pipe or any number of specials to be re-tested using a holiday detector with a copper bristle brush detector.

b) Coating Insulation Test

The *Employer's Agent* shall carry out a conductance test on the wrapping over any section of pipeline between valves when the pipeline has been wrapped and installed in the trench with padding and back filling completed. The test shall be conducted with the valves temporarily removed from the line, at the *Contract*or's expense, to ensure complete isolation of the pipeline section under test or between gaps left for tie-ins.

The length of the section of pipeline under test shall be carefully measured and the conductance over the section tested shall not exceed 180 micro-Siemens per square metre of pipe surface under all conditions of test. If the results of the test for the section of pipeline tested are not satisfactory, two sections immediately adjacent to the testing section will be tested. If the results on one or both of these sections tested are not satisfactory, all sections of wrapped pipeline shall be tested.

20.5.3 Destructive Testing

The Employer's Agent may from time to time collect samples of 10 metres of each type of tape and one litre of primer for testing, for compliance with the Specification, by any independent laboratory appointed by the Employer's Agent. The supply of samples shall be for the Contractor's account. The Employer's Agent reserves the right to reject the whole batch of materials from which unsatisfactory samples were obtained.

20.5.4 Repairs

The Contractor shall be required to locate areas of faulty protection on all sections on which unsatisfactory results are obtained and to affect the necessary repairs. The cost of this work and all additional materials provided or supplied, including the reinstatement of the trench and the retest shall be for the Contractor's account.

20.6 REPAIR METHODS

Where damage to the wrapping on a pipeline has occurred and where there are creases, wrinkles and folds in the wrapping, proceed as follows:

20.6.1 Small Damaged Areas

If the width of the tape being used exceeds by at least 100 mm the length of the section affected, cut the area of damaged wrapping away to bare metal leaving no raised edges or protrusions.

Clean and prime the exposed area in accordance with SC's 20.3.2 and 20.3.3 and apply a patch of tape, ensuring an overlap of not less than 50 mm on all sides onto the surrounding wrap.

Apply by hand-wrapping with a 55% overlap, a further layer of tape commencing two turns before and continuing for two turns beyond the patch.

20.6.2. Large Damaged Areas

Where the extent of damaged or faulty wrapping is such that the tape cannot span the affected area and provide a 50 mm overlap on all sides it must be completely removed from the pipe over the affected section. The area shall be cleaned and primed in accordance with SC's 9 and 10. The pipe must be re-wrapped with a 55% overlap, commencing two turns before and finishing two turns beyond the bared section.

20.6.3 Damage on Double Wrap

Where damage or a defect has occurred in a section that has been double wrapped and in the case of small holidays, the outer wrap shall be removed for a distance equal to three (3) times the width of the inner wrap tape on each side of the damaged area.

The appropriate procedure given in SC's 20.6.1 shall be used to effect the repair of the inner wrap.

The outer wrap shall be re-instated in accordance with SC 20.3.5

20.6.4 Outer Wrap Damage

Where damage extends through an outer wrap/rockshield (see Section 6 of SANS 10129), this shall be carefully removed for a distance equal to three (3) times the width of the inner wrap tape on each side of the damaged area without damaging the inner wrapping

The repair shall be carried out by the appropriate method given in SC's 20.6.1 and the outer wrap/rockshield re-instated in accordance with SC 20.3.5.

21 COLOUR CODING, LABELLING AND NUMBERING

21.1 Colour Coding

The colours for identification colour marking of pipelines and equipment shall be as indicated in the table below where a colour code is not available, the SANS10140-3 Pipe Colour Marking system must be used.

COLOUR	CODE	COLOUR	CODE
Arctic Blue	F28	Light Stone	C37
Black	GH19	Middle Brown	B07
Brilliant Green	H10	Pastel Grey	G54
Canary Yellow	C61	Primrose	C67
Cornflower	F29	Pastel Blue	E70
Crimson	A03	Salmon Pink	A40
Eau de nil	H43	Signal Red	A11
Emerald Green	E14	Strong Blue	F11
Golden Brown	B13	Verdigris Green	E22
Golden Yellow	B49	Water White (Blue)	F29
Jacaranda	F18	White	HG100
Light Grey Green	H40		
Light Orange	B26		

21.2.2 Pipelines

CONTENTS OF PIPE	BASIC COLOUR	IDENTIFICATION BAND 150MM WIDE	WORDING
Potable Cold	Brilliant Green	Cornflower	
Potable Hot	Brilliant Green	Crimson	
Raw	Brilliant Green		RAW
Sludge (All)	Brilliant Green		SLUDGE
Supernatant Return (From Sludge)	Brilliant Green	Pastel Grey	
Waste Water			
Raw Sewage	Middle Brown	Black	
Raw Sludge	Middle Brown	Golden Brown	
Humus Sludge	Middle Brown	Jacaranda	
Treated Sludge	Middle Brown	White	
Returned Sludge	Middle Brown	Crimson	

Supernatant Liquor	Middle Brown	Arctic Blue	
Final Effluent	Middle Brown	Brilliant Green	
Chemical Solutions			
Alum	Jacaranda	Arctic Blue	
Bentonite	Jacaranda		BENTONITE
Caustic Soda	Jacaranda	Black	
Copper Sulphate	Jacaranda	Light Stone	
Activated Carbon	Jacaranda	Pastel Grey	
Lime	Jacaranda	Crimson	
Polyelectrolyte	Jacaranda	Verdigris Green	
Soda Ash	Jacaranda		SODA ASH
Sulphuric Acid	Jacaranda	White	
Chlorine	Jacaranda	Canary Yellow	
Ferric Chloride	Jacaranda	Brilliant Green	
Sodium Hypochloride	Jacaranda	Canary Yellow	
Sodium Chloride	Jacaranda	Canary Yellow Brilliant Green	
Chloride of Lime	Jacaranda	Canary Yellow	
Gases			
Chlorine	Light Stone	Canary Yellow	
Ammonia	Light Stone	Signal Red	
Ozone	Light Stone		OZONE
Chlorine Dioxide	Light Stone	Canary Yellow	
Methane	Light Stone	Black	
Fuel and Oil			
Diesel	Golden Brown	White	
Petrol	Golden Brown	Signal Red	
Hydraulic Oil	Golden Brown	Salmon Pink	
Waste	Golden Brown	Black	
Air			
Blowers	Arctic Blue	Signal Red	
Compressed	Arctic Blue		
Instrument	Arctic Blue	Salmon Pink	
Vacuum	Arctic Blue	Primrose	

Where it is impractical to paint the whole pipeline the basic pipeline colour is to be painted in two 150mm wide bands on either side of the identification bands.

Where there is no identification band, but wording is specified, the specified wording shall be stencilled on the pipe, in the largest practicable lettering up to a maximum of 75mm in height, in clearly visible locations on either side of all fittings.

21.2.3 Plant and Equipment

Items of Equipment	Basic Colour
Pumps	According to Pipe Contents
Motors	To match supply voltage panel
Valves (Anti-clockwise Opening Valves)	According to Pipe Contents Brilliant Green
Body Bonnet, Yoke and Hand Wheel or Cap	
Valves (Clockwise opening valves)	According to Pipe Contents Signal Red
Body Bonnet, Yoke and Hand Wheel or Cap	
Electrical Switchgear	Light Orange
(Other than Starting and Stopping Devices and Emergency Stop Controls)	

Fan and Coupling Guards	Signal Red
Base Plates	Black
Exposed Moving or Rotating Machine Parts	Light Orange
Cable and Conduits	Light Orange
Starting Devices	Emerald Green
Stopping Devices	Signal Red
Emergency Stop Controls	Signal Red
Telemetry	Natural Colour
Fire Protection Equipment	Signal Red
Safety Equipment	Emerald Green
Handrails	Golden Yellow
Handrail Stanchions	Black
Crawl Beams	Golden Yellow with 50mm Black Diagonal Lines
Traveling Cranes	Golden Yellow with 50mm Black Diagonal Lines on lifting beams and rails only (i.e. not support columns)
Demarcation of Walkways	Golden Yellow
Housekeeping Markings	Golden Yellow

21.1.1 Mechanical and General

ITEMS		COLOUR
Structural Steel, Gates		Light Grey
Hydraulic Power Pack		Strong Blue
Hydraulic Oil		Salmon Pink
Hazardous Objects/areas (restricted headroom, crane hook etc)		Golden Yellow with Black Chevron
Handwheels and Levers		Golden Yellow
Handrails:	- Vertical	Black
	- Horizontal	Golden Yellow
Handrails on Dam Walls	- Aluminum	Un-coated
	- Stainless steel	Un-coated
	- Galvanized	Light Grey
Floors: -	safe and walking areas	Emerald green
-	restricted areas	Golden yellow
-open flooring (gratings) –	MS galvanized	Un-coated
	3Cr12	Un-coated
	Stainless steel	Un-coated
Fire Protection Equipment		Signal Red

21.2.1 Location of identification systems

Except in a case where only a basic colour is used and is painted over the entire length of the pipeline, place identifications at all junctions, service appliances, bulkheads, wall penetrations,

at both sides of valves, and at any other place where identification is regarded as necessary. Colour code indicators shall not be more than 6 m apart.

21.2.1 Labelling, Numbering of Plant, Equipment and Buildings

Room Numbers	White on Black Background
Electrical Circuits	Black on White Background
Plant Equipment Stock Numbers	Black on Yellow Background
Room Size	White on Cornflower (sky blue) Background
Distribution Board ID	Black on Yellow Background
Danger Signs	Signal Red on White Background
Information Signs	White on Emerald Green Background

21.3 Demarcation of "keep Clear" Areas

21.3.1 Refuse Bin Locations

All refuse bin locations shall be demarcated in the following manner:

The position where the "BIN" is to stand shall be indicated by a Golden Yellow (B49) circle (100mm greater than the diameter of the base of the bin) painted on the floor with the word "BIN" stenciled in black across the centre of the circle.

A 190mm x 190mm "keep Area Clean" symbolic sign shall be affixed to the wall or the other fixture next to the refuse bin to indicate its use as a refuse bin and not as a scarp (metal) bin.

21.3.2 Fire Extinguishers, Fire Hose Reels, Electrical Distribution Boards and other "Keep Clear" Areas

The demarcation shall be symmetrically 300mm greater than the maximum width of the equipment and extend 500mm from the supporting wall or fixture. An eighty millimetre wide black line, within the demarcated area shall be painted as a border to the demarcation. The remaining inner area shall be painted.

Golden Yellow and the words "KEEP CLEAR" and/or "UNGABEKI" stenciled in the yellow block. The lettering shall be 50mm high where possible.

On expanded mesh or similar perforated floor areas a solid metal plate shall be placed below the equipment on which the demarcation shall be painted.

22 MEASUREMENT AND PAYMENT

22.1 General

No separate payment shall be made for painting and corrosion protection. Payment for the requirements of this Section will be included in the payment item for the particular item supplied including painting or corrosion protection.

ANNEXURE 1
PRO-FORMA QUALITY CONTROL PLAN FOR CORROSION PROTECTION

QUALITY CONTROL PLAN FOR CORROSION PROTECTION			
PROJECT:			QCP NO.
EQUIPMENT:		SECTION:	REVISION:
DRAWING NO.:	QTY:	FACTORY ID NO.:	COMPILED BY: DATE:
CLIENT:		CONTACT NO.:	ORDER NO.:
CONTRACTOR:		CONTACT PERSON:	
APPLICATOR:		CONTACT PERSON:	

APPROVALS

CONTRACTOR	**EMPLOYER'S AGENT**	**UW QC**	**END USER**
NAME: SIGNATURE: DATE:	NAME: SIGNATURE: DATE:	NAME: SIGNATURE: DATE:	NAME: SIGNATURE: DATE:

LEGEND

H - HOLD POINT	W - WITNESS POINT	S – SURVEILLANCE	R – REVIEW

INSPECTION CODE

1 – APPROVAL	3 - TESTING	5 - REPORT REQUIRED	
2 – MATERIAL CERTIFICATE	4 - VISUAL	6 - RECORD REVIEW	

QUALITY CONTROL

	OPERATION	INSP. CODE	INSPECTION INTERVENTIONS				ACCEPTANCE CRITERIA
			CONTRACTOR	ENGINEER	UW QC	END USER	
	Documentation approval						
1.1	Quality Control Plan	1					
1.2	Corrosion protection programme	1					
1.3	Coating material	1					Data sheets
1.4	Pickling and passivation material	1					Data sheets
1.5	Rough blast material	1					Data sheets
1.6	Final blast material	1					Data sheets

2	**Pre-preparation**							
2.1	Dress protrusions and pits	4					Smooth surface	
2.2	Radius sharp edges	3					_____mm minimum radius	
2.3	Repair blowholes in castings	4					To be approved by *Employer's Agent*	
2.4	Fettle welds	4					Smooth contour	
2.5	Remove weld spatter, burrs, laminations, scabs and scale	4						
3	**Degreasing**							
3.1	Remove oil/grease contamination	3						
4	**Rough blast cleaning**	4						
5	**Measurement of soluble salts**						**Wet surface**	**Dry surface**
5.1	Wax at any point	3					100 mg/m^2	500 mg/m^2
5.2	Average over 250 cm^2	3					<100 mg/m^2	100 mg/m^2
5.3	Wet cleaning/Re-blasting						Clean soft water	
6	**Final blast cleaning**							
6.1	Blasting material	2						
6.2	Cleanliness: Wet surface	4					Sa	
6.3	Cleanliness: Dry surface	4					Sa	
6.4	Surface profile	3					50-100 μm	
6.5	Residual dust and debris	3					0.3%	
7	**Application of first coat**							
7.1	Dry Film Thickness (DFT)	3					μm	
8	**Application of second coat**							
8.1	Dry Film Thickness (DFT)	3					μm	
9	**Application of third coat**							
9.1	Dry Film Thickness (DFT)	3					μm	

10	**Completed system**						
10.1	Visual appearance	4					
10.2	Dry Film Thickness (DFT) - Wet surface	3					µm minimum
10.3	Dry Film Thickness (DFT) - Dry surface	3					µm minimum
10.4	Dry Film Thickness (DFT) - flange/ mating surfaces	3					µm minimum
10.5	Electrical Insulation Defect	3					Wet surface
10.6	Adhesion test	3					Where required
11	**Application of third coat**						
11.1	Degreasing	4					
11.2	Pickling	4					
11.3	Passivation	4					

ANNEXURE 2

PRO-FORMA COATING APPLICATION RECORD

COATING APPLICATION RECORD												
1. Pre-preparation												
Dress protrusions & pits:												
Radius sharp edges:												
Repair blowholes in castings:												
Fettle welds:												
Remove weld spatter, burrs, laminations, scale & scabs:												
Primary cleaning:												
2. Degreasing												
Material reference				Batch number:								
"Water break free" test												
3. Rough blast cleaning												
Date of rough blast cleaning				Blasting material:								
4. Measurement of soluble salts												
Maximum at any point mg/m^2				Average over 250 cm^2 mg/m^2								
Maximum at any point – final reading mg/m^2				Average over 250 cm^2 - final reading mg/m^2								
Wet cleaning/Re-blasting				Blasting material:								
5. Final blast cleaning												
Blasting material:				Cleanliness - wet surface: Sa								
Material certificate No.:				Cleanliness - dry surface: Sa								
Material pH	Hardness Moh's scale			Residual dust & debris: %								
Surface profile:	Maximum: µm			Minimum µm			Average µm					
Date of final blast cleaning:				Time completed:								
6. Ambient conditions	**First coat**			**Second coat**			**Third coat**			**Final coat**		
Time	08:00	12:00	16:00	08:00	12:00	16:00	08:00	12:00	16:00	08:00	12:00	16:00
Rain: Yes/No												
Ambient temperature °C												
Substrate temperature °C												
Relative Humidity %												

Dew point °C												
7. Application of coats	**First coat**		**Second coat**		**Third coat**		**Final coat**	
Base : Material reference								
: Batch number								
Activator : Material reference								
: Batch number								
Thinner/solvent : Type								
: Batch number								
Application equipment:								
Colour:								
Surface preparation:								
Areas stripe coated:								
Date of application:								
Time application started:								
Time application completed:								
Wet film thickness:								
Wet surface DFT: Min / Ave	µm	µm	µm	µm	µm	µm	µm	µm
No-off readings								
Dry surface DFT: Min / Ave	µm	µm	µm	µm	µm	µm	µm	µm
No-off readings								
Flange/mating surface DFT:Min/Max	µm	µm	µm	µm	µm	µm	µm	µm
No-off readings								
8. Completed system								
Visual appearance:								
Electrical Insulation Defect at V								
Adhesion test:								
Cure test:								
9. Stainless steel – uncoated components								
Degreasing								
Date of degreasing	Material reference:						Batch No.	
10. Pickling and passivation								
Date of pickling	Material reference:						Batch No.	
Date of passivation:	Material reference:						Batch No.	

ANNEXURE 3

PRO-FORMA SURFACE PROFILE AND DRY FILM THICKNESS READINGS

SURFACE PROFILE AND DRY FILM THICKNESS READINGS			
PROJECT:			
EQUIPMENT:		SECTION:	
DRAWING NO.:	QTY:	FACTORY ID NO.:	
CLIENT:		CONTRACT NO.:	ORDER NO.:
CONTRACTOR:		CONTACT PERSON:	
APPLICATOR:		CONTACT PERSON:	

SURFACE PROFILE

DATE:

WET SURFACE	1	2	3	4	5	6	7	8	9	10	TOTAL	MIN.	MAX.	AVERAGE
TOP														
MIDDLE														
BOTTOM														

DRY SURFACE	1	2	3	4	5	6	7	8	9	10	TOTAL	MIN.	MAX.	AVERAGE
TOP														
MIDDLE														
BOTTOM														

DFT FIRST COAT

DATE:

WET SURFACE	1	2	3	4	5	6	7	8	9	10	TOTAL	MIN.	MAX.	AVERAGE
TOP														
MIDDLE														
BOTTOM														

DRY SURFACE	1	2	3	4	5	6	7	8	9	10	TOTAL	MIN.	MAX.	AVERAGE
TOP														
MIDDLE														

BOTTOM														

DFT SECOND COAT

DATE:

WET SURFACE	1	2	3	4	5	6	7	8	9	10	TOTAL	MIN.	MAX.	AVERAGE
TOP														
MIDDLE														
BOTTOM														

DRY SURFACE	1	2	3	4	5	6	7	8	9	10	TOTAL	MIN.	MAX.	AVERAGE
TOP														
MIDDLE														
BOTTOM														

DFT THIRD COAT

DATE:

WET SURFACE	1	2	3	4	5	6	7	8	9	10	TOTAL	MIN.	MAX.	AVERAGE
TOP														
MIDDLE														
BOTTOM														

DRY SURFACE	1	2	3	4	5	6	7	8	9	10	TOTAL	MIN.	MAX.	AVERAGE
TOP														
MIDDLE														
BOTTOM														

DFT FINAL COAT

DATE:

WET SURFACE	1	2	3	4	5	6	7	8	9	10	TOTAL	MIN.	MAX.	AVERAGE
TOP														
MIDDLE														
BOTTOM														

DRY SURFACE	1	2	3	4	5	6	7	8	9	10	TOTAL	MIN.	MAX.	AVERAGE
TOP														
MIDDLE														
BOTTOM														

FLANGE FACES

DATE:

FLANGE SIZE	1	2	3	4	5	6	7	8	9	10	TOTAL	MIN.	MAX.	AVERAGE

COMMENTS:

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ANNEXURE 4

PRO-FORMA TEST CERTIFICATES FOR COATING MATERIALS

TEST CERTIFICATE FOR SINGLE PACK COATING MATERIAL

The Manufacturer's test certificate shall contain the following information to be supplied with each batch of product delivered to the *Contract*or:

Tender:	
Date:	
Product:	
Reference no.:	
Batch no.:	
Colour:	
Quantity made:	
Shelf life:	
Volume solids:	

Item	Method	Parameter	Results
Fineness of grind:	SANS 5053		
Viscosity:	SANS 5153		
Mass/l:	SANS 5050		
Non-volatile mass, %:	SANS 5193		
Surface dry:	SANS 5148		
Hard dry:	SANS 5148		
Volume solids:	SANS 3233		

TEST CERTIFICATE FOR TWO-PACK COATING MATERIAL

The Manufacturer's test certificate shall contain the following information to be supplied with each batch of product delivered to the *Contract*or:

Tender:			
Date:			
Product no.:			
Reference no.:			
Batch no.:			
Colour:			
Quantity made:			
Shelf life - base:			
Shelf life – curing agent:			
Mixed volume solids:			
Mixing ratio (by volume):			
Item	**Method**	**Parameter**	**Results**
Base fineness of grind:	SANS 5153		
Base viscosity:	SANS 5153		
Base mass/l:	SANS 5050		
Curing agent viscosity:	SANS 5153		
Curing agent mass/l:	SANS 5050		
Mixed viscosity after 1/120 of pot life at 20°C:	SANS 5153		
Mixed mass/l:	SANS 5050		
Mixed non-volatile mass, %:	SANS 5193		
Surface dry:	SANS 5148		
Hard dry:	SANS 5148		
Mixed pot life (for 1ℓ of mix):	SANS 5153		
Mixed volume solids:			

HARRY GWALA DISTRICT MUNICIPALITY

CONTRACT NO: HGDM746/HGM/2021

CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM: CIVIL, MECHANICAL & ELECTRICAL

PARTICULAR SPECIFICATION

GIBB 008 – CRANES GRANTRIES, HOISTS AND WINCHES

REV 1.2

Table of Contents

Revision	Date	Change Detail	Editor
1.1	December 2020	Initial Release	M. Funnell
1.2	June 2021	*Add revision table* *Edit section 1.2* *Edit section 2.2 EOT* *Add section 2.3 MOT* *Edit 3.6.2: add long travel drive system* *Edit 10.1*	M. Funnell/ M. Holmes

1 Scope and Definitions

1.1 Scope of Work

The scope of work shall include the design, supply of all materials, manufacture, shop assembly and testing, corrosion protection, delivery to site, storage and installation at site, site painting, putting to work, testing, Tests on Completion and maintenance (other than normal operating maintenance) of lifting equipment such as cranes, gantry cranes, hoists, crawl beams winches etc

Note: This specification shall comply with the GIBB 002 - General mechanical specification as well as GIBB 007 – Painting and Corrosion Protection Specification.

This specification must be read in conjunction to the project specific specification. All crane dimensions, tonnage parameters and cable lengths discussed in the project specification.

Where any ambiguity exists, this specification shall take precedence.

1.2 Definitions

(a) **"long travel"** means motion along the rails of the crane

(b) **"cross travel"** means motion across the span of the crane

(c) **"hoist travel"** means total movement of the winch in the y-axis (up and down)

(d) **"EOT"** means electric overhead travelling Crane

(e) **"MOT"** means manual overhead travelling crane

(f) "**overslung**" means the drive system on the long travel beam is positioned on top of the beam

(g) "**underslung**" means the drive system on the long travel beam is positioned on the bottom (under) of the beam

(h) **"Stooled up**" means the cross travel beam depth increases upwards after the long travel drive system decreasing the top head clearance height

(i) **"Stooled down**" means the cross travel beam depth increases downwards after the long travel drive system decreasing the bottom floor clearance height

(j) **"Top travelling**" means the trolley drive system is positioned on the top of the cross travel beam

(k) **"Bottom travelling**" means the trolley drive system is positioned on the bottom (hung under) of the cross travel beam

2 Hoisting equipment

2.1 Goliath Cranes

The vertical legs shall consist of an A-frame leg type design fully supported at the base and the top of the gantry structure

The primary cross travel members shall be dual welded box girders to allow a crab/trolley/hoist mechanism to span between the two girders. The trolley will traverse the length of the girders and shall be cantilevered on one or both sides, by the distance stated if specified

The wheel base span (created due the A frame) shall not extend to a point where it prevents the centreline of the goliath crane from lifting up any component in the works.

The control cabin shall not protrude beyond the exterior of the A frame legs. This is to ensure the cabin does not interfere with other parts of the works and remains within the footprint of the goliath crane.

The cabin shall not interfere with the hoist/trolley traversing through the A- frame legs as it travels to the cantilever, if a cantilever is specified.

The Contractor shall provide the complete crane. This includes the goliath structure, operator's cab, the rails, the hoist, the cross travel, the platform and access ladder plus electrical and control equipment.

The crane shall be sized and configured so that the hook can be raised high enough to pass over anything within the cranes operating area.

If counterweights are required in order to stabilise the crane under the test load at the limits of travel, then these shall be of solid material; i.e. water ballast is not acceptable. If the counterweight is bolted on, then this shall be of metal or reinforced concrete slabs.

The end of the rails shall be provided with a protective cage formed from DN 150 steel tubing which will form a primary barrier preventing damage by vehicle transgress.

Mechanical stops shall be provided for both long and cross travel and these shall be designed to safely stop the movement under test load and when the movement is at high speed; i.e. including when the slow speed changeover has failed.

The long travel; i.e. the goliath gantry legs' wheel movement; shall be stopped approximately one metre before the end of the rail beam so that a person can safely stand beyond that position.

2.1.1 Extent of Supply

All cranes, lifting beams and hoists shall be supplied strictly in accordance with this Specification (and the Drawings) and shall include the following, unless otherwise specified:

- Non-spin wire rope and fitted sheave block with swivel hook.
- Slack rope switch on all electrically operated cranes.
- Motorised cross and longitudinal drives.
- Proximity limit switches on all crane motions protected in accordance with IP 65 of SANS 1222 on all electrically operated cranes.
- Festoon cable, tracks and mountings for cross travel on all electrically operated cranes.
- Control cockpit cabin, all weather proof and protected to IP 65 of SANS 1222.
- Access ladders to the cockpit and to the top of the goliath crane structure. There shall be an open grid flooring walkway and guard railings on top to allow for maintenance and service of the crab, hoist mechanism.
- Electrical distribution box with isolator, fully weatherproofed and protected in accordance. With IP 65 of SANS 1222 on all electrical cranes. The cabinet door(s) shall be fitted with suitable seals to prevent the ingress of water.
- Crane long travel rails and appropriate temporary and permanent fixings with stop blocks at both ends.
- During movement of the crane in the long travel direction, a warning buzzer shall sound.
- Cross travel rails with stop blocks at both ends.
- A cow catcher shall be provided at each of the four wheels. The cow catcher shall be designed to push a person's foot and, thereby, prevent injury during movement of the crane in the long travel direction. The cow catcher shall, in addition, be provided with a flat, horizontal top surface onto which a person can climb if required.

- Power supply between the isolator box and the crane distribution box. This shall include an automatic cable spooling reel with suitable trailing cable and trailing cable strain restrictor both ends or a conductor rail system as well as all switch gear.
- Suitable waterproof floodlights.
- There shall be safety stops at each of the four ends of the rail tracks to prevent derailment

2.2 Electric Overhead Travelling Cranes

The EOT cranes shall be capable of spanning the distance and lifting the proposed load as specified in the bill of quantities. The crane shall be single or dual girder, depending on the manufacturer's requirements, and shall be manufactured to suit the specific installation.

2.2.1 Extent of Supply

All cranes, lifting beams, trolleys, crabs, drive systems and hoists shall be supplied strictly in accordance with this Specification (and the Drawings) and shall include the following, unless otherwise specified:

- Electric overhead travelling crane shall be single girder, unless otherwise stated, (welded box or cold rolled), configuration as detailed in the payment item. such as:
    - Overslung or underslung on the long travel beam
    - Stooled up or stooled down on the cross travel beam
    - Top or Bottom travelling trolley for the cross travel
- Motorised cross and longitudinal drives.
- Proximity limit switches on all crane motions protected in accordance with IP 65 of SANS 1222 on all electrically operated cranes.
- Festoon cable, tracks and mountings for cross travel on all electrically operated cranes.
- Push button pendant control shall be all weather proof and protected to IP 65 of SANS 1222.
- Electrical distribution box with isolator, fully weatherproofed and protected in accordance with IP 65 of SANS 1222 on all electrical cranes. The cabinet door(s) shall be fitted with suitable seals to prevent the ingress of water.
- Crane long travel rails and appropriate temporary and permanent fixings with stop blocks at both ends.
- Cross travel rails with stop blocks at both ends.
- Power supply between the isolator box and the crane distribution box. This shall include an automatic cable spooling reel with suitable trailing cable and trailing cable strain restrictor both ends or a conductor rail system as well as all switch gear.
- Suitable waterproof floodlights
- Personnel access to the crane shall be specified in the payment items. (e.g. ladder and grid platform shall be provided, if the hoist is positioned more than 4m above working level as defined by the Employer's Agent). Including all statutory safety requirements.
- There shall be safe an adequate access to the crane from floor level.

2.3 Manual Overhead Traveling Cranes

The MOT cranes shall be capable of spanning the distance and lifting the proposed load as specified in the bill of quantities. The crane shall be single or dual girder, depending on the manufacturer's requirements, and shall be manufactured to suit the specific installation.

2.3.1 Extent of Supply

All cranes, lifting beams, trolleys, crabs, drive systems and hoists shall be supplied strictly in accordance with this Specification (and the Drawings) and shall include the following, unless otherwise specified:

- Manual overhead travelling crane shall be single girder, unless otherwise stated, (welded box or cold rolled), configuration as detailed in the payment item. such as:
    - Overslung or underslung on the long travel beam
    - Stooled up or stooled down on the cross travel beam
    - Top or Bottom travelling trolley for the cross travel
- Crane long travel rails and appropriate temporary and permanent fixings with stop blocks at both ends.
- Manual chain operated cross and longitudinal drives as indicated below.
- Cross travel rails with stop blocks at both ends.
- Cross travel Trolley to be manually operated chain type geared wheel system
- Long travel manually operated chain type geared bridge wheel system. (Chain operated from single side)
- Chain block hoist mechanism to be manually operated chain type pulley system
- No positive locking devices will be required to store manually operated crane.
- The hoist mechanism and crawl shall be geared with operating chain shall correspond with the beam capacity and a manually operated block and tackle type chain hoist of the specified capacity.
- Personnel access to the crane shall be specified in the payment items. (e.g. ladder and grid platform shall be provided, if the hoist is positioned more than 4m above working level as defined by the Employer's Agent). Including all statutory safety requirements
- There will be no slack rope switch on manually hoisted lifting equipment.

2.4 Fixed Gantries and Crawl Beams

Fixed gantries are usually A frame portal frames, depending on the span and the horizontal loading, or upside down U shape gantries (bracing will be dependent on the application). Typically the preferred layout of the gantry will be depicted in the tender drawings or described in the scope of works.

Gantries and crawl beams shall typically be a mixture of I and H structural beams spanning distance as described.

2.4.1 Extent of Supply

All cranes, lifting beams and hoists shall be supplied strictly in accordance with this Specification (and the Drawings) and shall include the following, unless otherwise specified:

- There will be no slack rope switch on manually hoisted lifting equipment.
- Crawl beams and gantries may be both manual and electrically operated.
- Festoon cable, tracks and mountings for trolley travel on electrically operated cranes.
- Electrical distribution box with isolator, fully weatherproofed and protected in accordance with IP 65 of SANS 1222 on all electrical cranes. The cabinet door(s) shall be fitted with suitable seals to prevent the ingress of water.
- Manually operated hoist equipment will not require a power supply and electrical ancillaries.
- Trolley travel rails with stop blocks at both ends.
- No positive locking devices will be required to store manually operated crane.

- Personnel access to the crane shall be specified in the payment items. (e.g. ladder and grid platform shall be provided, if the hoist is positioned more than 4m above working level as defined by the Employer's Agent). Including all statutory safety requirements
- Should the crawl beam and gantry be manually operated, the hoist mechanism and crawl shall be geared with operating chain shall correspond with the beam capacity and a manually operated block and tackle type chain hoist of the specified capacity.

2.5 Common Design Features

Below is a list of common design features for the above cranes, hoists and winching equipment.

- Lifting hooks that shall raise and lower vertically on centre.
- Non-spin wire rope and fitted sheave block with swivel hook.
- Chain hoist are preferable to rope hoists.
- Slack rope switch on all electrically operated cranes
- Positive locking devices to store the crane at any point on the rails
- Power supply between the isolator box and the crane distribution box. This shall include an automatic cable spooling reel with suitable trailing cable and trailing cable strain restrictor both ends or a conductor rail system as well as all switch gear.
- Overload protection shall be included
- Design, manufacture, delivery to Site, erection and Tests on Completion on Site. The Contractor or his representative shall supervise the off-loading of the equipment at Site.
- Operating and Maintenance Manuals including Drawings.
- It is preferred that the hoist is a chain hoist.

If the Tenderer offers his standard equipment which exceeds the specified capacity, then the crane shall be designed for this higher load.

Unless agreed otherwise with the employers agent, each vertical leg of the lifting gantry portal frame shall be provided with a flanged, bolted connection approximately one metre above floor level. The lower portion of each leg shall be permanently anchored and grouted to the concrete surface whereas the upper section shall be bolted and temporarily removable. The top horizontal member of the portal frame shall be provided with two lifting eyes suitable for lifting.

The load capacity of the crane (as offered) shall be clearly displayed on both sides as well as on the sheave block e.g. SWL 6 000 kg.

The equipment shall be supplied with all the accessories necessary to give complete working installations including all built-in parts and anchors, rail tracks, hoists, covers and frames, operating gear, controls and safety devices and electrical control panels from and including the main isolating switch on the incoming supply.

The *Contractor* shall be responsible to ascertain that the capacity of each crane is suitable for lifting the equipment in the area serviced by that specific crane. Any deviations shall be communicated to the *Employer's Agent* in writing together with the Tender.

All civil Engineering work in forming and preparing box outs, chases etc., to receive the built-in parts and in placing concrete around them or grouting in base plates and holding down bolts and the like shall be done by the *Contractor*. The *Contractor* shall be required to define his requirements for such work.

The *Contractor* shall be deemed to have taken into account, inter alia, all of the operating requirements and physical conditions in preparing his Tender in addition to the operating and climatic conditions prevailing at the Site as set out in GIBB 002 - General Mechanical Specification. Evidence satisfactory to the *Employer's Agent* shall be provided that the designs

offered will meet the design and operating criteria given in the following sections/paragraphs over the operating life of the project (50 years).

3 Mechanical Details and Requirements

3.1 General

The cranes and hoists shall be, as far as possible, of a manufacturer's standard type with long and cross travel and shall comply with the Occupational Health and Safety Act (Act 85 of 1993).

The overall height shall be kept to a minimum and the general aesthetic appearance of the crane shall be pleasing with a clear, uncluttered silhouette. The minimum hook to deck level clearance shall be as indicated on the Drawings or specified in the payment item.

Unless shown on the Drawings or described in the payment item, the crane shall be capable of safely handling loads of full load capacity at all hook positions.

3.2 Design

3.2.1 Electrical Cranes and Hoists

Electrically powered cranes shall be designed in accordance with Federation European de la Manutention, Rules for the Design of Hoisting Appliances, Section 1, Second Edition, 1970 with the following duty factors:

Structures	**Cranes, Hoists, etc**	
Class of utilisation	A	
State of loading	2	
Group	3	
Mechanisms (all motions)		
Class of operation	$V_{0.5}$	V_2
State of loading	3	2
Group classification	$1A_m$	2_m

3.2.2 Factors of Safety

All parts of the cranes, hoists and lifting devices shall be designed to a factor of safety of at least 4 when working under full load conditions. Lifting ropes and attachments shall have a factor of safety of at least 6 when working under full load conditions. The term "full load" shall be the maximum working load rating specified for each crane.

3.2.3 Hooks and Shackles

The following standards shall apply:

- Ramshorn hooks BS 3017
- Standard hooks BS 2903
- Shackles BS 3032

3.3 Rails

Rails shall be installed complete with end stops, clamps, anchor bolts, fish plates etc. and shall be designed to permit expansion and contraction.

Cranes shall clear all walls and other constraints (as shown on the Drawings) by a minimum of 200 mm.

3.4 Crab

The crab shall as far as practicable be covered with checker plate for maintenance and access purposes. The arrangement and details of the crab and machinery shall be subject to the approval of the *Employer's Agent*.

The end carriage and crab wheels shall be double flanged, cast steel of approved diameter.

The end carriages and crab shall be provided with resilient buffers to engage with fixed stops at each extreme end of the crane travel.

3.5 Crawl Beams

Crawl beams shall be designed to BS 2853, including Amendment 3.

The capacity of each beam shall be displayed as described in Section 2.5. Each crawl beam shall be equipped with removable stops at each end.

Corrosion protection shall be as indicated and in accordance to GIBB 007 – Painting and Corrosion Protection.

3.6 Hoist, Trolley, Drums and Pulleys

3.6.1 Electric Hoist and Trolley Travel

Electric motorised hoists shall have suitable load cells (minimum 125 % of crane capacity) shall be incorporated in the hoist design to reflect the true load being manipulated by the crane at any time.

The load cell shall activate a remote digital display indicator, in metric tons, mounted in the pendant, control cabin or on the control panel.

The hoist trolley shall be fitted with four flanged stainless steel wheels or similar approved with permanently lubricated roller bearings, designed to be used on single girder parallel flanges.

The cross travel drives shall have two compact epicyclic reduction gears with pole-changing brake motors directly drive two wheels.

The electric hoist shall be monorail type to suit crawl beams where applicable.

3.6.2 Manual Hoist and Trolley Travel

Where manual hoists systems are used the following shall be adhered to:

For long travel:

- The long travel drive system shall be a manual hand operated with pulley chain, geared to wheel tracks and which shall be permanently attached, with chain guide and theft proof locking device. The long travel system shall only be operated from one side, hence there shall be a common drive shaft spanning the cross beam to each of the drive wheels
- Hand chain shall be stainless unless otherwise specified
- Double reduction gearing shall be required
- The maintenance-free sealed bearings increase reliability and reduce required pull force to lift loads

For trolley travel:

- The trolley shall be a manual hand geared trolley which shall be permanently attached, with chain guide and theft proof locking device
- Hand chain shall be stainless unless otherwise specified
- Double reduction gearing shall be required

- The maintenance-free sealed bearings increase reliability and reduce required pull force to lift loads
- Trolley track wheel shall be stainless steel or similar approved

Vertical hoist and loading chain:

- High Grade 100 nickel-plated with high-impact steel chain guide
- Hand chain shall be stainless unless otherwise specified
- The load chain shall be stainless steel unless otherwise specified
- The hoist mechanism shall be geared to reduce operator fatigue.
- There shall be an overload limiter.

3.6.3 Drums and Pulleys

Where drums are applicable, particular attention shall be paid to the design and positioning of the rope drum(s) to ensure a centre lift over the lifting points of hydro-mechanical equipment when raising and lowering. The ropes and sheave block shall not foul the wall at the extreme point of lowering.

The rope grooves in drums and pulleys shall be machined as follows:

The diameter of the drum measured at the bottom of the groove shall not be less than that given in the table below which is based upon the rope speed not exceeding 60 m per minute.

Table 3.1: Drum Diameters

Rope Construction	4 x 37	6 x 19	6 x 24	6 x 37	6 x 61
Drum Diameter	27D	24D	22D	19D	17D

*D = Diameter of rope

The contour at the bottom of the grooves shall be circular over an angle of approximately 120°. The radius of the groove shall be larger than the radius of the rope and not less than that required by BS 302 or equivalent standard. The depth of the groove shall not be less than:

- Drums: 0. 33 x diameter of rope
- Pulleys: 1. 05 x diameter of rope

and the edges shall have a radius.

The grooves shall be finished smoothly and be free from surface defects liable to damage the rope. The grooves on the drum shall be so pitched that there is a clearance of not less than 1.6 mm between the neighbouring turns of rope for 13 mm diameter rope, 2.5 mm for 13 mm to 28 mm and 3.2 mm for rope diameters above 28 mm.

The drums shall be of sufficient length to take the full amount of rope without overlapping when the load is at its highest position. When the load is in its lowest position, there shall be at least two full turns of rope remaining on each drum.

The method of attachment of the ropes shall be such that in the event of a rope unwinding completely there shall be no danger of it becoming freed from the drum. The rope anchorage shall be readily accessible.

Pulleys shall be provided with guards to retain the rope in the grooves.

The inclination between the rope and the plane perpendicular to the axis of the drum or pulley shall not exceed 1 in 12.

Rope drums shall be adjustable for rope stretch if balancing pulleys are not used.

3.7 Sheave Block, Hook and Rope

3.7.1 Sheave Block

Where applicable, the sheave block shall run parallel to the sealing face and shall be designed to suit the clearance shown on Drawings.

An advanced sheave block pulley system with multiple pulleys shall be used only if absolutely necessary and shall be at the approval of the Employer's Agent.

3.7.2 Hook

The hook shall be of the swivelling type and shall be fitted with a safety catch. The crane hook shall fit freely onto all lifting point/ lugs which include and but are not limited to of all grappling and lifting beams / cradles, hoist connections, lifting lugs, to hoist equipment. etc. The hooks shall have a positive locking device to prevent disengaging during operations in slack rope conditions.

3.7.3 Wire Rope

Ropes that will operate in water from time to time shall be IWRC galvanised and shall have a steel core.

Ropes with a fibre core shall not be acceptable.

The ropes shall be capable of supporting the maximum loads during lifting and lowering operations. The minimum breaking strengths of the ropes shall not be less than 6 times the respective maximum load. The ropes shall be impregnated with grease to resist corrosion and wear.

Where more than one fall of rope is used for the support of the load, the tension in the various parts shall be equalised by means of a pulley or equalising bar.

Eye splices, sockets, thimbles and rope anchorages shall be capable of withstanding 90 % of the guaranteed breaking strength of the ropes to which they are attached. The hoisting ropes and any slings shall be provided with a test piece to be cut for testing to destruction.

For hoist heights less than 5m a chain system shall be used, unless otherwise stated. For hoists heights including 5m and greater a wire rope system shall be used unless otherwise stated.

It is important to note that the *Contractor* shall be responsible to lower the sheave block to its bottom extreme during installation to remove all the spin in the wire rope prior to final fixing of the rope to the crane body or drum(s). All additional costs incurred by the *Contractor* to rectify spinning of the ropes and resultant damage during or after installation shall be for his account.

The wire rope shall under no circumstances interfere with the side walls while lowering equipment into the recesses.

3.8 Crane Speeds

The speeds of the various motions of the crane shall be as follows:

- Long travel: 3 to 5 m/min. (3 m/min preferred)
- Cross travel: 1 to 2 m/min. (1 m/min preferred)
- Hoisting and lowering: 3 m/min with a creep speed of 1 to 2 m/min
- Manual hoist: 10 m/min
- Trolley travel on single girder crawl beams: 3 to 5 m/min. (3 m/min preferred)

3.9 Gearing

The gears shall be designed so that all stresses are within the permissible limits when the hoists are handling the maximum load. The spur gears shall be of high grade steel with machine cut surfaces. All gears shall be quiet in operation when rotating in either direction. The gears shall have a factor of safety of not less than 6 under operating conditions. For determining this factor of safety, the formula given in BS 436 or equivalent standard shall be adopted. If the gears are based on BS 436 they shall be calculated for not less than 4 hours per day working.

Where worm gearing is used as a first motion drive, it shall be at least equal to BS 721 or equivalent standard and have the same lead and start time rating as the motor and the temperature rise of the oil bath shall not exceed 37° C above the ambient temperature. Worm wheels shall be of bronze with steel worms.

All gear wheels shall, where practicable, be a forced fit on the shaft and shall in addition be adequately secured to prevent any relative motion between the wheel and the shaft. Where gears and couplings are secured in position by means of keys, they shall be easily accessible for tightening or withdrawal. All keyways shall be machine cut and shall be at least equal to BS 46 or equivalent standard. Couplings and collars shall be of the shrouded or protected type, free from projections of any kind. All shafts shall be of adequate diameter and of suitable material for the purpose and shall be turned where necessary. Where shoulders occur, they shall be provided with adequate fillets.

3.10 Canopy for Outdoor Hoist Unit

The hoist unit shall be covered by a weatherproof canopy to protect it from dust and rain, if installed outdoors.

The canopy shall be manufactured from aluminium or stainless steel. Its design shall incorporate lockable panels on the sides and at the top, which can hinge open to allow access for maintenance. Hinges shall be of stainless steel. The panels shall be lightweight in order to facilitate easy handling. Built-in struts shall be provided to keep flip-up covers in the open position.

3.11 Lubrication and Maintenance

Adequate provision shall be made for grease gun and oil lubrication and all lubricating points shall be easily accessible. Grease nipples shall be of the stainless steel button head type ($^1/_8$" BSP) and shall, together with oil filler caps or plugs, be painted red for easy identification.

Maintenance procedures shall be in full compliance with the Occupational Health and Safety Act. A grease gun, as well as all special tools needed for maintenance, shall be supplied with the crane. All tools supplied shall be stored in a lockable, weatherproof stainless steel toolbox attached to the crane structure.

Should more than one crane exist in the same area or in a project that require similar tools, it is the Clients preference as to how and where the tools should be stored, kept and the number of tools.

Effective means shall be provided for lubricating all moving parts by either oil or grease.

Lubrication of all lifting ropes shall be in accordance with GIBB 002 – General mechanical specification.

3.12 Bolts and Nuts

All exposed fasteners, including those used for the fixing of proprietary items to the crane body and concrete works, shall be of stainless steel 304 or better. Where strength requirements prohibit this, bolts shall be hot dip galvanised.

3.13 Supports, Connections, Holding Down Bolts Etc.

The Contractor will be responsible for the design, specification, supply and installation of all supports (where applicable), connections, holding bolts, etc) required for the safe support and operation of the crane. (when mounted directly to concrete roofs or supported by Corbel attached to concrete columns the design of the roof or corbel and columns will be done by the employers agent once the loadings have been provided by the contractor)

4 Ladders and Platforms

Where required but not separately scheduled Ladders and platforms shall comply with the GIBB 002 - General Mechanical Specification and shall be included in the tendered rates for the supply of the lifting equipment.

5 Electrical Details and Requirements

5.1 General

The electrical systems of all cranes and hoists shall be in accordance with the general electrical specification

The electrical equipment shall comprise the operating motors with their controllers and resistances, brake-magnets, limit switches, lighting, main switches, fuses, and the collectors required for supplying power to the crane.

Control systems shall be designed to achieve the operational requirements stated. In particular the controllers shall allow smooth operation without jerk or snatch on all motions from standstill, each controller being provided with an adequate number of steps in either direction to achieve smooth acceleration or retardation.

All components of the control system shall operate with adequate safety margins to ensure reliable operation under all conditions of service with the minimum of maintenance.

The *Contractor* shall provide all required motor starters, MCCs, starter boxes, electrical connection boxes, isolators, cable connections between MCCs and motors and all other cabling required to connect to the local switchboard.

5.2 Power Supply

The power supply available is 400/230 volt, 3 phase, 4 wire, 50 Hz.

The main isolator box with isolator shall be measured separately with cabling from this isolator box to form part of the crane supply. The cost of which is to be included in the tendered rate for the supply of the crane.

5.3 Power Transfer to Equipment

Electrical supplies to travelling cranes working in an outdoor environment shall be obtained through longitudinal conductors and moving pick-up arms having physical and electrical properties complying with BS 23 and completely enclosed throughout their length. Collector shoes and assemblies shall be spring-loaded.

The length of the power transfer mechanism shall enable the crane to travel the full length of the area served by the particular crane. Power conductors shall be festoon cables of the flexible circular or flat form type.

The minimum requirements for the power transfer system, regardless of the type and crane location, shall be:

- Minimum of five conductors with separate neutral and earth conductors

- Weather resistant and suitable for outdoor service in a humid and alternatively open sunshine atmosphere
- Trailing cables shall be provided with an automatic cable spooling reel with tensioning device and with a strain restrictor at each end of the cable
- Conductor rails shall provide adequate personnel safety features and shall be protected against falling objects. Protection covers shall be easily removable for maintenance purposes

A triple pole, isolator switch incorporating "On", "Off" and "Earth" positions, shall be supplied for isolating the main power supply to the crane and for earthing the longitudinal conductors.

All isolators for power transfer systems shall be heavy duty and suitable for outdoor service.

The Contractor shall provide details in his tender submission regarding the method of power transfer to the crane.

5.4 Electrical Distribution Box

A lockable stainless steel electrical distribution box, protected in accordance with IP 65 of SANS 1222, shall be supplied and installed on or near the crane by the *Contractor*. It shall contain an isolator having provision for padlocking in the "OFF" position. It shall also have provision for the hanging of a "MAN WORKING" notice, which shall be included with the supply of the crane.

Three red indicating lamps, marked L1; L2 and L3 (one per phase and which shall illuminate when the supply is on), shall be provided on the distribution box. These indicating lamps shall be of the 230 V LED multi-cluster type and shall be clearly visible in normal daylight.

A danger sign shall be provided and fixed onto the distribution box.

5.5 Electric Motors

All motors shall be of the totally enclosed fan cooled squirrel cage type. Their characteristics and construction shall be suitable for outdoor crane service.

The motor for lifting operation shall be capable of continuous operation under full load as well as "inching" duty.

The motors of the crane shall have the correct phase rotation of the power supply after the Site wiring and connections have been completed.

Separate motors shall be provided for the hoisting, long and cross travelling motions, each motor being independent of the others.

5.6 Isolation Control Panel

Crane control gear shall be enclosed in a lockable 304 stainless steel or 3Cr12 cabinet, unless specified in GIBB 007 – Painting and Corrosion Protection Specification, mounted in an approved position on the crane in such a manner as will facilitate easy maintenance and inspection.

Control and operating circuit voltages shall not exceed 110V and the control panel shall include auxiliary transformers, main and auxiliary circuit fuses, contactors and all other equipment required for the complete control system.

Contactor control gear shall include for each drive a triple pole electrically and mechanically inter-locked stator reversing contactor fitted with self-resetting adjustable inverse time characteristic over-current relays.

The electrical load on the three phases shall at all times be balanced.

5.7 Pendant (If specified)

The crane, gantry and crawl beam shall be operated by means of a weatherproof pendant control by an operator standing on operating levels as indicated on the Drawings. The pendant shall be capable of being positioned at any point over the length of the girder independent of the crab. The pendant unit shall be suspended from an independent wire rope. Alternatively, where appropriate, a remote radio control shall be provided. Fixed hoists shall be operated from a control console mounted in an approved position adjacent to the hoist and on each floor serviced by the hoist.

Precise control of all functions is required to facilitate the accurate positioning of heavy components.

The complete pendant with all switches, indicators, etc., shall be weatherproof to IP 65 of SANS 1222.

Long and cross travel motions of the crane shall be arranged so that these motions may be driven simultaneously or separately without causing shock to or vibration of the crane rails. It shall not be possible to travel or traverse while raising or lowering the main hoist.

The pendant shall be provided with a lockable on/off switch with appropriate indicator light.

Controls shall be interlocked to prevent dual activation of functions and each shall be clearly marked with its function. Labels that only rely on adhesive to stay in position shall not be acceptable. All motions shall be controlled by non-latching control buttons.

All motion control push buttons shall be of the two stage type. The initial depression of the button shall select the creep speed and full depression of the button shall select fast speed. Control features shall be included to prevent fast speed being selected without first having accelerated the equipment in the slow speed range.

Where applicable, the following minimum controls shall be provided:

- On/Off switch
- Main Hoist Up/Down - Slow/Fast push buttons
- Cross Travelling Left/Right - Slow/Fast push buttons
- Long Travel Left/Right - Slow/Fast push buttons
- Emergency Stop mushroom head push button
- Floodlights On/Off

For outdoor cranes, provision shall be made to store the pendant in a lockable holder on the crane to prevent it from swinging in the wind when not in use.

In all cases, the directional orientation of the pendant horizontal motion controls (i.e. upstream / downstream; left / right) in relation to the appropriate crane shall be indicated by colour coding on the front panel of the pendant and on each crane. The colour coding on each crane shall be clearly visible from anywhere within the reach of the pendant and shall clearly contrast with the colour of the element on which it is mounted. Colour coding on the crane structure shall be by means of bolted on metal plates according to the following colour code:

- Upstream: Arctic Blue
- Downstream: Brilliant Green
- Left (looking in direction of flow): Golden Brown
- Right (looking in direction of flow): Signal Red

5.8 Cabin Control (if specified)

The crane shall be operated by means of a weatherproof control cockpit by an operator standing inside the cockpit. Cockpit shall be fixed to the crane. The cockpit shall be in full view

of the hoisted load at all times. Fixed hoists shall be operated from a control console mounted in an approved position adjacent to the hoist and on each floor serviced by the hoist.

Precise control of all functions is required to facilitate the accurate positioning of heavy components.

The complete cabin with all switches, indicators, etc., shall be weatherproof to IP 65 of SANS 1222.

Long and cross travel motions of the crane shall be arranged so that these motions may be driven simultaneously or separately without causing shock to or vibration of the crane rails. It shall be possible to longitudinal and cross travel or traverse while raising or lowering the main hoist.

The Cabin shall be provided with a lock and keys.

Controls shall be interlocked to prevent dual activation of functions and each shall be clearly marked with its function. Labels that only rely on adhesive to stay in position shall not be acceptable. All motions shall be controlled by non-latching control buttons.

All motion control push buttons shall be of the two stage type. The initial depression of the button shall select the creep speed and full depression of the button shall select fast speed. Control features shall be included to prevent fast speed being selected without first having accelerated the equipment in the slow speed range.

Where applicable, the following minimum controls shall be provided:

- On/Off switch
- Main Hoist Up/Down - Slow/Fast push buttons
- Cross Travelling Left/Right - Slow/Fast push buttons
- Long Travel Left/Right - Slow/Fast push buttons
- Emergency Stop mushroom head push button
- Floodlights On/Off

In all cases, the directional orientation of the control panel horizontal motion controls (i.e. upstream / downstream; left / right) in relation to the appropriate crane shall be indicated by colour coding on the front panel. Colour coding on the crane structure shall be by means of bolted on metal plates according to the following colour code:

- Upstream: Arctic Blue
- Downstream: Brilliant Green
- Left (looking in direction of flow): Golden Brown
- Right (looking in direction of flow): Signal Red

5.9 Fixed Control Panel (if specified)

The crane, gantry and crawl beam shall be operated by means of a weatherproof control panel by an operator standing insight of the lifting equipment. The control panel shall be in full view of the hoisted load at all times. Fixed hoists shall be operated from a control console mounted in an approved position adjacent to the hoist and on each floor serviced by the hoist.

Precise control of all functions is required to facilitate the accurate positioning of heavy components.

The complete control panel with all switches, indicators, etc., shall be weatherproof to IP 65 of SANS 1222.

Long and cross travel motions of the crane shall be arranged so that these motions may be driven simultaneously or separately without causing shock to or vibration of the crane rails. It shall be possible to longitudinal and cross travel or traverse while raising or lowering the main hoist.

The control panel shall be provided with a lock and keys.

Controls shall be interlocked to prevent dual activation of functions and each shall be clearly marked with its function. Labels that only rely on adhesive to stay in position shall not be acceptable. All motions shall be controlled by non-latching control buttons.

All motion control push buttons shall be of the two stage type. The initial depression of the button shall select the creep speed and full depression of the button shall select fast speed. Control features shall be included to prevent fast speed being selected without first having accelerated the equipment in the slow speed range.

Where applicable, the following minimum controls shall be provided:

- On/Off switch
- Main Hoist Up/Down - Slow/Fast push buttons
- Cross Travelling Left/Right - Slow/Fast push buttons
- Long Travel Left/Right - Slow/Fast push buttons
- Emergency Stop mushroom head push button
- Floodlights On/Off, if specified

In all cases, the directional orientation of the control panel horizontal motion controls (i.e. upstream / downstream; left / right) in relation to the appropriate crane shall be indicated by colour coding on the front panel. Colour coding on the crane structure shall be by means of bolted on metal plates according to the following colour code:

- Upstream: Arctic Blue
- Downstream: Brilliant Green
- Left (looking in direction of flow): Golden Brown
- Right (looking in direction of flow): Signal Red

5.10 Cabling

The cabling system on the crane shall be neatly routed and enclosed in non-corrodible ducts or cable trays with covers, securely fixed to the crane frame. Brackets, fasteners and cable tie-down straps shall also be of non-corrosive materials. Plastic type cable ties are not acceptable. All cables entering electric motors shall be protected in accordance with IP 65 of SANS 1222, supported and sealed by means of a metal cable gland. The armouring shall be clamped between substantial tapered sections which form an integral part of the gland.

5.11 Wiring Code Numbers

Code numbers shall be clearly marked on all electrical cables, cable cores, wiring and terminal blocks inside switchgear panels and field devices, to enable maintenance staff to trace faults easily. The wiring diagrams to be supplied with the Operating Manual (GIBB 002 - General Mechanical Specification) shall have the same code numbers marked on them and shall be strictly in accordance with the actual wiring on the crane.

A laminated A3 sized print of the wiring diagram shall be fixed inside the electrical distribution cabinet panel for easy reference.

5.12 Safety Devices

Safety clamps and positive locking devices, automatically operated and interlocked with the long travel motion, shall be provided on either side to secure the crane on the rails at any point. These devices shall also lock automatically when the power supply is switched off.

Each motor(s) of each motion shall be provided with an electro-magnetic brake. The brakes shall be arranged to operate after a time delay to ensure that the load is held by the drive motor before

the brakes are released. There shall be no slipping of loads when the drive motor is stopped or the electricity supply fails.

All lifting motions shall be equipped with slack rope and overload devices to cut out the hoist, preventing further rotation of the drums should the load jam for any reason while lowering or raising. These over-travel limit switches shall be of the double protection type with automatically self-resetting action. Creep speed only shall be available after operation of the over-travelling limit switches for long and cross travel motions, which will allow the crane to approach the end stops.

The isolator switch shall be a quick break change over type to isolate all crane conductors and it shall be possible to lock and switch in the isolated and earthed positions.

The crane structure and metal cases of all electrical equipment, including conduit and trunking shall be effectively earthed. The *Contractor* shall supply longitudinal conductors for the earthing equipment.

5.13 Lighting

At least two adjustable, waterproof 150W HPS floodlights shall be provided on the frame, which will enable safe operation at night. The supply of this circuit shall be from the available 230V within the crane control panel.

These shall be suitably positioned to illuminate the whole area underneath the crane and down the openings to be serviced by each specific crane. Shadows shall be eliminated.

Facilities shall be provided for the easy replacement of lamps.

5.14 Weather Protection and Safety Guards

The crane shall be weatherproof regardless of whether it is intended for outdoor use or not.

The crane electrical distribution boxes and limit switches shall be weatherproof to IP 65 of SANS 1222 and all moving machinery, including electric motors, shall be guarded to the satisfaction of the *Employer's Agent*. Guards, however, shall be easily removable for access and maintenance purposes.

Since the cranes will work in a humid atmosphere, all external electrical fittings forming part of the electrical distribution panels shall be protected in accordance with IP 65 of SANS 1222. Push buttons shall be covered with rubber hoods. Isolators, switches and instruments mounted on the panel and limit switches shall have the necessary 0-rings or rubber bushes for protection against a moist atmosphere. A space heater shall also be provided in the panel.

5.15 Lightning Surge Protection

All electronic and other equipment prone to lightning surge damage shall be protected in accordance with the guidelines detailed SANS 10142-1 – Wiring Code standard as well as described on the electrical tender drawings

Earth connection for lightning protection against all structures and equipment shall comply with SANS 10313.

All power and signal circuits shall be designed to separately cope with 65 kA, 5 kV, 1/50 microsecond pulses (0.5 joule), repeated 20 times per burst of pulses in a short period of time (of the order of 20 seconds).

6 Materials and Corrosion Protection

All equipment supplied under this Specification shall conform to GIBB 007 – Painting and Corrosion Protection.

The crane hoist unit shall be completely weatherproof under all weather conditions applicable to the Site and the steelwork designed and detailed so as to obviate the possibility of rain water entrapment prejudicing the life of the corrosion protection system employed.

See Specification for mechanical works as set out in GIBB 002 - General Mechanical Specification.

The highlighted (Orange) rows shall be the preferred material and coating used for the Works.

7 Tests

The cranes shall be completely assembled for functional tests and inspection at the Manufacturer's *Works*.

Full mechanical (including welding preparation and welding) and corrosion protection inspection of the items shall be carried out at the Manufacturer's works in the presence of an Inspector appointed by the *Employer's Agent*. Workmanship and dimensional correctness shall be checked prior to corrosion protection procedures.

Each crane shall be tested at the *Contractor*'s works at the specified working load plus a 25% overload.

Preference is given to the load test being carried out in the *Contractor*'s works by his staff and with the load he provides. If the *Contractor*, however, wishes to perform the load test at Site, then he shall be responsible for providing the test load (Working load + 25% overload) and arrange such tests to be witnessed by the *Employer's Agent*.

The Manufacturer shall provide, for each crane, a certificate of examination and test that shall be signed by the *Employer's Agent* or his representative who witnessed the test.

The electrical installation of the completely assembled and installed crane shall be tested at Site for compliance to SANS 10142.

The Contractor shall further carry out a load test as laid down in SANS 4310:2002 and as required by Regulation C46(2)(h) of the Machinery and Occupational Safety Act No. 6 of 1983 to the satisfaction of the Employers agent once the equipment has been installed. The costs of all tests and re-tests shall be borne by the Contractor.

The above requirements form part of this Contract and shall be provided as part of the rates by the *Contractor*.

8 Handling and Transport

Refer to General Mechanical Specification.

9 Installation and commissioning

The *Contractor* shall be responsible for the erection of all equipment supplied under this Section as well as for installation and adjustments to ensure proper functioning of the complete unit.

The *Contractor* shall allow a full day after erection is completed for pre-testing of each unit in the presence of the *Employer's Agent* or his representative. At least two weeks advance notice of this date is required to enable the *Employer's Agent* to finalise arrangements for attendance.

After comprehensive functional tests and general inspection of cranes and lifting devices, all outstanding defects, if any, shall be attended to by the *Contractor* within three weeks.

The *Contractor* shall advise the *Employer's Agent* as soon as all the outstanding defects are remedied to set a date for final Tests on Completion of the crane and to notify all the representatives (including the *Contractor*) to be on Site.

10 Measurement and Payment

10.1 Design, Manufacture, Supply and delivery to Site

Design, manufacture, supply and delivery to site lifting equipment as detailed below:

Unit : lump sum (Sum)
Or : Number off (No)

- Describe type of crane, [MOT, EOT, goliath ect.]
- Single / dual girder [specify]
- Estimated lifting capacity [xxx] (tonnes)
- Long-travel Length [xxx] (m)
- Cross-travel length [xxx] (m) if applicable
- Estimated Minimum Hook to Deck Clearance [xxx] (m)
- Estimated Maximum Hoist Travel length [xxx] (m)
- Maximum clearance height from top of corbel or support [xxx] (m)
- [Xxx] (No. off.) left Cantilever-travel length xxx (m), right Cantilever-travel length [xxx] (m) if applicable
- Control Type (Control Cabin, Pendant, Control Panel, Manual) [specify]
- Available Power Supply [specify yes/no]
- Including long travel rails and beams
- Long travel - [specify manual/electric] [if manual state “chain operated type geared bridge wheel system (chain operated from single side)” / If electric state “bridge wheel system”]
- Cross travel - [specify manual/electric] [if manual state “chain operated type geared trolley wheel system” / If electric state “trolley wheel system”]
- Chain block hoist mechanism - [specify manual/ electric] [if manual state “chain operated type geared pulley hoist system” / If electric state “hoist system”]
- Access ladder required [specify yes/no]
- If applicable, Hand chain Material [specify if other than stainless steel]
- [Specify material if other than stainless steel] Hoist Load [specify chain/wire rope]

The rates tendered shall include full compensation for:

a) the design of the complete installation including full design calculations; detailed working Drawings for all items; Specifications; schematic diagrams; electrical Drawings and wiring diagrams; layout Drawings; operating and maintenance instructions; programmes of work (manufacture and on-site) for the complete crane and hoisting structure including all long travel rails for wheels;

b) The manufacture and supply to site including supply of raw materials and bought-out items; fabrication/manufacture/assembly; quality assurance and quality control; inspection and testing (including attendance on inspection/tests witnessed by the *Employer’s Agent*); type and routine tests; application of finishes (paint or corrosion protection); any special tools required for general maintenance, all lubrication required for operation of the equipment, trial erection and dismantling; packing and transport to site and any other work as specified. Which shall include and not necessarily limited to

the entire lifting equipment and ancillary works, chain, hoist, sheave, hook, trolley, inclusive of electrical, control, power and mechanical requirements, complete with Walkway and guard rails (if specified), spot lighting, rail tracks, bolting and grouting. The rates tendered shall include full compensation for the delivery preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified.

c) If scheduled separately the Structural beams/ steel girders for crane rail placement are measured separately, if not they are deemed to be included in the tendered rates.

10.2 Installation of Equipment, commissioning and testing

Installation / Erection, testing, Commissioning preparation of O&M manuals of lifting equipment as listed above	Unit : lump sum (Sum) Or: Number off (No**)**

Measurement will be made on the basis of plant/equipment and/or associated items installed, the rates tendered shall include full compensation for:

a) For the installation including the provision of all labour, equipment, raw materials, lifting equipment (mobile crane, etc as required) and transport to and from site, scaffolding and temporary works necessary to install the complete works; on-site quality assurance and quality control, inspection and testing (including attendance at tests witnessed by the Employer's Agent); the installation and connection of all structural beams and crane rails to the permanent works which is including and not limited to concrete, steel with nuts, bolts, grouting etc., necessary for complete installation, the installation of all auxiliary equipment, electrical panels, cabling, etc., to complete a workable installation; supply of all consumables (electricity, fuel, oil and lubricants etc) necessary for the operation of the installation until taken over by the Employer's Agent; the putting into service of the complete installation; and any other work as specified.

b) for all Tests on Completion including labour, supervision, materials, instruments etc. necessary for the Tests on Completion, assuming responsibility for all operations necessary during testing, (including attendance on tests witnessed by the *Employer's Agent*), remedial work and any other work as specified.

Tests on Completion will be carried out under the following conditions of operation:

- Workshop load test
- Statutory Testing at Site under no-load conditions
- Statutory Testing at Site under full load conditions

c) For three full sets of Operating and Maintenance Manuals and record Drawings submitted to the *Employer's Agent* in accordance with the requirements of GIBB 002 - General Mechanical Specification. No separate payment will be made for Tender, manufacturing and site construction Drawings. The rates tendered shall include for full compensation of all costs incurred in preparing and submitting to the *Employer's Agent* of the specified Operating and Maintenance Manuals and record Drawings.

Payment for installation will be made on the following basis 80% on successful completion of the statutory testing upon completion of the installation and 20% upon submission of the operating and maintenance manuals and drawings of record. The rates tendered shall include for full compensation of all costs incurred in training of the *Employer's* staff in the use of all the lifting equipment supplied.

10.3 Spares

Spares….

Unit : lump sum (Sum)

Spares for lifting equipment as listed above
Description and or list of required spares to be provided

The rate tendered shall provide for the manufacture, supply and delivery to Site of the spares ordered and shall include permanent packing for long term storage. The spares shall be manufactured at the same time as the installed items.

HARRY GWALA DISTRICT MUNICIPALITY

CONTRACT NO: HGDM746/HGM/2021

CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM AND RISING MAIN: CIVIL, MECHANICAL AND ELECTRICAL

PARTICULAR SPECIFICATION

GIBB 011 – GENERAL ELECTRICAL

Table of Contents

Table of Revisions

Revision	Date	Change Detail	Editor
1.0	December 2020	Initial Release	A.Nel
1.1	July 2021	Edited incorrect references	M.Holmes

1 SCOPE AND GENERAL REQUIREMENTS

1.1 Scope

This specification contains clauses that are generally applicable to mechanical and electrical construction works forming part of civil engineers construction works.

1.2 Tenderer Responsibility

Unless otherwise specified, the Contractor shall allow for the supply, delivery, offloading, erection, installation, testing, commissioning, maintenance, Installation and Record drawings and Manuals for the electrical work described in the contract documents.

The specification and tender drawings generally show the character and extent of the proposed work in sufficient detail to enable the works to be competitively priced and implemented. It shall not be construed as showing every detail of the work to be executed.

Tenderers shall, therefore, make allowance for all fixings, fastenings, brackets and other items of equipment, material or labour obviously intended and necessary for the proper completion of the work. In this connection tenderers are requested to clarify any areas of doubt with the Employer's Agent prior to submitting tenders, as the decision of the Employer's Agent with regard to any ambiguity or dispute following the award of the contract, will be binding upon the successful Contractor.

1.3 Related Specifications

In the event of there being a discrepancy between any specification, including those specifications dealing with mechanical works, and/or the drawings and/or the Bills of Quantities, the discrepancy shall be drawn to the attention of, and resolved by, the Employer's Agent before the execution of any work associated with the discrepancy.

This General Electrical Specification, when read together relevant sections of the Project Specifications, indicates the minimum requirements. Where no specific requirement is indicated, it does not relieve the Contractor of any statutory or common law duty and the Contractor will still be required to comply with all relevant requirements and/or standards from any statutory body that is applicable to the plant and equipment being designed, supplied and installed.

2 INTERPRETATIONS

2.1 Definitions

For the purposes of this specification, the following abbreviations shall apply:

a.c.	Alternating current
d.c.	Direct current
ACB	Air circuit breaker
MCB	Mini circuit breaker
MCCB	Moulded Case Circuit Breaker
ELCB	Earth Leakage Circuit Breaker
RCCB	Residual Current Circuit Breaker
RCBO	Residual Current Circuit Breaker with Overcurrent
VCB	Vacuum Circuit breaker
Hz	Hertz

IP rating	A symbol which, followed by two characteristic numerals, signifies the degree of mechanical protection to ingress of foreign bodies and water as defined in BS 4999 : Part 20
kW	Kilowatt
RMS	Root mean square
V	Volt
A	Ampere (or Amp)
DSI	Dall short insert
NEMA	National Electrical Manufacturers Association
IEC	International Electrotechnical Commission

2.2 References

References made hereinafter to specifications of the Occupational Health and Safety Act (Act 85 of 1993), South African Bureau of Standards (SABS/SANS) or the British Standards Institute (BS) or the International Standards organisation (ISO) or the American Society of Mechanical Engineers (ASME) or the American Standard for Testing and Materials (ASTM) shall be deemed to include all revisions of and/or additions, supplements, modifications to such specifications ruling four weeks prior to the closing date of tenders, unless otherwise specified.

2.3 Compliance with Regulations

The latest editions and amendments of the following Standards and Codes shall be considered a minimum requirement, and the entire installation shall comply with these Standards and Codes of Practice unless otherwise specified elsewhere in this document or dictated by Government, Supply Authority or Local Authority By-Laws and Provisions:

- The Occupational Health and Safety Act 1993 (Act 85 of 1993)
- SANS 156 Moulded-case circuit-breakers
- SANS 164-1 to 7 Plug and socket-outlet systems for household and similar purposes for use in South Africa
- SANS 529 Heat-resisting wiring cables
- SANS 556-1 Low-voltage switchgear
- SANS 767-1 Earth leakage protection units
- SANS 780 Distribution transformers
- SANS 950 Plasticized polyvinyl chloride rigid conduit and fittings for use in electrical installations
- SANS 1063 Earth rods and couplers
- SANS 1085 Wall outlet boxes for the enclosure of electrical accessories
- SANS 1195 Busbars
- SANS 1213 Mechanical cable glands
- SANS 1239 Plugs, socket-outlets and couplers for industrial purposes
- SANS 1411-1 Materials of insulated electric cables and flexible cords – Part 1: Conductors
- SANS 1433 Electrical terminals and connectors
- SANS 1473-1 Low-voltage, switchgear and control gear assemblies – Part 1: Type-tested, partially type-tested and specially tested assemblies with a rated short-circuit withstand strength above 10 kA

- SANS 1507 Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3 300 V)
- SANS 1574 Electric cables – Flexible cords and flexible cables
- SANS 1765 Low-voltage switchgear and control gear assemblies (distribution boards) with a rated short-circuit withstand strength up to and including 10 kA
- SANS 1777 Photoelectric control units for lighting
- SANS 10114 Interior lighting
- SANS 10142 - Part 1 The wiring of premises; low voltage insulations
- SANS 10142 - Part 2 The wiring of premises; medium voltage installations above 1kV a.c. not exceeding 22kV a.c. and up to and including 3000 kW installed capacity
- SANS 10198 The selection, handling and installation of electric power cables of rating not exceeding 33 kV
- SANS 10199 The design and installation of earth electrodes
- SANS 10292 Earthing of low-voltage (LV) distribution system
- SANS 10313 The protection of structures against lightning
- SANS 10389 Exterior lighting
- SANS 10400 National Building Regulations
- SANS 10400-T (2011) Fire Protection
- SANS 10400-W (2011) Fire Installation
- SANS 60269/IEC 60269 Low-voltage fuses
- SANS 60309/IEC 60309 Plugs, socket-outlets and couplers for industrial purposes
- SANS 60439-4/IEC 60439-1 Low-voltage, switchgear and control gear assemblies – Part 1: Type-tested and partially type-tested assemblies
- SANS 60439-2/IEC 60439-2 Low-voltage switchgear and control gear assemblies – Part 2: Particular requirements for busbar trunking systems (busways)
- SANS 60439-4/IEC 60439-4 Low-voltage, switchgear and control gear assemblies – Part 4: Particular requirements for assemblies for construction sites (ACS)
- SANS 60439-5/IEC 60439-5 Low-voltage switchgear and control gear assemblies - Part 5: Particular requirements for assemblies intended to be installed outdoors in public places – Cable distribution cabinets (CDCs) for power distribution in networks
- SANS 60598-1/IEC 60598-1 Luminaires: General requirements and tests
- SANS 60529/IEC 60529 Degrees of protection provided by enclosures (IP Code)
- SANS 60570/IEC 60570 Electrical supply track systems for luminaires
- SANS 60598-2-18/IEC 60598-2-18 Luminaires – Part 2: Particular requirements - Section 18: Luminaires for swimming pools and similar applications
- SANS 60598-2-23/IEC 60598-2-23 Luminaires – Part 2-23: Particular requirements – Extra low voltage lighting systems for filament lamps
- SANS 60601/IEC 60601 Medical electrical equipment
- SANS 60669/IEC 60669 Switches for household and similar fixed-electrical installations
- SANS 60730-2 Part 7 Electronic controls
- SANS 60906/IEC 60906 IEC systems of plugs and socket-outlets for household and similar purposes
- SANS 60947/IEC 60947 Low-voltage switchgear and control gear
- SANS 60950/1/IEC 60950-1 Information technology equipment – Safety – Part 1: General requirements
- SANS 61000-4-5/IEC 61000-4-5 Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test
- SANS 61000-4-7/IEC 61000-4-7 Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and inter

harmonics measurements and instrumentation, for power supply systems and equipment connected thereto

- SANS 61008/IEC61008 Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)
- SANS 61024 The protection of structures against lightning
- SANS 61084/IEC 61084 Cable trunking and ducting systems for electrical installation
- SANS 61238-1/IEC 61238-1 Compression and mechanical connectors for power cables for rated voltages up to 30 kV (Um = 36 kV) – Part 1: Test methods and requirements
- SANS 61312/IEC 61312 Protection against lightning electromagnetic impulse
- SANS 61347-2-2/IEC 61347-2-2 Lamp control gear – Part 2-2: Particular requirements for d.c. or a.c. supplied electronic step-down convertors for filament lamps
- SANS 61386/IEC 61386 Conduit systems for electrical installations
- SANS 61558/IEC 61558 Safety of power transformers, power supply units and similar
- SANS 61643-1/IEC 61643-1Surge protective devices connected to low-voltage power distribution systems – Part 1: Performance requirements and testing methods
- SANS 62053-11/IEC 62053-11 Electricity metering equipment (a.c.) – Particular requirements – Part 11: Electromechanical meters for active energy (classes 0,5, 1 and 2)
- SANS 62053-21/IEC 62053-21 Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)
- SANS 62305 Parts 1 to parts 3: Protection against lightning-Physical damage to structures and life hazard.
- SANS 10086-1 The installation inspection and maintenance of equipment used in explosive atmospheres.
- SANS 10108: The classification of hazardous locations and selection of apparatus for use in such locations.
- SANS 10189-2 The Petroleum Industry-Electrical installations in the distribution and marketing sector.

National Standards and Codes of Practice take priority over foreign standards and codes, and where National Standards and Codes do not exist, the relevant BS and IEC Codes shall apply in that order of preference.

Notwithstanding anything to the contrary, in the event of any ambiguity or conflict between applicable standards, specifications and/or codes of practice which should arise, ***the most onerous condition will be deemed to apply.***

The Contractor shall issue all notices and pay all the required fees in respect of the installation to the authorities, and shall indemnify the Employer, Main Contractor and Employer's Agent from all losses, claims, costs or expenditure which may arise as a result of the Contractor's failure to comply with these requirements and the regulations or of any other relevant Authority.

It shall be assumed that the Contractor is conversant with the requirements outlined in the above should any requirements, by-laws or regulation, which contradicts the requirements of this Document, apply or become applicable during the course of the Works, such requirements, by-law or regulation shall overrule this Document and the Contractor shall immediately inform the Employer's Agent of such a contradiction. Under no circumstances shall the Contractor carry out any variations to the installation in terms of such contradictions without obtaining the written permission to do so from the Employer's Agent.

3 GENERAL

3.1 Standards and Quality of Work

As the SANS 10142-1 (Wiring Code) lays down strict requirements for complying with standards, a compulsory specification published in a government gazette, or otherwise approved in terms of the Wiring Code, no detailed list of Standards will be scheduled herein. However, portions of the Works falling outside the scope of the Wiring Code shall comply fully with the latest versions of the applicable standards and codes issued by the SANS or, in the absence of such standard, with an acceptable international standard. Any reference to a particular standard may be given for guidance/clarification only; this shall not relieve the Contractor from complying with all relevant standards in their entirety.

The complete Work shall be carried out by qualified, highly trained, skilled and competent operatives to the highest standard of workmanship. The minimum requirement is that a permanent on-site “Installation Electrician” whether working alone or leading the Contractor’s workforce, and who must be an ‘A’ Grade artisan as determined by the Department of Labour, is to be the appointed artisan who shall be responsible for the day to day installation work. Alternatively, the grade/s and/or qualifications of operatives will be specified in the Detailed Electrical Specifications.

An adequate number of workmen shall be employed at all times to ensure satisfactory progress of the Works in accordance with the overall pace of the project and/or in harmony with any Works programme set by the Architect, Main Contractor or Employer’s Agent, etc.

The Contractor shall liaise and cooperate with any other contractor(s) whose work is related to, close to or build into with the Works as detailed herein and shall coordinate the Work to avoid fouling, unsatisfactory setting out etc. Any failure by other contractors to collaborate with the Contractor herein shall be immediately reported in writing to the Employer’s Agent and Main Contractor.

The Work shall at all times and for the full duration of the Contract, be carried out under the management and supervision of a skilled and competent representative of the Contractor who will be authorised to receive and carry out instructions on behalf of the Contractor and to attend site meetings.

3.2 Selection of Equipment and Materials

All components shall be new and of the best available quality and of the class most suitable for the purpose and environment for which they are intended. The whole installation shall be extremely reliable and all parts shall be of such material as will ensure that they are capable of withstanding variations in temperature and humidity arising under working conditions without distortion or deterioration or setting up of undue strain on any part.

Any particular make or model of equipment referred to in the Documentation is for guidance purposes only in setting standards/types/performances required; equipment that is equal or superior in all respects, and to the approval of the Employer’s Agent, may be offered by Tenderers. No reference to any particular make of any equipment shall be construed as that equipment having been selected by the Employer’s Agent or Employer and the Contractor shall be fully responsible for the guarantee and performance of such equipment.

Only equipment and materials with a proven track record in similar applications will be considered. A minimum service period of 100 equipment -years is required.

Equipment and components of a similar class, such as wiring accessories, switch disconnector units etc, shall be of the same make, pattern, and where applicable, colour, throughout.

The Work shall comply with the requirements of the Documentation, but where it may become necessary to carry out the Work in a different manner; the Contractor shall first obtain the approval of the Employer's Agent in writing.

In cases where items offered by Tenderers are not in accordance with the contract Documentation, the deviation/s must be **fully detailed**, irrespective of whether a special form is included for this purpose or not, and such details shall accompany the tender submission in the form of a covering letter, or on the form provided. Merely stating 'as (manufacturer's name / item)', or submission of manufacturer's pamphlets etc. is not acceptable, will not be considered part of any offer and will be ignored. Where no details are submitted, in a covering letter, or on a form provided, the offer shall be deemed to comply fully with the Works Documentation and the successful Tenderer/Contractor shall be liable for performance strictly in accordance with all specifications and conditions.

3.3 Rejection of Inferior Work and Materials

All inferior work or work containing inferior material shall be rejected by the Employer's Agent whereupon the Contractor shall immediately remove and rectify the faulty work as necessary and bear all costs in connection therewith.

3.4 Drawings and Samples

The Contractor may be required to submit for approval, comment or records samples of materials, apparatus or components, and also drawings, schematic diagrams or technical details, including calculations, upon which their design and/or offer is based before any contract is awarded. Such details may also be called for during the course of the Contract prior to installation. Any approvals given or comments made shall be on the generality of the scheme and shall not relieve the Contractor of his responsibility to ensure full compliance with all performance and regulatory criteria.

NOTE: A request for submission of samples or drawings does not imply that the Tenderer's quotation will necessarily be accepted.

Drawings shall be clearly marked "WORKING DRAWINGS FOR APPROVAL", or as otherwise applicable. Samples shall be forwarded to and shall remain in the possession of the Employer's Agent until completion and taking over of the Works or, with the Employer's Agent's approval, the samples may be embodied within the installation.

All expenses in connection with the supply and return of the drawings and samples shall be borne by the Tenderer/Contractor.

3.5 Guarantee

All equipment supplied and all work performed shall be guaranteed against defective operation, poor design (where designed by the Contractor, or in components / assemblies with inherently poor design), and unacceptable / faulty workmanship, all as determined by the Employer's Agent, for a period of 12 months.

Any faults found during the guarantee period shall be timeously repaired or replaced by the Contractor, including peripheral damage/disturbance (e.g.: wall finishes etc damaged during the course of repairs), at his own expense, misuse and abuse by others and fair wear and tear exempted. Discharge type lamps shall be included in the 12 month guarantee period, however, incandescent lamps shall carry a 3 month guarantee.

The manufacturer's guarantee shall supersede the 365 day Defects Liability Period, and any claims initiated by the Contractor due to failure of equipment over the guarantee period are to be recovered from the manufacturer.

The Contractor is required to carry out any remedial work under the guarantee at times and in a manner which will cause the least disruption to the Employer's, or other occupant's, operations.

The Contractor shall ensure that he has access to sufficient spare components for all equipment readily available to forestall any delays in repairing the installation.

3.6 Operating and Maintenance Details

Three complete sets of technical manuals, complete with spares schedules, as-fitted layout drawings, schematic wiring diagrams and operating and general maintenance information, bound in hard-cover ring binders shall be prepared by the Contractor and delivered to the Employer's Agent at or before final handover. A full 'as-fitted' set of drawings shall also be submitted to the Employer's Agent for record purposes.

The motor control, electrical machinery installed, controls systems, main and individual distribution board (DB) single line diagrams shall be brought up to 'as-fitted' status and copies placed in the technical manual. A further copy of the main single line diagram shall be mounted in a glass-fronted frame and hung in a suitable position in the individual distribution board. Copies of the diagrams shall be folded (or reduced) to A4 size and placed in an A4 sized perspex fronted frame or document pocket in the applicable LV DB's. Such frames or pockets shall be fabricated from 1,2mm pre-galvanised steel and spot welded to the DB (usually to the inside of the DB door).

This documentation shall be submitted to the Employer's Agent for comment and approval prior to handing over to the Empoyer's Agent. It is therefore advisable to submit the details in draft format so that any amendments/corrections can be easily incorporated.

4 MINOR WORKS

4.1 Tubular Conduits And Fittings

4.1.1 *Types of Conduits*

a) Screwed Conduit

Heavy gauge screwed welded (HGSW) steel conduit and associated fittings shall be to SANS 1065-1 and shall be black enamelled or hot-dipped galvanised as specified. No conduit of less than 20mm diameter shall be used.

HGSW conduit shall be used for all general applications run either surface on walls, ceilings, on machinery etc, or else installed flush in walls, cast into concrete slabs etc.

b) Plain End Conduit

Plain end (non-screwed) steel conduit shall be to SANS 1065-1 with a minimum wall thickness of 0,9mm. Only hot-dipped galvanised conduit of 20mm diameter minimum size will be permitted.

Plain end conduit shall be used for all general applications, except heavy industrial environments or flameproof installations, run surface on walls and ceilings, or else installed flush in walls, cast into concrete slabs etc.

c) Non-Metallic Conduit

Plastic conduit shall be to SANS 950. No conduit smaller than 20mm diameter shall be used.

Plastic conduit shall be used for general applications, except any industrial or flameproof installation or any surface installation on walls, machinery etc. Non-metallic conduit shall be run surface only on ceilings or in ceiling voids, chased into walls, cast into concrete slabs etc.

d) Flexible Conduit

Flexible conduit shall be of the orange PVC covered spiral metal type, as Kopex, Adaptaflex or equal, with an internal diameter of at least 15mm. Flexible conduit connectors shall be of the gland or screw-in type manufactured from either brass or mild steel plated with zinc or cadmium.

Flexible conduit shall be used to form the final connection to equipment that has to be moved frequently to enable adjustments to be made, for the connection of motors or any other vibrating equipment, for the connection of thermostats and sensors on equipment, for stove and similar appliance connections etc.

4.1.2 *General Installation Details*

No manufactured bends less than 32mm diameter, or any inspection elbows or tees are to be used.

Open ends of conduits for future extensions and conduit and accessory boxes shall, during the building process, be temporarily plugged to prevent the ingress of moisture, rubble etc.

Where conduit crosses an expansion joint in a building or structure, the following method shall be used:

- An adaptable box shall be installed at a suitable position within 2m or the expansion joint and a draw box and a conduit sleeve one size larger than the circuit conduit shall be installed from the draw box to the edge of the expansion joint on the draw box side
- The circuit conduit shall pass across the joint and through the sleeve and project 30-35mm inside the box where the end shall be bushed
- For metallic conduits, an earth clip shall be secured to the circuit conduit end in the draw box and this shall be bonded to the box with a minimum 2,5mm² jumper
- In addition, for metallic conduits, an earth wire shall be installed between the fitting outlet boxes either side of the expansion joint
- Adjacent multiple runs of conduit which are to cross expansion joints should preferably be taken via one large adaptable box, across the expansion joint, into a second large adaptable/draw box.

All accessory boxes for switches and socket outlets etc shall be made of pressed galvanised steel and are to be provided with earth studs.

No portion of the conduit installation may be installed closer than 150mm to any other service, including gas, water etc. No wireway carrying mains voltage cables shall be installed closer than 150mm to any communications/data wireway or cable etc, except in the case of multi-service power skirting or similar.

'Unwired' conduits for other services shall be provided with rustless steel draw wires.

Where necessary, draw boxes shall be installed to facilitate the easy drawing-in of wiring and/or to avoid pulling wires through more than two right angled bends or the aggregate thereof. Adjacent multiple runs of conduit, which requires draw boxes should preferably be taken via one large draw-box. Where possible, draw boxes are to be installed at inconspicuous positions away from general view.

20% spare conduits, subject to a minimum of two, shall be installed from wall mounting distribution boards into the ceiling void for possible future additions. A coupling with a temporary plug shall be fitted to the ends of spare conduits.

4.1.2.1 Flush Con*duit Installations*

Where conduits are chased into brick walls or similar they shall be adequately secured with crampets or other approved devices driven into the wall fabric and shall further be secured at

strategic points by mortar. The clearance between the finished wall surface and the conduit shall be not less than 12mm. Only power tool chasing machines shall be used for making chases. (E.g.: angle grinders).

Accessory boxes shall be fixed square and mortared in. Concrete surfaces, columns and face brick surfaces shall not be chased without the written permission of the Employer's Agent in each case.

The building contractor will make good all normal chasing and cutting away except that the Contractor shall be held responsible for the cost of work done by the building contractor due to faulty setting out, redundant chases or late installation of conduits and accessories.

Conduits installed within concrete slabs, beams, columns or walls shall be firmly fixed in position before the concrete is cast. Adequate fixings and/or spacer blocks shall be employed to prevent conduits 'creeping' to the surface. Conduit must not be fixed longitudinally together with reinforcement rods.

The general disposition of conduits within the slabs shall be agreed upon before installation between the Employer's Agent, structural Employer's Agent and the Contractor. Furthermore, where such conduits occur in large concentrations, or where large diameter conduits (32mm dia. or larger) are installed, the Contractor shall obtain the approval of the Employer's Agent for the positioning of such conduits. Generally, however, conduits shall be installed in the middle or neutral axis of the slab thickness and extension boxes or extension rings shall be provided for as necessary.

Where conduit runs occur in groups or in large concentrations (e.g. near distribution boards, draw-boxes or in similar situations), they shall be fixed with a clearance between adjacent conduits of not less than one conduit diameter to permit adequate penetration of concrete.

Conduit may be installed in surface beds provided that the conduits are clear of contact with ground and are completely encased in mass concrete.

Conduits may only be installed directly into floor screeds where a cover of at least 40mm can be effected. For clearances of 20-40mm, "chicken wire" shall be used as a cover over the conduit to act as a screed binder. For clearance less than 20mm, the conduit may be chased into the slab, provided the written permission of the Employer's Agent is obtained in each case.

Conduit crossings in screed shall be avoided as far as possible. Where this is unavoidable, one conduit may be set under the other one and chased into the slab, provided the written permission of the Employer's Agent is obtained in each case.

Conduits shall be firmly fixed to slabs intended to receive screed by means of half saddles or similar.

Conduit boxes, draw-boxes etc. installed on shuttering decks or wall shutters shall be suitably sealed against the ingress of moisture and vibrated concrete with dampened paper rammed in them, and shall be securely fixed to the shuttering by means of lashing with galvanized steel wire (except in the case of off-shutter ceilings) or else by temporarily fixing the box to the shuttering by screws through the shuttering into the fixing lugs of the box. It is of the utmost importance that fixing screws or lashings be released immediately the concrete has been allowed to set and before the shuttering is struck.

Where fibreglass or other pre-formed plastic shuttering is used by the builder, equipment shall be fixed to the reinforcement steel only and the equipment/box shall be arranged to press firmly against the shuttering. No holes shall be made in the shuttering

The Contractor shall stand by when concrete is being poured in order to rectify any defects that may occur such as loose boxes or displaced upright conduits.

All conduit boxes and accessory boxes shall be finished flush with the finished plaster work and the Contractor shall co-operate with the building contractor to this end. Where necessary, extension plates or rings shall be fitted to meet this requirement.

4.1.3 *Surface Conduit Installations*

Galvanized conduit shall be used for all surface installations unless otherwise stipulated

Conduit run surface on walls, floors, ceilings, or in accessible ceiling voids, etc. shall be installed in a neat manner running generally with the building lines. The conduits shall be vertically plumb and horizontally level as applicable.

Bends in multiple runs of conduit shall have following bends. Other right angle bends shall be standard machine made. In all instances the installation shall present a neat and workmanlike appearance.

Evenly spaced spacer bar saddles shall effect fixing of tubing. Light gauge saddles may be used for general internal installation while heavy base saddles are to be used for external installations and industrial applications.

Unless otherwise specified, all surface mounted metallic conduits and accessories shall be painted after installation. Conduits shall be cleaned, degreased and de-rusted and finished with 2-coats of brush-applied enamel paint. Galvanised steel shall be bristle-scrubbed with solvent detergent complying with SANS 1344 and rinsed with clean water to achieve a water-break free surface prior to painting.

Colour Schemes shall be as per Section 9

Mechanical and electrical continuity shall be maintained throughout all steel conduit installations.

4.1.4 *HGSW conduit*

Only HGSW conduit shall be used for ;-

- Flameproof installations
- Load-bearing situations
- Suspension pendants
- Damp or exterior surface areas

HGSW conduit shall be cut square and clean before threading. Threads shall be made using suitable conduit thread dies and the liberal application of cutting grease or similar. The length of thread shall be such as to permit conduits to be firmly butted together in couplings and hard against the shoulders of threaded conduit box spouts. The ends of all cut lengths of conduit shall be reamered free from burrs and any loose swarf shall be removed from inside the conduit. Running joints in conduit shall be securely locked with a conduit lock nut.

Terminations into non-threaded equipment and accessories shall be mechanically secure and electrically continuous. Terminations may be threaded and locknutted on both sides of the termination point together with a brass female bush. Alternatively terminations shall be made with couplings and brass male bushes. All mating faces are to be thoroughly cleaned of paint, couplings being filed flat and free from unevenness at the mating face. All conduits shall be earth bonded at distribution boards using copper tape and wire.

Exposed threads of screwed conduit and damaged paint or galvanised surfaces shall be painted with red-lead or zinc rich paint to prevent rust.

Couplings and box entries of plain-ended conduit in cast-in situations shall be taped up with adhesive PVC tape to prevent the ingress of moisture or vibrated concrete.

All bends and sets shall be undertaken using bending apparatus suited for the purpose. Plain-end conduit bends shall be made with benders recommended by the conduit manufacturer.

Any damaged conduit resulting from incorrect bending methods shall be completely removed and replaced, including any wiring installed, all at the Contractor's expense.

Mechanical and electrical continuity shall be maintained throughout all steel conduit installations.

4.1.5 *Non-metallic Conduit*

Unless otherwise specified, only steel accessory boxes shall be used in conjunction with plastic conduit installations.

Hand bending, using a bending spring, may be used for conduits up to and including 25mm diameter. Above this size, the appropriate manufactured bend/accessory must be used.

Tubing is to be out square and clean using a fire-toothed hacksaw, and all burrs and loose material removed. The correct adhesive is to be used on clean and dry surfaces with all excess adhesive being wiped off after fitting together.

Plastic conduit and accessories are not to be used for mechanical load-bearing, luminaires support etc. nor are they to be used where they could be subject to temperatures below -10°C or above 70°C.

4.1.6 *Flexible Conduit*

In installations where the equipment has to be moved frequently to enable adjustment during normal operation, for the connection of motors or any other vibrating equipment, for the connection of thermostats and sensors on equipment, for stove connections and where otherwise required by the Employer's Agent, flexible conduit shall be used for the final connection to the equipment.

Flexible conduit shall preferably be connected to the final connection point from a local draw-box. The flexible conduit may be connected directly to the end of a conduit if an existing draw-box is available within 2m of the junction and if the flexible conduit can easily be rewired.

Flexible conduit shall be metal-reinforced plastic conduit (Kopex, Adaptaflex or equal) orange PVC-covered spiral metal conduit with an internal diameter of at least 15mm, unless approved to the contrary.

Connectors for coupling to the flexible conduit shall be of the gland or screw-in type, manufactured of either brass or mild steel plated with either zinc or cadmium.

4.1.7 *Installation Of Conduit*

All conduits shall be installed in accordance with SANS 10142-1.

All conduits shall be built in brickwork or concrete whilst the building operations are in progress or chased in the masonry thereafter, unless otherwise specified. Horizontal chasing of load bearing brickwork will not be permitted. Chasing of structural concrete work will also not be permitted.

The conduit shall be looped from point to point and draw in boxes shall not be used other than in surface installations or in accessible roof spaces.

In surface installations and roof spaces, the conduits shall be grouped together and kept a saddle distance apart, fixed to the supporting structure at regular intervals not exceeding 1,5 m. The conduits shall be installed in straight lines, with easy set bends at changes of direction. Inspection tees and elbows shall not be used. For inspection purposes, circular through or 90□ boxes shall be used. Conduits shall not be installed in any ground floor slab, unless prior approval is obtained from the Employer's Agent.

Bending and setting of screwed and plain end metal conduit must be done with special benders and apparatus manufactured for this purpose and obtained from the suppliers of the conduit system.

The metal conduit installation shall be mechanically & electrically continuous. During construction, precautions shall be taken against the ingress of dirt and moisture in the system and open ends must be plugged. Where conduit enters boards, trays and equipment, it shall be cleaned free of burrs and sharp edges and for a screwed conduit system, fitted with locknuts on the outside and female bushes inside.

Plain end metal conduit joints and terminations shall be glued and made watertight.

Conduit installed in concrete shall be laid above the reinforcing and securely tied to the bars. Deep circular galvanised iron boxes pre-painted with red oxide paint shall be used for outlets. The position of all conduit outlet boxes shall be verified on site with the latest architectural detail drawing.

Conduit runs crossing expansion joints shall have an approved outlet box installed on one side of the joint and be sleeved through it, entering the box freely and without being secured thereto. A properly secured earth connection shall ensure the system continuity.

All possible precautions shall be taken to ensure the electrical and mechanical continuity of the conduit installation. It is a requirement of this specification that the maximum acceptable earth path resistance of any point of the conduit installation to earth must not exceed 2,0 ohms.

Flexible tubing, where approved, shall be of the corrugated PVC type or reinforced plastic hose with jubilee clips and internal earth wire, as it may be directed by the Employer's Agent.

PVC (PLASTIC) CONDUIT OR PVC OUTLET BOXES SHALL NOT BE EMPLOYED TO CARRY THE WEIGHT OF SUSPENDED LIGHT FITTINGS OR APPLIANCES - REFER CLAUSE 7 PARAGRAPH 3.

4.2 Trunking Wireways

This section describes the following types of wiring trunking:

- Standard wiring trunking
- Lighting channel
- Power skirting, dado and bench-top trunking
- Underfloor trunking

4.2.1 *Wiring Trunking*

Wiring trunking and accessories shall be fabricated from folded or cold-rolled sheet steel. The trunking manufacturer shall supply all bends, tees, stop-ends etc. No accessory shall be made up where a manufactured accessory is available.

Any made up accessories shall be neatly fabricated and shall be brazed or strongly pop-rivetted at joining edges.

Accessories and sections of trunking shall be coupled with coupling pieces and earth bonded together with copper bonding links. In addition, the links shall be bonded to the trunking main earth or largest circuit earth wire with a jumper of at least 2,5mm².

The maximum number of circuit and earth wires that may be installed into any trunking shall be such that the total overall cross-sectional area of the wiring including the insulation does not exceed 45% of the free area of the trunking.

With the exception of underfloor trunking and loosely filled "opening-up" trunking, wiring retainers shall be installed every metre of run and at other positions as required.

The trunking shall be installed in a neat and workmanlike manner on ceilings, walls, plant machinery etc., as indicated in the drawings.

All standard trunking used in industrial applications shall be finished in the colour code appropriate to the service.

Where channel passes through a “fire-wall” the channel lid shall be cut 100mm either side of the penetration and the wall entry around the channel shall be sealed by the building contractor. The Contractor shall supply and install suitable fire-barriers inside the channel. These shall consist of intumescent or other approved fire resistant material, as supplied by PH Protection Plaster Systems (Pty) Ltd of Johannesburg, Pyro-Cote cc of Durban, or equal and approved and installed in accordance with the supplier’s recommendations.

4.2.2 *Lighting Channel*

4.2.2.1 General:

Lighting channel and accessories shall be “Cabstrut” or equal and approved, and shall be manufactured from cold-rolled steel sheet and galvanized. For industrial installations and elsewhere as specified the channel shall be epoxy coated and coloured as per Section 9

Unless otherwise required the dimensions of the channel shall be 41,3mm x 41,3mm.

Lighting fittings or pendant drop conduits shall be fixed directly to “opening-down” channel using special connecting nipples as supplied by the channel manufacturer. Alternatively, fittings may be fixed to the solid underside of channel installed “opening-up” using bushed entries and screws, nuts and washers. Self-tapping screws shall not be used.

Conduit connections to wiring channels shall be terminated directly into the channel using a screwed and bushed entry. Alternatively, where channels are fixed surface directly to a soffit, entry may be effected from a flush conduit box through a bushed hole in the back of the channel.

4.2.2.2 Surface Installations:

Self-supporting lighting channel shall be manufactured from cold-rolled steel of thickness at least 2,5mm, and shall be fixed in such a manner that the maximum deflection recommended by the channel manufacturer is not exceeded with all wiring and fittings installed.

Fixings shall be by stirrups supported from structural members via threaded steel rod of at least 10mm diameter, or 20mm diameter conduit. Alternative or additional supports shall be effected by girder clamps etc. Cartridge pin fixings shall not be permitted without the prior written approval of the Employer’s Agent.

Where required, channel installed directly to a soffit shall be fixed at intervals not exceeding 1m subject to a minimum of two substantial fixings to every accessory.

Clip-in lidding of plastic or of zinc-coated metal, as specified, shall be installed over all faces of the channel left open after the installation of fittings etc.

4.2.2.3 Flush Installation

Lighting channel installed flush, either in or forming an integral part of a suspended ceiling, shall be manufactured from minimum cold-rolled or folded sheet steel of thickness not less than 1,6mm.

Where the channel is cast into concrete, fastening straps shall be provided every 600mm as supplied by the manufacturer of the channel. The channel shall be firmly fixed to the shuttering by galvanized steel wire lashing or by screws fixed through the concrete insert lugs. The channel shall be suitably sealed against the ingress of vibrated concrete by the use of dampened paper or expanded polystyrene inserts.

Where the ceiling finish is “off-shutter”, narrow clip-in plastic or metal lid shall be used. This shall be grey for non-painted ceilings and white for painted ceilings. Wire lashings may not be used for fixing channels to shuttering in “off-shutter” areas.

Where plaster finish is to be applied, the plaster shall be taken up to the edges of the channel. Overlapping metal lidding finished white shall be used, fixed over the opening by means of special extension screws into fixing nuts installed in the channel.

For suspended-ceiling lighting channels, the channels will be supplied and installed by the ceiling erector, unless otherwise specified

White plastic clip-in lidding shall be used for all suspended-ceiling lighting channel. The Contractor shall supply and fit the lidding unless otherwise specified.

In the case of mullion partitioning the mullion may be utilized as a wiring channel where specified. For other types of partitioning, conduit switch-drops shall be used. Any entry into the lighting channel shall be suitably bushed to obviate abrasion of wiring.

4.2.2.4 Power Skirting and Dado Height Trunking

4.2.2.5 General

Power skirting and dado height trunking shall, unless otherwise specified, be formed from folded and welded pre-galvanized sheet steel of thickness not less than 1,2mm, to form two or three equal compartments designed for power services, socket outlets etc., (upper compartment) and communications/data services (lower compartment(s)). The power skirting shall be finished in baked enamel of colour(s) as stated in Section 9 The paintwork shall be in accordance with the specifications with due account being taken of the pre-galvanizing. The trunking shall be 150-225mm high x 50-55mm deep with fixed partitions to divide it into two or three compartments. The compartments shall each be provided with separate removable covers.

Where a building module is applicable, the power compartment shall have provision for 16 A switched socket outlets at the module interval, or where the module interval exceeds 2m, twice every module interval. Socket outlet positions shall be centred between the window mullion or column modules. At the mullion or column position, a permanently fixed 250mm wide cover shall be provided across all compartments to permit the erection of partitions etc., without interfering with accessibility into the power skirting.

Socket outlets shall be 16 A 3-pin and shall be attached to a fixing grid or mounting bracket in the trunking body. The cover shall be pre-punched to accept the socket outlet and shall be fixed both to the trunking body and socket outlet fixing grid. Wiring terminals shall be of the recessed type, or alternatively fitted with an insulated cover, to prevent accidental contact with bare earth wiring that may be installed or disturbed while adjacent circuits are alive.

Where the trunking is a non-modular type, the punched socket outlet cover shall normally be 250mm long. Where it is of the modular type, the power section cover between the over-lapping covers shall be in one piece. Irrespective of whether socket outlets are indicated or not, full facilities including blanked off pre-punched covers shall be provided at the spacings specified herein.

Unless otherwise required, provisions for telephone and data outlets shall comprise a blank plate, or plates, mounted in line with socket outlets.

4.2.2.6 Installation

Power skirting shall, unless otherwise required, be installed surface against the wall at finished floor level. Where vinyl tiles or other fixed finish is to be laid, the power skirting shall be laid on top of the tiles. Where carpeting is specified, the power skirting shall be installed onto the screed before the installation of carpets.

Dado trunking shall be installed surface on the wall at 900mm above finished floor level (to underside), or as otherwise specified.

Fixings, suitable for the particular application, shall be provided at intervals not exceeding 1m. subject to a minimum of two substantial fixings to each accessory or section of trunking.

Conduit entry into power skirting installed along brick or concrete walling shall be effected via a bushed entry from a conduit box or standard 100mm x 50mm switch box mounted in the wall behind the respective compartment.

Conduit entry into power skirting installed along sheet metal curtain walling or similar shall be effected via a bushed entry from a conduit box, or similar, mounted in the floor under the power skirting. Wiring to the upper compartment(s) shall pass through a short conduit link within the lower communication(s) compartment(s). The conduit links shall be installed towards the back of the lower compartment(s) to afford adequate space for wiring to pass.

The trunking main earth wire immediately adjacent to the socket outlet positions including the socket outlet earth jumper, shall be suitably sleeved at the tee-off to prevent accidental contact with live terminals.

All covers shall be adequately bonded to earth either through the fixing screws or a separate earth wire jumper fixed to an earthing stud brazed, at the manufacturers' works, to the lid. Where necessary, power skirting covers shall be specially ordered to include earthing studs.

4.2.2.7 Bench-Top Trunking

Where called for, bench-top socket outlet trunking shall be installed along bench tops etc. in workshops and laboratories. The general construction, socket outlet mounting and installation procedure shall be similar to power skirting or dado trunking. Details of compartments, sizes etc, shall be as detailed in the drawings or specified in the Detailed Electrical Specifications.

4.2.3 *Underfloor Trunking*

4.2.3.1 General

Several types of underfloor trunking are available and in the main, the choice depends upon certain structural restraints as floor type, screed thickness etc. Therefore the exact type to be used will be specified in the Detailed Electrical Specifications or drawings.

Unless otherwise specified, the trunking shall be manufactured from pre-galvanized folded sheet steel and shall be single, double or triple compartment as specified.

Pre-formed outlets, suitably blanked off, shall be provided at intervals to suit the particular application.

Flush floor level junction boxes shall have a removable trafficable cover and shall be designed to accept a portion of the floor tile, carpet or similar. The Contractor must liaise with the Main Contractor to determine the thickness of the floor finish.

Multi-channel junction boxes shall be so designed that the compartmentalisation is continued through these accessories.

Socket outlets, telephone outlets and data outlets shall be provided where required in surface floor level pedestals or recessed floor boxes as specified. Suitable barriers shall be included to segregate different classes of services.

4.2.3.2 Installation

Trunking designed to be fully built into the screed shall be fixed to the slab surface by suitable straps or clips. A topping of at least 50mm of screed cover the trunking shall be applied. Where a cover of less than 50mm, but exceeding 25mm occurs, expanded metal shall be applied over the trunking to act as a screed binder. Where less than 25mm of screed topping

occurs, the trunking shall be installed into the concrete slab to achieve at least the minimum cover. The written permission of the Employer's Agent shall be obtained in each case.

Trunking designed to be set flush with the screed surface shall be installed straight and level on mortar bedding on the slab. The trunking shall be slightly dove-tailed in section or shall have other suitable means to ensure that the trunking will remain firmly fixed into the screed.

The Contractor shall obtain the screed finish datum line from the building contractor for levelling trunking and junction boxes.

4.3 General Wiring and Cabling Method

The wiring shall be looped from outlet box to outlet box or draw box. THERE SHALL BE NO JOINTS IN WIRING.

Wiring shall not be installed in conduit until the entire circuit has been completed and swabbed dry and clean or until the building is in an advanced stage, so as to avoid the likelihood of dirt and moisture entering the conduit.

Only one single or three phase circuit shall be run in any conduit provided that control wiring associated with the circuit and interlocked with the circuit isolator, may be construed as forming part of the same circuit.

More than one circuit may be installed in trunking, trays or power skirting, provided that all conductors belonging to the same circuit, including neutral and earthing conductors, are neatly strapped or laced together and shall be so disposed as to afford easy removal. Adhesive insulating tape or similar shall not be used for binding of circuit wires.

Connections to bulkhead type, enclosed luminaires and other equipment subject to high operating temperatures (above 55°C), shall be executed with silicon rubber cables or other approved insulation.

Individual earth wires shall be installed with each of the following circuits :

a) Feeder circuits for distribution boards, where the boards are supplied by cables in conduit.
b) Light switch, socket outlet, stove, geyser, incinerator, waste disposal unit, transformer/ballast luminaire circuits and all metallic fittings.
c) With PVCAPVC cable and PILCA cable in trunking, unless ECC cable is specified or allowed for by the contractor.
d) To motors, solenoids and other electro mechanical plant operated by mains supply, unless ECC cable is specified or allowed for by the contractor.
e) With all circuits installed in non-metallic conduits and tubing.
f) As specified elsewhere.

As a minimum, earth wires shall be stranded copper conductors, not less than half the size of the circuit conductors, up to a maximum size of 70 mm^2.

Notwithstanding anything to the contrary the contractor shall, in terms of the relevant Wiring Code of Practice, ensure that the earth loop impedance of, and therefore final earth wire sizes for all circuits, are sufficient to ensure operation of the relevant overcurrent device, in the event of a solidly connected phase to earth fault.

Underground LV cables laid in the ground shall be installed in trenches excavated to a depth of 750 mm. Underground MV cable shall be excavated to a depth of 950mm. Clean sand bedding shall be provided under and over the cables for a depth 150mm for the protection of the cables from stone and sharp debris. Trenches shall be backfilled with clean, loose soil and well compacted in 150 mm layers. Cable covers shall not be provided unless specified elsewhere.

Where cables enter buildings or cross under roads or hardened pathways, UPVC sleeve pipes shall be provided by the Electrical Contractor, unless specified to the contrary. Cable sleeve pipes shall extend 1200mm on either side of the road and shall be sealed at both ends after installation, with end caps to prevent entry of rodents or soil. After installation of cables, sleeve pipe ends shall be sealed with an expanding, non ageing foam.

Cables installed on walls shall be protected to a height of 2000 mm by galvanised steel pipes securely saddled to the wall. Cables installed through floor slabs and connected to equipment resting on the floor shall be protected by galvanised steel pipes to a height of 250 mm above the finished floor level.

Secondary, extra low voltage, bell, television, telephone, intercom and visual call system wiring shall be installed each in a separate conduit system and where this wiring is carried in the same trough, tray or power skirting as mains power cables, it shall be shielded therefrom by earthed metal sleeves or baffle plates.

Scheduled cable lengths are for tendering purposes only. The contractor shall ascertain the actual lengths on site and variations from the scheduled lengths shall be adjusted at the Schedule of Variation Prices rates.

4.3.1 *Mounting Heights And Positions*

Subject to the provision of and any overriding information contained in the drawings, the mounting height and positions of the listed equipment shall be as follows:

DESCRIPTION	**COMMERCIAL & RESIDENTIAL (mm)**	**INDUSTRIAL (mm)**	**locations meant for persons in wheelchairs (mm)**
Surface and flush mounting light switches	1400	1500	1100
Single Phase socket outlets	300	1500	300 or 1100
Single Phase socket outlets in kitchens, laundries, garages & plantrooms	1000 or 200 above work surfaces	-	-
Stove Isolator (outlets 300 AFL)	1400 or 200 above work surfaces	-	1100
Bell Pushes	1400	-	1100
Bell Indicators	2100	2500	-
Telephone Outlet Points	300	1500	300 or 1100
Wall Mounting Luminaries	2000	2500	-
Upper edge of Distribution Boards	2100	2100	-

The dimensions indicated above shall be measured to the lower edge of square and rectangular outlet boxes or to the centre line of round outlet boxes, from the finished floor level.

Where switches or outlets are located on walls near a change of wall finish, e.g. on tilted, face brick, or wood panelled dadoes, they shall be positioned so that the cover plates fall completely within one or other of the surfaces, but not on the junction line of the different finishes. The Contractor shall liaise with the relevant other trades to ensure that switches on surfaces present a neat appearance.

4.3.2 *Wiring Sizes*

Unless otherwise specified, the installation shall be wired with 600/1000 V Grade PVC insulated, annealed copper conductors of the following rating :

DESCRIPTION	CONDUCTOR AREA (mm^2)
Single and three phase circuits protected by 15 A hrc fuse or mcb	1,5
Single and three phase circuits protected by 20 A hrc fuse or mcb	2,5
Single and three phase circuits protected by 30 A hrc fuse or mcb	4
Single and three phase circuits protected by 40 A hrc fuse or mcb	6
Single and three phase circuits protected by 50 A hrc fuse or mcb	10
Single and three phase circuits protected by 60 A hrc fuse or mcb	16

Notwithstanding the above table, the contractor shall comply in every respect with the Codes and Standards for cables used in undefined conditions, high ambient temperatures and long loop lengths, and shall ensure that voltage drop for all circuits is in accordance with statutory requirements. The contractor shall also verify that the actual conduit route lengths and manner in which the system is wired, does not result in voltage drop exceeding the design basis or statutory requirements.

4.3.3 *LV Cable / Wiring Types*

The Contractor shall be responsible for all main, sub-main and final circuit tablework.

Only the following types of cables shall be used for LV work:

4.3.3.1 PVC Insulated, Armoured Copper Cables (PVC/SWA/PVC)

Polyvinylchloride insulated, armoured, copper cable shall be 600/1000V grade in accordance with SANS 1507, comprising PVC insulated stranded copper conductors with PVC bedding, galvanised steel wire armouring and PVC sheathing overall.

Mains voltage cables shall be at least 2,5mm² and no larger than 185mm² for ease of handling. Parallel cables of equal size shall be utilized where the current demand is greater than that rated for 185mm² cables.

Control cables shall be at least 1,5mm² unless otherwise specified.

4.3.3.2 PVC Insulated, Armoured Aluminium Cables (PVC/SWA/PVC) and PVCATAPVC Cable)

Polyvinylchloride insulated, armoured, aluminium cable shall be 600/1000V grade in accordance with SANS 1507 comprising PVC insulated solid aluminium conductors with PVC bedding, galvanised steel wire or aluminium tape armouring and PVC sheathing overall.

The cables shall be at least 16mm² and no larger than 120mm². Parallel cables shall be utilized where necessary.

Aluminium cables shall be used only when specifically specified.

4.3.3.3 PVC Insulated, Non-Armoured Cables (PVC/PVC)

Polyvinylchloride insulated non-armoured cable shall be 600/1000V grade in accordance with SANS 1507, comprising PVC insulated stranded copper conductors with PVC sheathing overall.

PVC/PVC mains cables shall only be used for trefoil configured applications.

For ease of handling the core size shall be limited to 240mm² except in special circumstances where space, routing etc. may allow for larger sizes.

Trefoil cables shall comprise 3 sets of three single core cables (R, Y & B), and one set of two cables for the neutral.

4.3.3.4 XLPE Insulated Cables

Where called for Cross-Linked Polyethylene (XLPE) insulated cables shall be used. These are similar to the specifications for the foregoing PVC insulated cables, except that the initial insulation shall be XLPE, thereafter PVC bedding and sheathing shall be used.

The Contractor must ensure early ordering of these cables as they are usually only made upon request and to a minimum quantity. For ease of identification, the Contractor shall insure that the manufacturer embosses the outer sheath: "XLPE insulated".

4.3.3.5 Flame Retardant and Halogen Reduced/Free Cables

Where called for in the Detailed Specification, low halogen (LH), halogen free (Non-halogenated, low smoke and fume, flame retardant - or "NHLSFR") or flame retardant (FR) PVC cables to SANS 1507 and BS6724 (latest issues) shall be used.

4.3.4 *LV Cable Terminations and Joints*

Cable glands shall be used for armoured multi-core cables and are to be of the electroplated brass or bronze compression type and shall be matched to the type of cable used and shall be suitable for waterproof, flameproof or general installations, as required. PVC or neoprene shrouds and plated earthing washers shall be used in all instances.

Termination of single core PVC/PVC cables in distribution boards, transformer cable boxes, etc. shall be undertaken by securely clamping the cables onto a fixed section of galvanised "Unistrut" type channel, or galvanised angle-iron, using nylon cable straps and then taking the individual cores through bushed holes in the non-ferrous gland plate, thence to the termination point. Alternatively, with the Employer's Agent's approval, a treated hardwood cleat arrangement may be employed.

The following shall apply for cable joints:

Because of the relatively short runs of cable utilized in industrial general lighting and power services, through-joints shall only be used in exceptional circumstances and only with written permission from the Employer's Agent.

Where a tee-off is required in indoor circuit cabling, this shall be effected using a suitable cable junction box, as Pratley, or equal and approved. Such junction boxes shall be of the weatherproof type, complete with integral compression glands and DIN rail-mounted terminals of appropriate rating.

Joints in power cables shall only be allowed

a) where the cable runs exceed a standard drum length, or,

b) with the express permission of the Employer's Agent in writing

The following shall apply for conductor lugs:

a) Lugs for the termination of conductors onto busbars and equipment are to be of the compression type and of the correct size and type for the application.

b) For cables of size up to 16mm², the locking type of handplier crimpers may be used. Above this size, the hydraulic type must be employed.

c) Where aluminium lugs, used for aluminium conductors, are bolted to a dissimilar metal (e.g. copper, tinned copper, etc.), suitable bonding compound shall be used to obviate the possibility of electrolytic action.

d) Shaped lugs shall be used in conjunction with shaped cable cores.

4.3.5 *MV Cable / Wiring Types*

The medium voltage (MV) cable procured shall be new and be manufactured in accordance with SANS 1339.

Further reference is made to the details and requirements for the MV cables in the Project Detailed Electrical Specifications.

4.3.6 *Wire Markers*

All wires in industrial installations, and where otherwise specified, are to be provided with closed-sleeve markers at each feeder termination point, including each leg of looped wires. The markers shall indicate the relevant distribution board and circuit number, e.g.: "DB-AP/P9" etc.

4.4 Installation of MV and LV Cables

4.4.1 *Surface (Direct)*

Where cables are run along horizontal or vertical building surfaces, structural steel members, in vertical ducts, etc., they shall be secured with approved means of fixing such as saddles, cleats, etc.

All cable runs shall be vertical or horizontal, or run parallel to building or structural members and shall at all times present a neat appearance.

4.4.2 *Cable Trays*

Where a sheet steel cable tray is required, this shall consist of approved galvanised sheet-metal perforated medium duty tray supported with approved substantial brackets or hangers at suitable intervals to reduce sag to a maximum of 10mm. Where necessary to achieve this, the run of cable tray shall be reinforced along its length with angle iron or similar stiffening members, or shall be of the heavy duty type.

When wire mesh trays are required, these shall be of heavy duty hot-dipped galvanised type, or stainless steel, left bright as required. Mesh trays shall be installed in a similar manner to perforated tray.

All cable tray accessories such as bends, tees, etc., shall be as supplied by the tray manufacturer and made-up components will not normally be allowed.

Trays shall be installed vertically or opening-up horizontally as specified. Brackets and hangers shall be constructed to permit the easy removal of any cable from the tray. Flat horizontal runs of tray suspended from slabs shall be installed at least 200mm clear of the soffit. Trays crossing under beams shall be spaced off the beam soffit to allow the removal of the largest cable(s) in the group.

Earth continuity shall be maintained throughout the complete run of cable tray.

4.4.3 *Cable Ladder-Rack*

Where ladder-rack is called for, this shall consist of 2,0mm thick galvanised steel with side sections of 75mm and cross-rungs every 350 – 400mm.

Only manufacturer's accessories shall be used for ladder-rack.

Ladder-rack shall be installed in the same manner as cable trays

Where specified, cable trays and racks shall be finished in an epoxy coating, with colour appropriate to the service as per Section 9, to SANS 1091. Epoxy coating damaged or removed during installation shall be made good.

4.4.4 *Cable Installation on Racks and Trays*

Racks and trays shall be sized to afford at least 20% spare space. Control cables may be installed touching, but not bunched. Power cables shall be laid-up spaced apart not less than the diameter of the largest adjacent cable, unless otherwise specified.

Cables shall be fixed to racks and trays using stainless steel cable strap and buckles fixed every 500mm, or fixing-rung intervals for edge-on rack / tray installations and at 1000mm or every second fixing-rung interval for cables laid flat and also where installed vertically.

Different classes of services (e.g. power and instrumentation) shall not be installed on the same rack or tray.

4.4.5 *Common Earthing for Racks and Trays*

Cables for final circuits installed on racks and trays shall, unless otherwise specified, be provided with an integral earth core or shall have a separate bare earth conductor per cable, or as indicated in the circuit diagram.

Multiple runs of heavy power feeder cables may share a common earth conductor comprising bare copper tape of at least 70mm² run along mesh type trays or ladder rack. (Perforated cable tray would normally carry light circuitry only and common earthing would not apply).

Earth tapes are to be fixed and bonded at regular intervals and the final earth connection shall comprise an appropriately sized bare copper earth-wire tail bonded to the common tape earth using a compression lug and high tensile bolt and nut arrangement.

4.4.6 *Underground Cable*

Before any excavations take place the Contractor is to mark out the proposed route and confirm with the Employer's Agent where possible services may exist. The Electrical Contractor shall forward a methodology to the Employer's Agent detailing how excavation works are to be carried out. Excavations shall be executed as per acceptable methodology. Should any unidentified services be encountered in that area, work should be stopped and the Employer's Agent notified immediately. The contractor shall be held responsible for any damage to the identified services.

Unless otherwise specified, the minimum cover over LV cables shall be 600 mm installed earth trenches.

Unless otherwise specified, the minimum cover over MV cables shall be 800 mm installed earth trenches.

Multiple runs of cables shall be laid 150mm apart throughout the run.

Cables shall be drawn along the trench using rollers, corner rollers, snatch blocks and skid plates as necessary.

Unless stated to the contrary, the Contractor shall carry out all excavations of cable trenching, including bedding, topping, backfilling and compaction, generally in accordance with SANS 1200 LC and SANS 1200 DA. Differing soil-type classifications shall be as specified in the bills of quantities, or Electrical Detailed Specification.

The Contractor shall allow for all necessary removal of vegetation, roots and tree branches, hazard protection, drainage, including pumping, watching, lighting, barriers, disposal of spoil

and vegetation, supply of fill, levelling of subsidence and 10mm thick temporary steel plates to allow vehicles of 3 tonnes maximum axle load and pedestrians to pass over excavations where these cross roads, driveways etc.

Where applicable, the Contractor shall comply fully with Traffic Ordinances, the Mines and Works Act 1956 (Act 27 of 1956) and all other requirements at or near public roads, bridges, buildings and other structures.

No excavations shall be backfilled until the Employer's Agent has the opportunity to inspect cables and has given permission to backfill.

The floor of the trench shall be free of stones and sharp projections. A 75mm layer of 6mm fines sifted soil or no-sharps sand shall be applied (bedding), onto which the cables shall be laid.

The trench shall be back-filled with clean builder's sand to provide 150 mm of cover as soon as possible after the cable has been laid and compacted to 93 % AASHO compaction.

Dampened soil free from fibrous matter, rocks and large stones shall be backfilled on top of the cable(s) (or cable sleeve(s)), as follows:

- Two 150mm hand-rammed layers to 93 % AASHO compaction
- Thereafter, well compacted power-rammed layers of not more than 150mm, to 93 % AASHO compaction.
- The backfill shall be raised by approximately 50mm above the normal surface level to allow for settlement. Such raised surfaces shall be periodically levelled, as necessary, and finally levelled not less than 90 days after backfilling. Grassed surfaces shall be made good. Others will make good paved or concrete surfaces etc.

Cable trenches may be hand or machine excavated and shall be of such a width as to afford a minimum of 150mm clearance between the cable(s) and the trench walls. Excavation within 600mm of other services shall only be done by hand.

Unsuitable soil and filthy material encountered during the execution of the Works shall not be deposited on the surface of any road or footpath, but shall immediately be carted away to a dumping site.

The Contractor shall take all necessary steps to avoid the pollution of streams, drainage systems etc. by excavated soil and its dust.

Where required, concrete protective cable tiles shall be installed 300mm over the tops of cables. These shall cover the full width of the layer of cables within the trench. Concrete cable protective tiles shall be of the interlocking type approximately 900mm long by 150mm wide with a suitable inscription on the supper side such as "Danger Electric Cables" or similar. Where non-sleeved cables cross other services, they shall be taken at least 500mm under such service. Interlocking concrete cable tiles shall be laid 300mm above the cables and shall extend 900mm each side of the crossing point.

4.4.7 *Cable Markers and Tape*

Cable markers shall be provided for all underground cable routes. Such markers shall be provided at each point of entry to any building, at either side of any road to rail crossing, at any change of direction of the cable, at intervals not exceeding 30m along any straight runs and over cable joints. Cable markers shall be made of concrete and cast in the form of a truncated pyramid, approximately 250mm high, 100mm square at the top and 150mm square at the base. The markers shall be provided with brass plates complete with direction arrows and suitably inscribed.

Yellow 0,1mm thick cable marker plastic warning tape 450 mm in width of approved design with the skull and cross bones insignia together with the words "DANGER, GEVAAR, INGOZI"

printed in black at regular intervals, shall be laid at a depth of 300mm below the finished surface level and immediately above all cables and sleeve pipes. Should a roadway or paved area base layer exceed 300mm, the tape shall be laid immediately below the base.

4.4.7.1 Cable Sleeves

Cables sleeves shall be provided wherever required or indicated on drawings and also for all cables entering or leaving any building, crossing a road or other services. Such sleeves shall be supplied and installed by the Contractor unless otherwise required. In all cases the Contractor shall ensure that all sleeves are installed in good time, in correct positions, and in the proper manner.

Where no details are given, the sleeves shall be of generous size and made of substantial material, which may be galvanised steel, ceramic, pitch fibre, high impact uPVC, corrugated high-density polyethylene (HDPE), etc., capable of withstanding any stresses to which they may be submitted, e.g. road compacting. Care shall be taken to ensure the easy passage of cable through the sleeves by providing large radius bends where necessary.

The use of pipes containing asbestos is strictly forbidden.

The ends of all sleeves shall be sealed with non-hardening watertight compound after the installation of cables. All sleeves intended for future use shall likewise be sealed.

4.4.7.2 Earthworks by Others

Where trenches, sleeves etc. are provided by another contractor e.g., civils, the Contractor shall liaise and co-ordinate with such other party regarding general advices, sleeve positions, radii etc. Moreover, the Contractor shall stand by and ensure correct backfilling and the positioning of marker tape.

4.4.7.3 Cable Identification

A non-corrosive strap with the cable number, or circuit number, stamped or embossed upon it shall be provided at each end of the cable (and at joints, in cases where these are permitted).

4.4.7.4 Handling of MV and LV Cable Drums

Drums of cable shall be delivered to Site with seals intact and shall be off-loaded and stored in an approved manner. Any drums, which show signs of damage or mishandling, shall at the Employer's Agent's option, be replaced with fresh undamaged stocks. The Contractor shall bear all costs of replacing such unacceptable cables.

Cable drums shall be supported on an axle and support jacks when the cable is unreeled. The arrow on the drum flanges showing the direction of rotation shall be observed. Rolling of drums along the ground will not be permitted.

Empty cable drums shall be stored in a tidy and safe manner prior to their removal from the Work Site. The Contractor shall be responsible for the removal and disposal of all empty drums at intervals dictated by Work progress, or upon instruction by the Employer's Agent or the Main Contractor.

4.5 Lighting Switches

Switches shall be of 15-20 A rating and shall comply with the requirements of SANS 60669-2-1. No switch shall be used to control more than 2000 W of incandescent, or 1500 W of discharge and fluorescent lighting. All switch boxes shall be fitted with an earth stud.

4.5.1 *Types of Switches*

4.5.1.1 Flush Switches

Flush switches with pressed steel or plastic overlapping cover plates shall be mounted into pressed steel rust-proofed boxes installed flush in the building fabric. The switch boxes shall be installed square and shall be flush with the wall finish. Boxes chased into walls shall be fixed square and mortared in position prior to plaster or other finish being applied.

4.5.1.2 Surface Switches

Surface switches shall be of the metal-clad type. Protected dollies shall be used for all industrial applications. The switch plate and box shall have a suitable rust resistant enamel finish.

4.5.1.3 Architrave Switches

Architrave switches shall be used in partitioning mullions as required.

Unless otherwise specified, tapped holes for screws and outlet openings will be provided by others. The Contractor shall co-ordinate fully with the contractor providing the holes with regard to positions and switch screw templates. Fixing screws shall be provided by the Contractor.

Wiring to architrave switches may be run within the hollow mullion or other hollow metal structural members of the partitioning, but shall be run in conduit from the lighting outlet, terminating with a bush at the point when wiring enters the hollow mullion.

Where the wiring for lighting circuits is run in a ceiling channel which is situated directly over the hollow mullion or other wire carrying member, then the wiring to switches may be taken directly into the latter without the use of conduit or lead-in tubes. Under no circumstances shall the wire pass over sharp edges and suitable provisions shall be made to shield the wiring accordingly.

4.5.1.4 Watertight Switches

Watertight switches shall be used for all external applications and in potentially damp areas.

Watertight switches shall have cast alloy or UV stabilised high-impact plastic enclosures.

The minimum protection rating shall be IP55.

4.5.2 *Dimmers*

4.5.2.1 Standard Dimmers

Dimmer units suitable for controlling 220/230 V incandescent and fluorescent luminaires shall be of the integral controller/dimmer unit type suitable for mounting in a standard switchbox, or else in a suitable box supplied with the unit. The units shall be rated at 250 V and sized according to the load.

Dimmer units used in conjunction with 12 V dichroic luminaire transformers shall be of the induction type.

All dimmers shall be provided with a mains on-off switch and a dimmer control knob. Multi-lever switches may be utilized where there is a combination of dimmed and non-dimmed circuits fed from the same position.

The correct pre-heat transformers and lamps shall be used for all dimmable fluorescent luminaires, in accordance with the supplier's details. Alternatively units suitable for use with electronic fluorescent ballasts shall be used where electronic ballasts are employed.

Dimmers shall be noise-free and fully suppressed for radio and fluorescent ballast interference.

4.5.2.2 Remote Dimmers

Dimmers for loads larger than 1200 W are to be of the two-part type, i.e. with a local controller and a remote dimmer.

4.5.3 *Photo-electric Controls*

Where specified photocells shall be used to switch external lighting installations. Photo-electric switches shall be of the type comprising a photo-sensitive resistor, thermal actuator with an inherent operating delay to make it insensitive to short duration changes in light levels and a change-over switch mechanism, all housed within a tough, translucent, weather proof ultra violet stabilised cover. The operating level shall be factory preset to switch on at approximately 50 lux and off an approximately 100 lux. The response time after sudden changes in light level shall be not less than 15 seconds.

Integral protection against voltage surges shall be provided.

Photocells shall be positioned in such a way that they will not be affected by spill-light from the external lighting installation or by vehicle headlamps.

4.5.4 *Bell Pushes*

Bell pushes shall be 250 V rating, even where used for low voltage bell installations. In all other respects the requirements for lighting switches given shall apply to bell pushes. Bell pushes shall be mounted in separate boxes to switches or other components.

4.5.5 *Labelling*

All switches in industrial applications, and elsewhere as specified shall be provided with a Traffolyte label screwed to the wall, or other fixed member, immediately adjacent to the switch. The label designation shall indicate the distribution board and circuit and outlet number, e.g.: “DB-AB/L4.3”.

4.6 Socket Outlets and Plug Tops

4.6.1 *16 A Switched Socket Outlets (SSOs)*

Refer to the Detailed Electrical Specifications for specifics on the type of socket outlets required.

Outlets on circuits rated up to 20 A shall be of the normally switched type whilst outlets on 25-32 A circuits shall be provided with a class F0 SP MCB, or where especially detailed, a DP MCB. The ratings shall be 16A unless otherwise specified.

Both single and twin flush wall mounting SSOs shall be housed in 100 x 100 x 50mm accessory boxes. Surface single-outlet sockets shall be housed in 83 x 119 x 50mm galvanised steel boxes. SSOs for mounting in power skirting, bench-top trunking, hospital bed-head channels etc. shall be mounted on cradles suitable for such applications. Unless otherwise required, flush wall mounting outlets shall have pressed steel cover plates finished white or ivory. Surface outlets shall be of the industrial protected-dolly type with grey pressed steel cover plates.

Where SSOs complying with SANS 164-1 are to be used in exposed areas, they shall be housed in a York S15 weatherproof enclosure, or equal and approved.

4.6.2 *Non-Standard Socket Outlets*

4.6.2.1 Data/Electronic Equipment Outlets

Dedicated 16 Amp SSOs shall be similar in construction to normal SSOs but shall have flattened earth pins in the 10 o’clock or 12 o’clock position as specified. The earth socket shall be isolated from the chassis of the unit to allow for the connection of ‘clean’ earths.

Unless otherwise specified, the socket outlet plate shall be of a distinctive colour as per SANS 10142-1 Annexure R Alternatively the socket pin shrouds and switch dolly shall be of the

selected colour; the latter instances usually being applied to outlets in power skirting or hospital bed-head channel etc.

Where specially called for, dedicated SSOs are to be of the British Standard square pin, 13 Amp type. The earth socket shall be isolated from the chassis of the unit.

Wall mounting 13 Amp SSOs shall be suitable for mounting in a standard 100 x 100 x 50mm accessory box. Surface and power skirting mounted units shall generally be as detailed for 16A SSOs.

16 A dedicated plug tops, colour-matched to the respective plate or shrouds, and 13 A plug tops in ivory or white plastic, complete with 5 A cartridge fuses, at the rate of 60 % of all relevant outlets shall be provided and handed to the Employer's Agent at Works handover.

4.6.2.2 Luminaire Outlets

Where required luminaires shall be fed via a locally mounted 5A SP, N + E non-switched socket-outlet. In these instances, the luminaires shall be fitted with 3m of 3-core flex and a rubber-clad 5A plug-top.

4.6.2.3 230V Plug-Tops

When required to be supplied by the Contractor, 13 A plug-tops shall be white or ivory plastic. 16 A plug tops shall be white or ivory plastic for general office areas and rubber clad type for workshops, production areas, etc. or colour coded plastic for dedicated types

When wired, a small loop shall be made in the earth core of the flex within the plug top so that in the event of undue stress upon the equipment flex, the earth connection will tend to remain intact even if the feed wires are pulled loose.

4.6.3 *3-Phase Socket Outlets*

4.6.3.1 Existing Installations

400 V 3-Phase socket outlets for use in existing factories etc. shall generally match the units already installed, unless otherwise specified.

4.6.3.2 New Installations

Generally multi-phase sockets shall be BICC Marachel type DS 16/30A or 32/50A TP + N + E wall mounting decontactors, or equal and approved, or as otherwise specified.

Each de-contactor or similar shall be supplied with a plug unit which shall be handed to the Employer upon Works completion and handover. 16 A units shall be fed with cable not exceeding 6mm² and 32 A units with cable not exceeding 10mm².

4.6.4 *Labelling*

All switches in industrial applications, and elsewhere as specified shall be provided with a Traffolyte label screwed to the wall, or other fixed member, immediately adjacent to the switch. The label designation shall indicate the distribution board and circuit and outlet number, e.g.: "DB-AB/SSO4.3".

4.7 Miscellaneous Power Connections

4.7.1 *Geysers*

Domestic-type geysers will be supplied, installed and connected to water services by a qualified plummer. A qualified electrician shall undertake all electrical connections.
For wall mounted geysers, flush supply conduit shall terminate in a flush round box conveniently close to the electrical entry to the water heater. A surface type metal clad or polycarbonate encased 30 A DP switch disconnector shall be superimposed over the conduit box and the final connection shall be made using surface galvanised conduit, painted after installation.

Where geysers are installed in concealed positions such as roof voids, the final connection from the local switch disconnector may comprise PVC covered flexible steel conduit.

Unless otherwise indicated in the single line diagrams, wiring for geyser circuits not exceeding 4 kW single-phase shall be carried out with conductors and earthwire at least 2,5mm² each.

Connections to calorifiers and large type geysers shall be as specified.

4.7.2 *Kitchen Equipment*

4.7.2.1 Domestic Stoves

Domestic stoves will be supplied and placed in position by others.

The Contractor shall provide a suitable electrical supply and final connection. A feed shall be taken to a flush mounted 60 A DP switch-disconnector positioned 300mm to one side of the stove and at a height determined by work surface, kitchen cupboards etc. From the switch-disconnector, flush conduit shall be taken to a point 450mm above floor level, and centred to the rear of the stove, terminating in a round conduit box. The final connection shall be carried out using a superimposing spout-entry conduit box and PVC covered flexible conduit for permanently connected units and via a 'stove connector' socket for plug-in units.

4.7.2.2 General Kitchen Equipment

Canteen kitchen equipment such as stoves, fryers etc. shall be connected up by the Contractor.

Unless otherwise specified, equipment shall be fed via a local polycarbonate encased switch-disconnector mounted at 1400mm on the wall behind the appliance. The switch-disconnector shall be single-phase DP, or 3-phase 4-pole as required. The final connection shall be taken from the switch-disconnector using flush conduit offset out of the wall at 450mm above floor level. Water-tight PVC covered flexible steel conduit shall connect directly to the end of the wall conduit and shall then connect to the particular item of equipment.

Where no wall exists, a stainless steel pedestal and switch-disconnector arrangement shall be supplied, as detailed in the Work drawings.

4.7.2.3 Air Conditioning Units

Console, ceiling and wall-mounting air conditioners (ACs) will be supplied and installed by specialist subcontractors.

The Contractor will undertake electrical and control connections to the extent outlined in the drawings.

Unless otherwise specified, AC units shall be fed via a locally mounted 30 A DP switch-disconnector unit and the final connection shall comprise the 3-core flex supplied with the AC unit taken via a cord-outlet arrangement mounted on the switch-disconnector faceplate.

4.7.2.4 Fans

<u>General</u>

Where fans are required to be supplied by the Contractor, they shall be supplied complete with all necessary accessories as applicable, such as mounting brackets, diaphragm plates, wire guards where fan blades are liable to be touched by hand, weatherproof louvres where fans are mounted on an outside wall, etc.

Fans and all accessories supplied therewith, shall be bolted, screwed or secured to walls and other surfaces as required.

Holes in walls or windows will be provided by the building contractor to details to be supplied by the Contractor.

Connection to Lift Motor Room Fans

Where a lift motor room fan connection is required, the Contractor shall, in addition to the fan, also provide and install a "close-on-rise" 20 A rating thermostat, having room temperature range, which shall be mounted near the fan unless otherwise indicated.

The wiring to the fan shall be taken from a SP MCB on the distribution board through a clearly labelled local 15/20A switch disconnect and through the thermostat to the fan motor terminals.

Final connections to the fan shall be carried out in flexible conduit.

Connection to Small Extract Fans

Where a small extract fan, such as is used in domestic kitchens toilets, etc., is specified, and when no facilities exist on the fan for conduit entry, connections may be made to the fan terminals by means of 3-core plastic-covered or "cabtyre" flexible cord, taken from a cord-outlet 15/20A switch disconnector unit in close proximity to the fan.

4.8 Luminaires

Luminaires shall, unless otherwise specified, be supplied by the Contractor in accordance with the Detailed Electrical Specifications and / or luminaire schedule as applicable. All luminaires shall bear the SABS "S" safety mark and, where applicable, the SABS "A" approved performance mark also.

All luminaires shall be fitted with the appropriate lamps.

Unless otherwise specified, fluorescent lamps shall be "cool white", colour temperature 4300°K with a minimum colour rendering index (Ra) of 64.

Dichroic lamps shall be of the sealed type. Open reflectors will not be permitted.

Linear tubular fluorescent lamps shall have bi-pin end cap arrangements. The lamp holders shall be of the telescopic or spring-mounted type.

4.8.1 *Lenses*

Prismatic, opal and clear lenses shall be manufactured from UV stabilised high-impact acrylic material for general luminaires.

Where specified, luminaires, floodlights and lanterns shall be fitted with clear glass or clear tempered glass lenses as required.

All tungsten halogen fittings shall be complete with glass lenses

Streetlight and area lighting post-top lanterns shall be in accordance with the Detailed Electrical Specifications and/or drawings.

Lantern ballasts shall have tappings for 95% and 100% of the nominal voltage, unless otherwise specified.

For ease of maintenance, luminaires and lamps in the following classes shall be from one single manufacturer / supplier per class ;

- Fluorescent luminaires, general incandescent fittings and LED fittings.
- Indoor decorative / display luminaires (downlighters, decorative spotlights etc.)
- Outdoor lanterns, bollards and floodlights
- Industrial high-bay luminaires
- Pump station luminaires
- Control room luminaires
- Transformer room, Gensets room and switch room luminaires
- Area lighting
- Other specialised luminaires as specified (E.g.: specialized lighting etc.).

4.8.2 *Installation of Luminaires*

Where possible, all luminaire outlets shall terminate in standard round boxes to which the fitting shall be fixed in addition to other fixings that may be required. Where conduit is run in roof spaces, or where conduits are cast into screeds and not directly into the slab, back-entry conduit boxes are to be used which shall be so installed as to be flush with the finished ceiling.

4.8.2.1 Mounting

Fluorescent fittings shall be fixed to one conduit box in the centre with two further independent fixings either side, one sixth of the fitting length from each end of the fitting. Fittings of 300mm or wider shall be fixed with two pairs of fixings.

Where fluorescent fittings are fixed in continuous rows, wiring may be carried out from one outlet and then wired through the channels of the fittings. The entry from one channel to another shall be suitable bushed and the internal wiring shall be clipped to the insides of the channels.

Corrosion proof and explosion proof type fluorescent luminaires shall be fixed using external stirrups or brackets. The wiring entry must be made via the gland entry arrangement using suitable multicore wiring (e.g. “Cabtyre”, PVC/PVC etc.) routed from an adjacent conduit box or Pratley type box, as appropriate. Under no circumstances shall the body of the fitting be pierced for any reason whatsoever.

In surface installations to incandescent bulkhead type fittings, the conduit shall not enter the fitting directly but shall terminate in an adjacent conduit box; one outgoing way of the conduit box being terminated in the fitting. A fixed porcelain or plastic terminal block within the conduit box and heat resisting wire, (e.g. silicon insulated), shall form the final connection to the fitting. Alternatively, the whole circuit wiring shall be heat resistant.

Where luminaires are mounted onto conduit boxes in external or potentially damp situations, a suitable neoprene gasket seal or other approved means shall be used at the junction of the fitting and the conduit box.

The mounting positions of the luminaires shall be verified on Site with the Employer’s Agent before installation commences. Fittings will normally be mounted in an even or symmetrical pattern in relation to the particular area having due consideration for architectural features, beams, ceiling tiles, etc.

Where fluorescent/LED fittings are specified to be suspended on pendants the Contractor shall provide at least two pendants for each fitting, such pendants consisting of 20mm diameter conduit finished in white enamel for commercial and domestic installations and electrical standard light orange for industrial installations. The wiring to the fitting shall be taken through one of these pendants. The pendants shall be secured to the outlet box or fixing surface by means of dome lids. Where the length of the pendants exceeds 0,6m. Dome lids shall be of the swivel type. The dome lids shall be painted to match the pendants.

Luminaires shall not be mounted directly to ceiling boards and suitable wooden inserts are to be supplied and installed by the Contractor for this purpose. Alternatively, fixings may be made into brandering where convenient.

Heavy industrial high-bay luminaires, floodlights etc. shall be fixed to substantial steel brackets or “Cabstrut” type channel or as indicated in the drawings or Detailed Electrical Specifications.

Where specified, luminaires shall be fed via a 5 Amp socket outlet mounted close to the fitting. The Contractor is advised to procure luminaires with suitable 3-core flexible cords with rubber clad plug-tops attached, as necessary.

4.8.2.2 Mounting Facilities

Where no facilities exist for supporting fittings, the Contractor shall supply and install brackets, hangers, angle irons, wooden battens inside ceiling space or other means as approved by the Employer's Agent.

4.8.2.3 Fixings

Fixings direct to conduit boxes shall consist of cadmium plated or sheradised steel screws screwed into the conduit box fixing lugs. Extra independent fixings into concrete or brick shall consist of suitable fibre or plastic fixing plugs and steel or brass wood screws. Wooden fixing plugs shall not be used. Fixings for fittings over 10kg in mass shall be of the self-drill anchor or expanding bolt-type. Fixings into hollow blocks etc. shall consist of steel screws secured into the hollow cavity with a spring loaded toggle-nut or other approved cavity fixing device.

Cartridge pin fixings shall not be used unless the prior approval of the Employer's Agent is obtained in writing.

4.8.3 *Poles and Masts*

Street lighting and area-lighting poles and masts shall be supplied in accordance with the Detailed Electrical Specifications and/or drawings.

All poles, masts, outreach arms etc. shall comply fully with all relevant SANS Specifications and Codes of Practice and shall be manufactured as detailed from:

- Galvanised Steel
- Self-Coloured fibre-glass
- Aluminium,

Poles and masts shall be suitable for fixing to a concrete surface (this method being restricted to post-top lanterns of no more than 4m height), or burying the "root" in soil. Where buried, each pole must be provided with a suitable base-plate complete with drain hole. Baseplates shall be secured with a minimum of 2 off 20mm dia. hook bolts.

Spigots shall be provided to suit the specified lantern. Particular care shall be taken to establish the exact diameter and length of the spigot or spigots required such that the luminaire fits neatly up against the shoulder formed between the pole and the spigots. Care shall be taken to avoid damage to the spigots during transport, storage and erection.

Galvanised poles shall be provided with a "corrosion collar" which must extend at least 150mm below and above finished ground level. Unless otherwise stated, galvanised poles will not require painting.

After galvanising, poles shall be stacked and transported in such a way as to minimise mechanical damage to the zinc coating. In particular, poles shall not be stored in direct contact with the ground and if stacked on top of each other, wood spacers shall be used to prevent the formation of white rust. Poles shall be carefully handled at all times and shall not be dragged along the ground in such a way that the coating may be damaged.

Notwithstanding the foregoing, any small areas of the galvanised coating which have become damaged shall be repaired by shot blasting and zinc spraying to a nominal thickness of not less than 0,1mm. Care shall be taken to ensure that all loose flakes of coating around the area to be repaired are removed prior to zinc spraying. Any signs of substantial damage to the galvanised coating, as determined by the Employer's Agent, will result in the pole being rejected.

Poles and masts shall be provided with suitable cable entries and access openings with fixing chassis suitable for the connection of cables and the installation of MCBs. Access openings

shall be provided with a cover plate of the same material as the pole. Covers shall be provided with suitable gaskets and means of fixing to the approval of the Employer's Agent.

Unless otherwise specified no cable glands or gland plates are required for the termination of PVC/SWA/PVC cables. The cable shall be brought up to a convenient position adjacent to the lower section of the access opening. The outer PVC sheath shall be stripped back and the steel wire armouring pulled away from around the cables, twisted into compact tails and bonded together by means of an adequately sized line tap.

A separate earth conductor shall be taken from this line tap to the earth stud in the pole base compartment. Phase and neutral conductors shall be jointed using shrouded line taps and the cables neatly secured to the bottom of the fixing chassis by means of saddles.

Poles shall be planted in the positions indicated on the drawings. They shall be planted absolutely plumb with the outreach, where applicable, at right angles to the roadway edge. The root depth shall be as recommended by the manufacturer.

Should any pole position coincide with trees, building canopies, driveway entrances, overhead conductors or other obstacles, an alternative position is to be confirmed with the Employer's Agent before excavation of the pole hole.

Poles shall be carefully aligned with each other to form straight lines or smooth curves generally following the alignment of the associated roads. The planting depth shall be carefully controlled to ensure that all luminaires will be at the same height above the level of the roadway, parking area etc.

Care shall be taken when backfilling around the pole to ensure that compaction is even all around the pole and is to the requirements as specified in this document. Where poles are to be planted in fill material, on ramps, etc., one pocket of dry cement shall be mixed with the backfill material before commencing backfilling and compaction. Subject to the prior approval of the Employer's Agent, this technique shall also be applied wherever it is considered necessary to stabilise the pole due to unsuitable soils, etc. Where the Contractor feels that this situation exists, he must advise the Employer's Agent immediately and obtain a decision.

Where poles are to be anchored into rock, the base of the pole shall have a reinforced concrete block cast around it. The dimensions of this block shall be approximately 1,25m x 1,25m x 0,5m and the bottom face shall be reinforced by R10 bars at 250mm centres in both horizontal axes. A Y20 bar shall be grouted into the rock for a distance of 300mm. The grouted end shall be straight while the end located in the concrete shall be provided with a hook around the reinforcing bars. Alternatively, 20mm "Rawplug" or similar duplex studs may be used in place of grouted bars.

4.9 Distribution Boards

Distribution Boards (DBs) shall be of the type as detailed in the single line diagrams, the Detailed Electrical Specifications and, where applicable, the equipment schedules. Unless otherwise indicated, distribution boards shall be provided with prefitted space/s for a minimum 20% extra switchgear, subject to a minimum of one space for each class of circuit breaker, combination fuse switch (CFS), contactor etc, viz.: 3-pole, single pole etc, as the case may be.

Switchboards shall be either of wall mounting type with front access or free standing with front and/or rear access, as specified. The general power installation shall be in accordance with the Employer's Agents drawings.

The switchboard(s) shall be dustproof, vermin proof and adequately ventilated to prevent overheating of the equipment.

Drawings of the switchboard(s) shall be submitted to the Employer's Agent for approval prior to manufacture.

Surface mounted cartridge type fuses for instrument protection, as specified, shall be mounted on the busbars.

Current transformers (ratio and burden as specified) shall be of the pedestal type or as noted, and shall be securely mounted in the switchboard.

The completed switchboard(s) may be inspected by the Employer's Agent at the manufacturer's works prior to despatch. The Electrical Contractor shall inform the Employer's Agent timeously in writing when the switchboard(s) is ready for inspection.

4.9.1 *Construction*

The switchboard (s) shall be of robust construction consisting, in general, of a channel, box or angle iron frame covered with sheet steel panel(s). The panel(s) shall be reinforced to prevent distortion and to ensure rigidity.

The material used for construction of the switchboards, panels, modules and kiosks shall be 3cr12.

The electrical equipment shall be flush mounted on a chassis within the switchboard. The panel shall be suitably slotted or drilled to allow the operating handles of the switchgear to protrude.

Removable panels shall be provided for access to the wiring, busbars and equipment. The panels shall be held in position by chromium plated coin slot, square key or knurled captive thumb screws. Switchboards shall have lockable doors where specified.

Space for 20% spare ways, unless otherwise noted, shall be allowed on the switchboard for future equipment. Each spare outgoing way shall include sufficient space for future switchgear and associated instrumentation, similar to the equipped outgoing ways.

All drilling, cutting or any other metalworking operations shall be completed prior to any paint process being undertaken.

4.9.2 *SANS Compliance*

DBs shall comply fully with SANS 10142-1, SANS 1765 up to and equal to 10 kA and SANS 1473-1 above 10 kA.

4.9.3 *Enclosures*

Distribution boards for internal applications shall be constructed from folded pre-galvanised 1.6mm mild steel sheet suitably welded, bolted and braced to form a rigid construction and finished with an epoxy coating after fabrication. DBs for external applications shall be similar to internal DBs, but shall be fabricated from 1.6mm 3CR12, plus a suitable epoxy finish. Boards for special applications may be made from polished 1.6mm 316 stainless steel, fibreglass etc; these will be more fully described in the Detailed Electrical Specifications where applicable.

All equipment, except door mounted instruments, indicators and so forth, shall be mounted behind removable fascia plates with only the switchgear operating handles protruding.

Normally, free standing boards shall not exceed 2,2m in height with operating handles, push-buttons etc not exceeding 1,8m from the floor nor lower than 600mm above floor level (subject to any equipment part not being lower than 300mm from the floor).

Cabinet type boards used mostly for LV distribution shall be 'Form 1' degree of separation to IEC 439 while cubicle boards used mostly for Motor Control Centres (MCCs) shall be 'Form 4'.

The Contractor is to check all access routes for distribution boards. Where necessary, DBs are to be made in sections to allow access into their final position.

4.9.4 *Protection*

All boards shall be rendered moisture and vermin proof and shall be adequately ventilated. Unless otherwise specified, free standing and wall mounted DBs in a normal internal environment shall be protected to IP43. DBs in certain factories may have to have a higher degree of protection which will be stated in the Detailed Electrical Specifications or single line diagrams. The complete DB and its components shall be suitable for coastal conditions.

4.9.5 *Bus-Bars*

The bus-bars shall be of high conductivity 99,9% pure copper of adequate cross section for the current and short circuit rating, mounted on edge (**not flat**). Multiple/laminated bars shall be appropriately derated as necessary and shall be spaced by a distance equal to the bar thickness. Bars shall be supported on resin type insulators suitable for mechanical stresses due to prospective fault currents and otherwise so arranged and braced as to obviate distortion under short circuit conditions. The material used for bracing, shielding etc must be tested and approved by SABS and shall be completely non-hygroscopic and non-tracking.

Bus-bar current ratings for both phase and neutral shall be based on an internal temperature of 40°C with a maximum bar temperature rise of 60°C.

As a guide, the following current densities should not be exceeded for single bars:

- 100 Amps and below : 3,50A/mm²
- 101 - 300 Amps : 2,65A/mm²
- 301 - 1000 Amps : 1,85A/mm²
- 1001 Amps and above : 1,20A/mm²

In addition to the current rating, the bars shall be sized to accommodate the prospective fault rating and the cross sectional area of the bars shall be the greater of the calculated sizes. Sizing for fault levels shall be based on the following:

$a = 8,2 \times Isc \times \sqrt{t}$, where:
a = minimum cross section in mm²
Isc = prospective short circuit current in kA
t = maximum time in seconds to clear fault, subject to a minimum of 0,2s

An earth bus-bar shall be installed at a convenient position, usually near the bottom, along the entire length of DBs with an incomer size of 200 Amps or more, or they may be of shorter but adequate length for smaller DBs' Earth bars need not be supported on insulators. The cross sectional area of the earth bars shall be equal or greater than half the cross sectional area of the incomer feeder cable. Earth terminal strips with screw connections may be used for boards with a maximum incomer size of 100 Amps.

Teed-off neutral bars are to have the same cross sectional area as the sub-feeder phase bars and shall be mounted in a suitable position adjacent to the switchgear, which they serve. The outgoing connections must match the sequence of the switchgear to which they relate. Neutral terminal strips with screw connections may be used for boards with a maximum incomer/sub-feeder size of 100 Amps. These requirements shall also apply to smaller DBs where such neutral bars are also the main neutral bars.

A separate neutral bar shall be installed for circuits protected by adjacent single phase earth leakage breakers connected to the same phase.

4.9.6 *Gland Plates*

Bottom entry boards shall be provided with minimum 2mm galvanised steel gland plates installed across the full width of each DB section at a minimum height of 300mm above the level of the bottom of the DB. Sufficient clearance for the bending of cable cores shall be provided between the lowest terminals of any equipment.

Where single core cables are to be terminated, 10mm non-hygroscopic Delaron, or similar material shall be used for the gland plate. Alternatively, gland plates for single core cables shall be made from 4mm thick aluminium.

4.9.7 *Doors*

Where called for, doors shall be fabricated from the same material as the main enclosure and shall be provided with closed-cell silicon gaskets to obtain the level of protection required. The doors shall be provided with catches, square-key turnbuckles, lockable catches or cylinder locks and handles, as specified in the Detailed Electrical Specifications and/or drawings. All DB keys, where provided, shall be the same for all DBs on the particular project.

4.9.8 *Paintwork*

Pre-galvanised sheet metal shall be cold galvanised at all exposed edges and welded surfaces, degreased, bonderised, etch-primed and then finished with baked epoxy enamel or powder coatings per SANS 51274, as applicable and to paint manufacturer's recommendations to achieve a dry film thickness (DFT) of 70 microns.

3CR12 panels shall be pickled, passivated and etch-primed before being finished, similarly to pre-galvanised sheet steel boards, with baked epoxy enamel or powder coatings to achieve a DFT of 70 microns.

Colour finishes shall be as Per Section 9 with a minimum of 1 litre of touch-up paint for each colour shall be provided.

4.10 Lightning Protection and Earthing

The earthing system shall be as required by the Supply Authority who may require additional earthing to that specified to meet their particular requirements.

In instances where soil resistivity surveys have been carried out to determine the design of the earth electrode system/s, the Contractor shall submit their price in accordance with the Contract Documentation, including the bills of quantities where applicable.

Where no resistivity survey has been conducted prior to calling for tenders, prices shall be based upon a provisional design and, where applicable, a provisional bill of quantities. The final design will be based upon a subsequent soil resistivity survey.

All earthing and lightning protection surveys, installations and testing must be carried out by a recognised specialist. Unless the Contractor is also the earthing specialist the Contractor must submit full details of their proposed specialist sub-contractor.

This section does not include switchyard earthing.

The contractor shall ensure that contact of dissimilar metals is avoided throughout and that the Employer's Agent is kept informed of the methods being employed, which methods shall comply to SANS wherever applicable.

4.10.1 *Earthing*

4.10.1.1 Earth Resistance Testing

Soil resistivity tests shall be carried out at the proposed location of the electrode/s and following ground levelling by the civil/building contractor, where applicable.

The Contractor must give at least 5 working days' notice of impending tests to the Employer's Agent to allow him to attend and witness them at his option.

The tests must be carried out in accordance with SANS 10199 using a recognised method (e.g.: Wenner method) with a four terminal null balance 'megger' tester. A meter calibration certificate proving calibration within the last six months undertaken by a recognised testing authority must

be submitted to the Employer's Agent prior to carrying out earth readings. If there is any reason to suspect the accuracy of any instrument, the Employer's Agent may call for confirmation testing at the Contractor's expense.

The result of tests, including a specification for the electrode design (see 1.1.3), shall be submitted to the Employer's Agent within seven days of the tests being performed. The test results in tabulated and graphical form shall be accompanied by a copy of the meter test certificate.

The following maximum resistances shall apply:

- Transformers
  - up to 500kVA 5 Ohms
  - 500 - 800kVA 3 Ohms
  - 800 - 1000kVA 2 Ohms
  - above 1000kVA 1 Ohm
- Lightning Protection
  - SANS 10313, category A structures: 30 Ohms overall, subject to a maximum of 200 Ohms for any single electrode (or per SANS 10313, whichever is the lower reading).
  - SANS 10313, category B & C structures: 50 Ohms overall, subject to a maximum of 200 Ohms for any single electrode (or per SANS 10313, whichever is the lower reading).

Unless reference is to be made in the Detailed Electrical Specifications on the maximum allowable resistances which shall be applied for the earthling installation.

4.10.1.2 Plant Bonding – Hazardous Areas

Where specified to be bonded, the electrode reading for fuel tanks, silos etc. must not exceed 7 Ohms with the electrode disconnected from any other electrode system. The hazardous area bonding shall comply with SANS 10142-1, SANS 10086-1, SANS 10108 and SANS 10189-2 standards

4.10.1.3 Earth Electrode

The earth electrode shall consist of earth rods, bare copper wire, copper tape etc, or a combination of these, or as specified in the Detailed Electrical Specifications and/or drawings.

Earth rods shall nominally be 1500mm long, 16mm diameter extensible type steel cored, copper jacketed where the copper cladding is at least 250 microns thick molecularly bonded to the steel rod, as 'Cadweld', or equal and approved.

Mains earthing conductors ('trench earths') shall consist of 70mm² bare copper cable while conductors for lightning protection and static bonding shall be 50mm².

Trench earth conductors, as well as the tops of earth rods shall be not less than 600mm below finished ground level.

Earth rods shall be driven into the soil utilising a purpose made driving head in conjunction with a mechanical hammer. In hard ground and in rock, the rods shall be installed into pre-drilled holes made with an earth-drilling rig. Whilst loose soil or a soil slurry may be used to back-fill holes in hard soil, carbonaceous conductive aggregate, such as 'Marconite' or equal and approved, shall be used for holes bored in rock.

Rods longer than the nominal 1500mm shall be coupled using an external sleeve arrangement and the liberal application of silicon or hydrocarbon grease. Rods must butt against one another inside the coupling; gaps will not be allowed.

Rods, tapes and cable conductor in highly corrosive soils shall be of stainless steel, or as otherwise specified.

Joints in copper cable electrodes shall only be effected using an exothermic welding process as 'Cadweld', or equal and approved.

4.10.1.4 Mains Earthing

A main earthing bar of high conductivity copper, at least 50mm x 6mm in section and 500mm long, (or as otherwise specified in the Detailed Electrical Specifications and/or drawings) installed in the transformer room facing the LV side of the transformer/s shall be provided. This shall be mounted onto insulators at 500mm above finished floor level. The bar shall be pre-drilled with 12 No. M12 diameter holes for the connecting of earth leads.

The earth electrode cable/s and all earth bonding leads shall be connected to the bar by means of brass or stainless steel bolts, nuts, washers and lock-washers. Earth cable terminations shall comprise hydraulically crimped tinned lugs. The point of origin of each conductor must be clearly indicated by means of an embossed or punched metal tag attached to the conductor near its lug or connection point.

The following points shall be bonded to the earth bar with 70mm² conductor, or as otherwise specified:

- Transformer star points (*)
- LV switchboard neutral bar (*)
- LV switchboard earth bar (*)
- MV switchgear

(*) : Subject to the earth conductor being not less than half the cross sectional area of the of the relevant phase conductor between the transformer and the LV switchboard.

The following references shall be made with respect to earthing, protective earthing and earth continuity conductors:

- SANS 10142-1 Table 6.24 (a) for the minimum cross- sectional area of corresponding protective conductors.
- SANS 10142-1 Table 6.26 for the maximum protection rating for nominal cross-sectional area of small conductors.
- SANS 10142-1 Table 6.28 for the minimum size and maximum length of copper earth continuity conductors.
- SANS 10142-1 Table 7.7 for the minimum cross sectional area of earthing (PE) conductor for the corresponding phase conductor.
- SANS Table 8.1 for the maximum resistance of earth continuity conductor.

Minisubs shall be earthed in a similar fashion to main substations except that the earthing bar in the LV compartment shall take the place of the separate main earth bar.

4.10.1.5 Electrical Earth (Circuit Earth)

Circuit earth loop impedance shall comply with the relevant section of the SANS 10142-1 Code of Practice for the Wiring of Premises. The contractor shall provide earth loop resistance readings test certificates for all Main and Sub distribution circuits.

The contractor shall bond all piping, sanitary fittings, structural steelwork and other exposed bare metal into the earth system with suitable robust copper earth strips and bolt on type earth clips.

The substation main earth and earth bar shall be bonded to the incoming main earth conductor. In addition an individual local earth shall be effected by means of an electrode system. The

contractor shall allow for preliminary testing prior to casting of floor slabs to ensure that the local earth electrode resistance will be 2 ohms or better.

An internal rectangular copper common earth strap of minimum cross section area of 80 mm² shall be provided for the ring earthing of all equipment in each room of the substation. All ring earths shall be inter connected to each other and the "T" off method of connecting equipment shall be used.

The conductor shall be laid flat and fixed at suitable intervals to prevent bulging. Bends shall be made via 100 mm flat bends. The strap shall not be mitre folded and shall not be kinked or sharply bent.

Connections to equipment shall be made in such a manner as to avoid the conductor lying in close proximity to equipment panels and oil tanks.

Earth wires run into terminal equipment and in conduit switch and plug boxes shall be of the PVC insulated type.

Earthing shall generally be provided in accordance with SANS 10142-1, SANS 10142-2 and SANS 10292 and SANS 10199 and the local supply authority.

The earthing installation shall include an accessible common consumer earth terminal, to which all incoming services using metallic conduits. All metallic hot and cold water pipes and waste pipes shall be bonded with copper tape clamped by means of a brass bolt and nut and earthed. Metal roofs, gutters, and downpipes shall be bonded together and earthed

Earthing of dedicated or “clean” circuits shall also be ultimately bonded to the consumer earth. Dedicated or “clean” earth conductors shall be insulated.

All steel building structures and roofs to be bonded to ground via earth rods at building corners and at intervals not exceeding 10m along the length of the building.

The Contractor shall earth all satellite dishes and antennas in accordance with SANS 10142-1

4.10.1.6 Earth Continuity Conductors

Separate bare copper earth continuity conductors shall be run with all multi-core cables (where no earth core is incorporated), and green/yellow PVC insulated earth conductors, or bare earthwires, as specified, shall be installed with all mains circuits, sub-circuits and final circuits wired with PVC insulated conductors in conduit or trunking wireways.

Only one earth conductor is required per group of conductors run in one wireway provided that such earth conductor is not less than half the cross sectional area of the largest conductor in the group (subject to a minimum are of 1,5mm²), and provided the earthing complies with the requirements of SANS 10142-1. Teed off connections shall be undertaken using crimped tee-ferrules, or shall be soldered. Under no circumstances shall the common earth be broken.

Where practicable, common earth continuity conductors shall be run as a “ring main”.

4.10.2 *Lightning Protection*

The lightning protection installation shall comply in all respects with the latest relevant South African Bureau of Standards Code of Practice (SANS 10313) as amended.

The Contractor shall arrange for the design of the lightning protection system, including air terminals, roof bonding, down conductors etc to be carried out by a reputable specialist. The Employer’s Agent will provide suitable drawings to the Contractor for this purpose either as transparencies or as DXF Computer Assisted Draughting (CAD) files.

Following submission of the design to the Employer’s Agent for comment (modification where necessary) and approval, the Contractor shall submit the final design to the SANS for approval. Transparencies of the SANS approved drawing/s shall be submitted by the Contractor to the

Employer's Agent for record purposes prior to, or simultaneously with, the start of the installation.

Lightning protection trench earths shall not be run directly in soil under pathways. In these instances the conductor shall be run in 75mm diameter uPVC sleeving which shall be laid under the path and at least 1000mm clear of its edges.

Air terminals may be of various designs.

As a general guide, the following basic requirements shall be complied with:

- All conductor material shall be electrical grade aluminium alloy in accordance with the requirements of BSS 1476/H/E9 or American Standards Specification 6063. Conductors shall be installed in such a way that no part of the system shall come into contact with concrete of plaster.
- Circular conductors shall have a minimum cross sectional area of 50mm². Flat conductors shall be 20mm x 3mm minimum.
- Joints in circular conductors shall be done using a hydraulic crimping machine. Flat conductors shall be joined with either two bolts, or else two aluminium rivets of 6mm diameter
- Bonding to extraneous metallic surfaces shall be done by bolting or riveting.
- Conductors must be mounted into aluminium alloy guides which in turn are seated on a suitable barrier material (plastic, or similar) and which allow free longitudinal movement of the conductor.
- Straight horizontal runs of conductor shall be provided with expansion loops every 30m or less.
- Electrically continuous metal roofs shall be used as the air termination. Where flat metallic roofs may be surrounded by non-metallic parapet walls, conductors are to be installed on top of the wall and bonded to the metal roof sheeting at intervals not exceeding 20 metres.
- Non-metallic roofing supported by steel trusses and purlins which are electrically continuous may be treated as for a complete metal construction.
- Where required 12mm diameter x 500mm long finials shall be installed at the outer corners of buildings of 15m to 30m in height and in addition at intervals of no more than 30m along exposed parapet walls. The finials, in turn must be bonded to the peripheral conductors.
- Tall structures, as defined in SANS 10313, shall, where required, have 12mm diameter x 1000mm long finials. These shall be installed at an angle of 30° out from the structure and bonded to the peripheral air terminal system, all as required by the Code of Practice
- Down conductors shall consist of aluminium alloy run surface down the outside of buildings, or, where suitable, shall comprise structural steel columns, or reinforcement steel in reinforced concrete columns all as described in the Detailed Electrical Specifications and/or installation drawings and/or in accordance with the Contractor's SANS approved design.
- Down conductor spacing shall not exceed 30 - 0,4h metres, where h = the maximum height of the structure. However the minimum separating distance need not be less than 10 metres except for tall slim structures (like chimney stacks) where a minimum of two down conductors must be installed.
- Large expanses of external metal wall cladding as well as external metal staircases, ductwork etc shall be bonded to ensure vertical electrical continuity and to the lightning protection system at their upper and lower extremities.

- Aluminium based down conductors shall terminate at 500mm above ground level where they shall be bonded to the earth electrode system. Under no circumstances shall aluminium conductor come into contact with the ground.
- The Contractor must liaise closely with the building contractor to ensure the timeous placement of cast-in threaded bonding sockets at the tops and bottoms of reinforced concrete columns.
- Test points shall be provided where specified. These shall be either mounted near the base of the down conductor in the lower part of the wall or else contained in a small cast iron inspection chamber installed in the ground, or as detailed in the installation drawing/s and/or Detailed Electrical Specifications.
- The contractor will be required to submit two copies of SANS approved installation drawings to the Employer's Agent prior to commencing work on site. The contractor may, however, exercise the option to submit SANS approved record drawings of the completed installation to the Employer's Agent. In the latter instance the contractor will be responsible for and shall bear the full cost of any rectification work that may consequently be necessary to meet SANS requirements.
- All reinforcing steel shall be tied together by means of metal steel binding wire and shall be similarly connected to the steel in concrete piles where applicable.
- The reinforcing steel shall in turn be connected through to any metal roofing and facade cladding on the building by means of adequate corrosion resistant bonds and connecting devices.
- The contractor shall ensure that the individual roofing and cladding section/sheets are cross bonded to each other and to all metallic gutters, downpipes, handrails, window frames, etc., to provide low resistance earth continuity throughout all exposed metal work.
- Connections from the building to earth electrodes shall be provided with test links/joints at convenient positions approximately 300 AFFL.
- The contractor will be responsible for supervising all bonding and reinforcing steel bondings undertaken by his own staff or other contractors prior to concrete being poured and for ensuring that the earth resistance and the system as a whole has been installed in accordance with the SANS 10103 Practice for the Protection of Buildings and Structures against Lightning.

4.10.3 *Testing And Maintenance Manuals*

Upon completion of the earthing and lightning protection installation, notwithstanding the fact that the Local Supply Authority tests and accepts an installation, the following tests in accordance with the relevant SANS specification/s shall be carried out by the Contractor and the results submitted to the Employer's Agent.

In addition, the contractor is responsible for all commencement and completion forms, applications for testing, etc., as required by the Supply Authority and payment of any testing and connection fees.

a) Insulation tests ("Megger tests") of all power circuits :
    a. Between phases
    b. Phase to earth
    c. Phase to neutral
b) Earth continuity tests of all circuits.
c) Earth loop impedance tests of all cables.
d) Earth spike resistance tests.
e) Earth resistivity tests between earth spikes where more than one exists in an installation.

The results shall be comprehensively detailed and cross referenced in a legible form to the circuit numbers of the installation.

NOTE : THE CONTRACTOR SHALL, AT NO EXTRA COST TO THE CONTRACT PRICE, TAKE CORRECTIVE MEASURES TO ENSURE THAT THE INSTALLATION MEETS THE STANDARD OF THE SANS 10142-1 CODE OF PRACTICE FOR THE WIRING OF PREMISES WHERE TEST RESULTS FALL SHORT OF THIS.

The total load shall be balanced as nearly as practical across the phases or poles of the supply.

The following information shall also be submitted to the Employer's Agent :

- Sizes of outgoing circuit wiring/cabling cross referenced to the size of the MCB fuse which is protecting the circuit.
- Settings of motor overload devices/fuses cross referenced to the rating of the motor which is being protected.
- The above information and results shall be included as part of the "as built" record manuals.

The Contractor shall also supply maintenance manuals, including as-fitted and SANS approved record drawings, test certificates etc, all as outlined in the above specifications.

4.11 Fixings and Supports

The Contractor shall be responsible for all fixings in connection with his installation, including: brackets, suspensions, clamps, bolts, screws etc, and all accessories and fixing devices to effect a substantial and proper means of fixing equipment, components, wireways, cables etc.

All items shall be selected to fully suit the application, due cognisance being taken of:

- Weight of equipment and fixing media ('pullout strength')
- Temperature and humidity
- Effect of corrosive and damp environments
- Weathering, UV degradation etc
- Electrolytic effects

The following details shall apply to all fixings irrespective of the various categories in which they are described.

4.11.1 *Concrete and Brickwork*

4.11.1.1 Wall Plugs

Fixings into concrete and brick surfaces for equipment with a maximum mass of 10kg may be undertaken with plastic or fibre 'wall-plugs'. Under no circumstances shall wooden inserts be used.

A masonry drill of the correct size shall be used, in conjunction with a suitable hammer drill or similar, to make holes into the brick or concrete fabric; fixings into mortar joints will not be allowed. The fixing plug length must match the threaded portion of the fixing screw; undersized plugs will not be allowed.

Round or cheese headed screws of the correct diameter to match the respective plug shall be used throughout.

4.11.1.2 Anchor Bolts

Fixings into concrete and brick surfaces for equipment with a mass exceeding 10kg, or where the fixing holes are 10mm or larger, shall be undertaken using expanding anchor bolts, or by means of bolts cast into concrete.

For expanding anchor fixings, holes shall be made similarly to wall-plug holes. A masonry drill of the correct size shall be used, in conjunction with a suitable hammer drill or similar, to make holes into the brick or concrete fabric; fixings into mortar joints will not be allowed.

4.11.1.3 Channel Fixings

Where brackets, cable-rack support arms etc are to be fixed, the Contractor shall supply and install Cabstrut, or equal and approved, galvanised channel supports and associated clamps, cantilever arms and so forth. Surface channels for the support of various brackets, pendant studding etc shall be fixed into concrete ceilings or brick/concrete walls using anchor bolts.

In instances where cast-in support channels are to be used, the Contractor shall liaise with the building/civil contractor to ensure that inserts are installed timeously on to shuttering and that all openings are protected from the ingress of vibrated concrete.

Unless otherwise detailed in the Detailed Electrical Specifications and/or drawings, the Contractor shall submit particulars, including sketch drawings, of proposed fixings to the Employer's Agent for approval prior to installation. Such proposals shall be accompanied by design calculations of loadings and fixing spacings.

4.11.1.4 Cartridge Fixings

Shot or cartridge fixings, using fixing guns, percussion charges and fixing pins in accordance with the relevant manufacturer's recommended methods, shall only be used with the express written permission of the Employer's Agent. Where used, the Contractor shall comply fully with the requirements of the Occupational Health and Safety Regulations and shall ensure that warning signs are placed at all entrances where such work is in progress.

4.11.1.5 Hollow Partitions, Hollow Blocks and Ceiling Boards

Fixings shall not be made using gypsum, fibre or similar ceiling boards or ceiling tiles as the supporting medium.

For ceiling boards, the component shall be installed to a substantially fixed conduit box. In the case of linear fluorescent luminaires or other large components, further fixings shall be made into the support brandering. Where there is no brandering conveniently located, the Contractor shall supply and install independently fixed wooden inserts.

Surface fixed items mounted to ceiling tiles within support tees shall be fixed similarly to the foregoing except that, with written permission of the Employer's Agent, supplementary fixings may be made into the ceiling tee lips using approved self-tapping screws.

Fixings into hollow partitioning material, or hollow building blocks, shall be done by means of spring-loaded 'toggle' fixings, or, where suitable, compression type cavity fixing devices may be used.

4.11.1.6 Fixings on Steelwork

Support brackets, hangers etc shall be fabricated from galvanised angle iron or channel iron, or shall be made up using Cabstrut, or equal channel and associated accessories to suit the application.

Brackets etc shall be fixed to the structural steelwork using purpose made galvanised beam clamps, Caddy clips or similar. Welding to structural steelwork may only be carried out with the written permission of the Employer's Agent.

4.11.1.7 Painting

All exposed steel shall be cold galvanised.

Where specified, supports etc shall be primed and painted using an epoxy finish, with colour as specified in Section 9.

4.11.1.8 Adhesives

Under no circumstance will any adhesive material be used for any fixing with the single exception of the fixing of door gaskets.

The adhesive for use with gaskets shall be applied as per manufacturer's specifications, or self-adhesive gasketing material shall be used. The adhesive shall be of the silicone based type suitable for use under extreme weathering and temperature ranges between -40ºC and +70ºC.

4.12 Provisions for Ancillary Services

4.12.1 *General*

Where provision only for telephones and other systems of communication, fire defence, security, aerial, computer data or other services are specified, the Contractor shall supply and install all necessary conduit, wiring channel, cable tray, boards, outlet boxes, sleeves etc., as detailed.

4.12.2 *Junction Boards*

Where called for, junction boards for telephone and data services shall be supplied as specified. The boards are to be similar in construction and finish to flush, surface or semi-flush distribution boards, as required. Boards shall generally be 100 – 115 mm deep with an internal 15 mm softwood backing. Doors shall be secured with square-key turnbuckles and provision for padlocking. Main distribution frames (MDFs) shall generally be similar to normal junction boards but are to be 150 mm deep.

4.12.3 *Cable Sleeves*

Unless otherwise specified or indicated on the drawings, the Contractor shall supply and install all sleeves for telephone and other service cables of sizes and in positions as detailed.

Where sleeves are specified to be supplied and installed by others, the Contractor shall be responsible for ensuring that such sleeves are installed in good time and in their correct positions. Suitable rustless draw wires are shall be provided in all sleeves.

4.12.4 *Conduit*

All conduit for telephones and other services shall be provided and installed to the same requirements as for the electrical installation, and shall be fitted with rustless draw wires. Colour coding for industrial project and other installations where specified shall be in accordance with the colour coding as described in this specification.

Each class of service shall be kept entirely segregated from any other service.

4.12.5 *Outlets*

Unless otherwise specified all outlets for telephones and other services shall consist of standard 100 x 50mm flush type pressed steel boxes generally mounted a height of 0,3m from finished floor level to bottom of box.

Where switch sockets or other outlets are mounted in the same room at nominally the same height above floor, care shall be taken to ensure that the undersides of all such outlets are accurately lined up.

4.12.6 *Cover Plates*

The Contractor shall supply and fit metal or plastic cover plates of the same material and finishes to match flush switches and switched socket cover plates. A blank cradle shall be fitted in the outlet box to which the cover plate shall be screwed, allowing for proper alignment of the cover plate. Nickel or chromium plated screws shall be used to secure all blank cover plates.

4.12.7 *Co-operation*

The Contractor shall co-operate with the suppliers and installers of other services in providing all information required, and shall assist such other installers in the event of difficulties which they may experience with drawing in of their cables into conduit or channel provided by the Contractor and where such difficulty arises because of want of knowledge of location, blockages broken draw-wires etc.

5 LV SWITCHBOARDS, DISTRIBUTION BOARDS

5.1 Scope Of Work

This specification covers the supply, installation, testing and commissioning of low voltage switchboards and distribution boards for use at phase to phase voltages up to 600 V.

5.2 Standards

The equipment shall be designed, manufactured, tested and installed in accordance with the requirements of the latest edition of:

(a) The Occupational Health & Safety Act Nº 85 of 1993 and subsequent amendments and regulations issued thereunder.

(b) SA National Standards (SANS)

61869 Parts 1 to 5	Instrument Transformers
60439 Parts 1 & 2	Low-voltage switchgear and control gear assemblies
60947 Parts 1 to 6	Low-voltage switchgear and control gear
1473 Part 1	Low-voltage, switchgear and control gear assemblies – Part 1: Type-tested, partially type-tested and specially tested assemblies with a rated short-circuit kA withstand strength above 10 kA.
SANS 1765	Low-voltage switchgear and control gear assemblies (distribution boards) with a rated short-circuit withstand strength up to and including 10kA.
61643 Part 1	Low-voltage surge protective devices
	60529 Degrees of protection provided by enclosures (IP Code)
10142 Part 1	The wiring of premises Part 1: Low-voltage
556 Part 1	Low-voltage switchgear Part 1: Circuit-breakers
60269 : Parts 1 & 2	Low-voltage fuses
1195	Busbars
60439 Parts 1 & 2	Low-voltage switchgear and control gear assemblies
62040 Parts 1, 2 & 3	Uninterruptible power systems (UPS)
60950 Part 1:2014	I T equipment - Safety Part 1: General requirements
(c) British Standards	
BS EN 13601:2013	Copper rod, bar & wire for general electrical purposes
BS 159:2016	Specification for high-voltage busbars and busbar connections

The equipment shall in addition comply with the following requirements which shall supersede the provisions of the above specification in the event of differing requirements.

5.3 Sheet Metal Enclosures

5.3.1 *General*

a) Sheet metal enclosures for switchboards, distribution boards and motor control panels shall be wall or floor mounting as indicated on the drawings or described in the Detailed or Standard Specification.

b) In general, the enclosure is to be fabricated from a welded steel frame, to which the doors and other covers are to be fitted. The use of pop rivets in any of the frame construction is not permitted.

c) All welds are to be ground smooth and all external voids to be filled.

d) Lap welding of panels and boxing of sections shall be avoided in the construction to obviate corrosion of the unpainted surfaces and facilitate the cleaning of the boards. Bolted stiffening channels and braces are acceptable.

e) Completed sheet metal enclosures shall be free internally and externally from burrs, sharp edges and blemishes. The metal enclosures shall be dust and vermin proof throughout and constructed to meet ambient conditions. A removable steel base frame shall be allowed for floor mounting boards and be constructed of at least 3 mm channel with a clearance of at least 100 mm above the floor. Removable lifting eyes shall be provided for heavy panels.

f) The sheet metal enclosures shall be designed to accommodate the electrical distribution and control equipment shown in the diagrams and comply with the constructional requirements of this specification.

g) The construction of the LV switchboard enclosures shall allow for the board to be extended on both sides by the addition of panels without the need of cutting openings for busbars.

h) Bolts, nuts and washers used throughout shall be suitably plated to prevent corrosion, preferably cadmium plated with the exception of busbar bolts, which shall be of high tensile steel.

i) Screwed knobs used for securing doors or hinged covers shall be provided with retaining washers to prevent the screwed knob falling out when the door or cover is opened.

j) The use of self-tapping screws is unacceptable (except for the securing of labels). The use of double sided or "mirror" tape or self-adhesive components for the fixing of any equipment is not acceptable.

k) All equipment, covers, wireways and ducting shall be bolted to the enclosure with threaded rod or welded bolt. No loose nuts are acceptable. All tapped holes in metal work shall have a minimum tapped thread length equal to the diameter of the tapped hole and the exposed metal work shall be protected against corrosion by the application of a suitable inhibitor over the tapped area.

5.3.2 *Mild Steel*

Unless otherwise specified, the metal enclosures, internal panels and all equipment support frames shall be manufactured from "Zintex" steel plate or similar approved metal with corrosion inhibiting properties. When required, glass panels may be specified for viewing indication equipment.

The minimum thickness of the "Zintex" sheets used shall be 1,6 mm for panels not exceeding 0,5 m² or 2 mm for larger panels. Thicker sheets shall be used for very large panels and where the weight of the equipment would cause buckling or vibration.

All metal used for the fabrication of the board, i.e. internally and externally, shall be painted. The steel plates and extrusions used in the fabrication shall be thoroughly de scaled and de greased on completion of the manufacturing operations and treated with a corrosion inhibiting process before painting.

The corrosion inhibiting process shall be suitable for the environmental conditions to be encountered on site and full details shall be provided at the time of tendering. Details of the chemical process employed and the method of application shall also be provided at the time of tendering.

As a minimum requirement, the painting process shall consist of the following:

De grease and clean metal with trichloroethylene.

Apply two pack wet primer Plascon EPD 661 (base) with EPD 325 (catalyst) to 15 microns, allow to air dry for 30 minutes and low bake in oven at 80°C to 100°C for 20 minutes. Alternatively, allow primer to air dry for 24 hours. Should primer require thinning, use Plascon TH 127 solvent.

Apply epoxy polyester powder coating with electrostatic gun to thickness 40 microns minimum and 80 microns maximum and bake in oven at 180°C for 12 minutes. Final colour to be as stated in Section 9.

5.3.3 *Stainless steel & 3CR12*

Minimum thickness of sheets and general requirements to be as per galvanised steel enclosures. However, 1,6 mm thick stainless steel panels may be used for panels up to 1 m² provided adequate bracing or the construction is such that bowing and twisting is prevented. Special attention must be given to doors fitted with indicating instruments or push buttons to ensure the door is rigid and that the dust proofing gasket seal is maintained.

As a minimum requirement, the painting process shall consist of the following :

(a) Completely degrease and clean.

(b) One (1) coat of suitable etch primer.

(c) Apply epoxy polyester powder coat, final colour as specified.

3CR12 steel, where specified, shall be correctly pickled and passivated prior to being painted. Pickling and passivation shall be undertaken after basic manufacture of the DB is complete.

5.4 PROTECTION CLASS

The protection class for the assembly as a whole shall be with all covers in place and all doors secure and locked.

The minimum protection class of the assembly shall be as follows unless otherwise specified :

a) If the assembly is to be installed within an enclosed room for example an unpressurised substation then the class shall be IP 52.

b) If the assembly is to be installed within an enclosed and clean room for example a pressurised substation then the class shall be IP 42.

c) If the assembly is installed in a general plant area where it is subject to washing down then the class shall be IP 54.

d) If the assembly is installed outdoors and subject to rain then the class shall be IP53.

e) If any assembly door is open or cover removed then the protection class shall be IP 30.

f) This protection class also applies to the separators between cubicles within a switchboard.

g) The protection between the cable and feeder compartments in Form 3 or 4 assemblies is to be provided by means of neoprene grommets or Tufnol sheets cut to fit around the conductors.

h) If the assembly is wall mounted, surface or flush, where switch toggles protrude and the assembly is installed in a clean area for example an office then the enclosure class shall be IP 40.

i) Any ventilation louvres are to be fitted with a 1 mm anti-vermin mesh.

5.5 HINGES, LOCKS AND ACCESSORIES

Hinges and door handles shall be manufactured from non ferrous materials, suitably finished and treated against corrosion by an electro plating process. Pewter components or insufficiently resilient materials will be rejected.

Hinges and door locks of the weld on type will not be acceptable. "Piano" type hinges are also not acceptable.

Hinges and door locks shall be well designed to ensure satisfactory operation and a pleasant appearance.

The repeated opening and closing of the hinged panels or the operation of the door locks shall not cause chipping or scratching of the painted surfaces or other blemishes to the finished boards.

Key operated, lockable door handles shall be 6 mm square drive locks and fitted only if specifically requested. In general, door latches which may be operated by electrician's tools such as screwdrivers and panel keys, are preferred to those requiring special keys or handles, which may be removed or lost. All doors must be fitted with a handle.

All doors shall be fitted with "Barker and Nelson" type door locks with an 180° movement or otherwise approved.

Door latching and de latching operations shall be smooth and quick, whilst ensuring proper compression of the sealing gaskets without damaging or marking the paintwork or corrosion resistant surface of the board.

Sealing strips and gaskets shall be made of durable, non hardening rubber, neoprene or other synthetic material. Care must be taken to ensure that even pressure is exerted along the entire length of the gasket and that neither deflection or buckling of panel occurs when the gasket is compressed.

To avoid damage to the paintwork, screws, bolts, door locks, etc., must not be in direct contact with painted surfaces.

5.6 ASSEMBLIES

5.6.1 *Switchboards*

Switchboards are defined as assemblies which are floor standing, except where the circuits are predominately single phase and the designed fault level is not more than 10 kA, in which case the assembly is classed as a distribution board.

Switchboards shall consist of a sheet steel enclosure, free standing on a supporting base frame. The base frame shall be provided with pre-drilled holes for fixing the board to the floor. Conduit and cable entries shall be provided on the top and bottom panels and front and/or rear access shall be provided, as indicated on the drawings.

Busbars shall be installed at the top or bottom of the board and along its full length. Busbar droppers shall be provided either behind or alongside the feeder cubicles as specified elsewhere.

The incoming main switch shall be mounted in its own cubicle, be easily accessible at all times and shall be easily distinguishable from the other switchgear.

The distribution equipment installed within the board (i.e. ACB, CFS or MCB), shall be mounted in vertical parallel rows unless the arrangement calls for the horizontal placing of the equipment and provided the equipment manufacturer warrants operation in this direction.

Large withdrawable air circuit breakers and switch fuse units shall not be positioned at high level unless facilities are provided to assist maintenance staff in withdrawing these units.

The arrangement shall be such that ample space exists between adjacent items of equipment for the installation of incoming and outgoing conductors and the expansion of the ionised gas generated during circuit interruption.

The incoming busbars to the board's main switch shall be either heat shrunk PVC insulated or covered with a removable insulated barrier. All live parts must be protected to IP 30 irrespective of the form of separation. Where applicable, the incoming isolator is to be fitted with a shroud over the incoming terminals.

Flash barriers shall be interposed between items of equipment which, by virtue of their design or arrangement in the board, are likely to cause the breakdown of the di electric insulation to adjacent items of equipment during operation.

The board shall be of sufficient dimensions to allow the installation of all equipment specified and any future equipment indicated on the drawings without unduly restricting the access to and the clearance between the various items.

Particular attention shall be paid to the accommodation and bending of incoming and outgoing conductors within the enclosure and the working space necessary for making off the cables, installing the lugs and connecting into the equipment. Suitable provision shall be made for verminproofing the cable entries and earthing the armouring.

Any part of the distribution board metalwork shall be electrically continuous and a suitable earth bar shall be provided for the earthing of the enclosure. Particular attention shall be paid to the earth continuity of removable and hinged access panels, particularly those carrying supervisory and control equipment. Flexible copper straps may be used for the purpose of ensuring the earth continuity between the board and the panels.

The minimum form of separation as depicted in SANS IEC60439 Part 1, shall be Form 2 in which the busbars are separated from the functional units and from the feeder outgoing terminals. Components within a functional unit, which may consist of a number of feeders, are not required to be separated.

In the case of Form 3 or 4 assemblies, the neutral bars need not be run through the feeder compartments, but need only be provided in the cable compartment. The neutral busbar must be clearly distinguishable from the earth busbar.

In Form 3 or 4 assemblies the protective devices must be operated via door mounted handles.

Where busbar stubs are connected to protective devices to accommodate other equipment, such as CT's, then these busbars must be supported on stand-off insulators near the cable termination point. In the case of parallel connected outgoing cables, sufficient space must also be provided on the busbar to permit a lug to be bolted to each side of the busbar.

5.6.2 *Distribution Boards*

Distribution boards are defined as assemblies which are wall mounted or which are floor standing, in which case the outgoing circuits are predominately single phase and the designed fault level of the board is not more than 10 kA.

Distribution boards may be flush, semi recessed or surface installed, as indicated on the drawings. Conduit and cable entries shall be provided on the top and bottom panels.

Distribution busbars which are pre-drilled and fully tinned and mounted on suitable stand-off insulators shall be provided in all 3-phase boards. It is desirable that if busbars are not installed within a sheet or expanded metal enclosure, then a clear perspex safety cover shall be supplied to prevent accidental contact.

All wall mounting boards, unless differently indicated on the drawings, shall be front access only and shall be manufactured in two parts : a rear chassis, which is either built into or attached to the supporting wall, and an outer panel secured to the chassis on completion of the work and readily removable from it.

The arrangement is sought in order that chassis may be supplied at an early stage, whilst building and installation work are in progress, without the risk of damage to the outer panel or equipment installed therein.

The chassis shall be manufactured from galvanised mild steel plates, in order that they may withstand the rough handling and dirty ambient conditions prevailing during construction. Surface wall mounted panels may alternatively be supplied with chassis finished in Matt Black.

Chassis shall have suitable knockouts along the top and bottom panels for the terminations of all conduits in not more than two rows. A feeder cable entry knockout shall also be provided, suitable for the feeder cable rating indicated on the drawings.

The outer panel, secured to the chassis by means of adjustable bolts, shall support the equipment trays, the busbars and the wiring harness.

Single phase sections of three phase boards shall be arranged in three horizontal parallel rows, directly above one another and in the phase sequence Red-White-Blue from top to bottom.

3-phase MCB's, where these are not used for sub-distribution, may be installed at the right hand end of the single phase row. If more than three (3) 3-phase MCB's are required in any DB (i.e. more than 1 per row) then a separate 3-phase section must be provided. These arrangements are illustrated in the standard layout drawings.

Lighting and power circuits shall be separated by a blank space along the horizontal rows. Extra space for future circuits shall be allowed for at the right hand side of each single phase lighting and power row of equipment, in the ratio of one spare space for each four lighting or power circuit installed. A minimum of one space shall be allowed to each lighting and power row.

Dummy covers are to be provided over spare spaces. Similar provision for future circuits shall be made on the busbars, neutral and earth bars.

The phase, neutral and earth bars must be positioned so that it is possible to connect additional circuits to the bars without having to remove any other equipment. The earth bar must be bonded to the chassis and the incoming earth conductor must connect directly to the earth bar.

In the case of single phase DB's, the incoming isolator may be of the same type and size as the rest of the MCB's in the DB. However, in the case of 3-phase DB's, the incoming isolator must be of the large frame (MCCB) type, even if the outgoing feeders are small frame MCB's. The large frame isolator must be fitted with a shroud over the incoming terminals.

Any part of the distribution board metalwork shall be electrically continuous and a suitable earth bar shall be provided for the earthing of the enclosure. Particular attention shall be paid to the earth continuity of removable and hinged access panels, particularly those carrying supervisory and control equipment. Flexible copper straps may be used for the purpose of ensuring the earth continuity between the board and the panels.

A removable escutcheon plate shall be provided, behind a hinged door, through which toggles and other operating handles shall project. All wiring terminations and connections shall be made behind the escutcheon and shall not be accessible without its prior removal. The board shall be designed so that the switch toggles, instruments, etc., are easily accessible to operators of average height (i.e. upper edge of equipment not higher than 2 m or lower than 0,25 m above floor level), unless otherwise specified.

5.6.3 *Special Requirements for Generator Changeover Boards*

Generator changeover boards shall be free standing and manufactured from sheet steel on a supporting base frame, same as for the construction of switchboards.

The neutral of the generator set shall be solidly connected to the frame of the generator and directly to the earth bar with appropriately sized cables rated at half the full load current capacity of the generator. The neutral bar itself shall be rated at the full load current capacity of each phase.

The neutral and earth bars of the generator changeover panel must be separately solidly connected to the neutral and earth bars of the mains switchboard.

5.6.4 *Special Requirements for Motor Control Centres*

Motor Control Centres (MCC's) are defined as assemblies where at least either 60% of the feeders or 60% of the total load is devoted to motor drives.

The general requirements of switchboards apply irrespective of whether the MCC is floor or wall mounted.

Unless otherwise specified, the form of separation shall be Form 4. Each motor drive is to be considered a functional unit and is to be in its own compartment. The layout of the board shall be modular in design. Draw-out compartments shall be inter-changeable.

The following will be the minimum provisions on each motor drive, unless otherwise specified :

a) Main protective device, either MCCB or CFS, as specified.
b) Control protective device either MCB or fuse, connected downstream of the main protective device.
c) Door mounted interlocked operating handle with padlockable facility.
d) Contactor and overload relay / electronic motor protection relay.
e) Numbered outgoing connection terminals.
f) CT and instantaneous ammeter.
g) Earth leakage device with CT if specified.
h) Door mounted control devices

- Stop / Start push buttons.
- Run / Stop / Trip indicator lights.
- Overload reset.
- Local / Remote switch, if specified.
- Earth leakage test and reset

NOTE : The selection of switchgear components shall be in compliant with Type 2 co-ordination (SANS 60947).

5.7 Busbar And Bus Chambers

The busbars and their supports shall be :

a) Electrically and mechanically designed to withstand the short circuit stresses which may occur with the fault level specified for a period of not less than one second. (Attention of tenderers and manufacturers is drawn to the requirement for type test results of the short circuit capability of the busbars.)

b) Of uniform cross-section throughout the busbar run.

c) Manufactured from copper.

d) Designed to accommodate expansion and deflection due to thermal and mechanical stresses without damage or distortion occurring to the busbars or the equipment connected to them.

e) Shall comply with the latest SANS 1433-1, SANS 1973-1, SANS 1195 and BS 159 where applicable.

Busbars on the incoming side of the main switch/breakers are to be insulated with heat shrink sleeving with distinctive phase colours. The earth bar and busbar joints and cable terminations must not be insulated.

If the busbar is close to areas where cable terminations and connections are carried out whilst the busbar is energised and if the busbar is not housed in a chamber then a clear perspex safety cover shall be supplied.

Busbar chamber covers to be bolted in the four corners and equispaced at least every 500 mm around the periphery. Nuts welded to the cover frame may be used for fixing or the frame may be tapped as specified. Loose or captive nuts may not be used.

The construction of the enclosure shall allow for the extension on both sides by the addition of panels without the need of cutting openings for busbars.

Phase identification colours are to be fixed to the bars at regular intervals and shall be Red, White & Blue (R-W-B) from top to bottom, from left to right, from back to front when facing the front of the board, unless otherwise specified. Both main and secondary bars must be identified. Unless this is not allowed due to the type tested design of the panel.

The minimum clearance between live conductors or live conductors and earth shall be 20 mm for systems up to 600 V.

Busbars shall be adequately and continuously rated for the specified current with a maximum temperature rise of 40°C relative to a peak ambient temperature of 40°C giving a maximum peak busbar temperature of 80°C.

In the case of fault levels of 20 kA or higher, the manufacturer shall produce type test results of the proposed busbar arrangement, in the enclosure intended, to prove the correct sizing of the bars and that the temperature rise is within the limits specified.

In the absence of such type tests the following minimum criteria will be used in determining the rating of rectangular bars with the larger side in a vertical plane :

Current rating of multiple bars relative to single bar rating :

2 bars	:	1,66
3 bars	:	2,09
4 bars	:	2,30

Derating of current carrying capacity within steel enclosure relative to free air rating 0,68

Derating of capacity for 40°C temperature rise instead of 50°C : 0,88

In this case the ratings given in the publication "Copper for Busbars" by the Copper Development Association are to be used.

Neutral busbars in three phase, four wire, supplies shall have a cross-section of at least 50% of the cross-section of the phase busbars and shall be pre-drilled.

Where multiple busbars are used per phase, the current rating of the neutral bar shall be at least 50% of the rating of the phase bar combination.

Earth bars are to be run the full length of the switchboard and must be continuous. The bar is to be positioned near the gland plate top or bottom or both as necessary. Earth bars are to have the following minimum cross-sectional area with a minimum thickness of 6,3 mm :

Specified Three Phase Symmetrical Fault Currents	
Fault Level : (kA)	*Earth Bar Size (sq.mm)*
Up to and including 5	36
Above 5 and up to 10	75
Above 10 and up to 10	150
Above 20 and up to 10	200
Above 30 and up to 40	300
Above 40	400

In main switchboards, which derive a supply directly from a transformer, the neutral of the transformer is to be bonded to earth at a point inside the switchboard.

This point of bonding shall be close to the point of entry of the incoming conductors into the switchboard and is to be in a conspicuous place. The bonding conductor is to be at least of the same area as the earth bar and is to be insulated in green or green/yellow PVC for identification.

Incoming and outgoing connections from the busbars shall be designed for the specified fault conditions and shall be rigidly supported by brackets to support their mass from the busbar stack or the equipment terminals.

Pinch screw terminals must not be used on any of the busbars. Terminals must be of the clamping plate type or else the connections must be lugged and bolted.

Main and subsidiary busbars shall be of the same material and all bolted joints shall be tinned or silver plated. The joints shall be tightened to the correct bolt torque and shall be locked into position to prevent connections becoming loose due to thermal cycling or mechanical vibrations.

Switchboards with incomers and/or bus-couplers shall be constructed so that the bus-couplers are each in a segregated compartment and that the busbars associated with each incomer are

also segregated. The main and secondary busbar chambers must also be segregated from each other. Furthermore, in long switchboards, the main busbar chamber is to have segregating barriers provided at intervals of not more than 5 metres. The degree of protection between the above busbar compartment is to be at least IP30.

5.7.1 *Primary connections*

Primary connections shall be liberally rated for continuous operation. The mechanical and di-electric strengths of connection supports shall be able to withstand the worst conditions of electrical surge which can occur on the installation.

Primary connections shall be housed in air-insulated enclosures or be insulated and provided with suitable warning labels, which shall be arranged such that no direct access to or contact with live conductors is possible via slots or apertures. Suitable baffles shall be provided to prevent the accidental entry of tools, etc., whilst maintenance work is being carried out in the vicinity of the busbar chambers.

Primary connections shall have a short time rating not less than that of the associated switchgear.

5.8 Safety arrangements

All terminals, connections, relays and other components which may be "Live" when front access doors are open shall be adequately screened. It shall not be possible to obtain access to an adjacent cubicle when any door is opened. Cabling And Wiring

All wiring and cabling shall be carried out and be readily accessible from the front of the enclosure unless otherwise stipulated.

The requirements of SANS 10142-1 and SANS 10142-2 must be complied with.

The minimum conductor area of any power circuit shall not be less than 1,5 mm². Suitably protected control circuits may be wired with no less than 1,0 mm² flexible conductors. 2,5 mm² wiring shall be used for the secondary circuits of current transformers.

If the current rating dictates that multiple flexible conductors are to be connected to a protective device, then the conductors are to be connected to the device via stub busbars.

The connections between the incoming supply and the busbars or between the busbars and the incoming side of the outgoing power circuit protective devices, shall be made with conductors having a fault capacity equal or higher than the fault level indicated for the board. Flexible conductors may not be used to connect to the incoming side of the power circuit protective devices at specified fault levels of 20 kA or higher, in which case only solid busbars may be used.

Control wiring connected to the main or secondary busbars shall be protected with HRC fuses, preferably mounted directly on the busbars, but otherwise with no more than a 150 mm long live conductor from the busbar. Unprotected wiring may not be run into a compartment of a switchboard which is separated from the compartment in which the tap-off is made. In general, where control supplies are obtained directly from the busbars, upstream of any feeder protective devices, the instruments so supplied are to be protected via 2 fuses in series : a collective 10 A busbar mounted fuse for all instruments and an individual 2 A fuse for each instrument.

Sub distribution circuits protected by HRC fuses need only be rated for the maximum prospective asymmetrical fault level possible when the largest fusible link is installed in the fuse base.

Multi-stranded conductors shall be used in preference to solid conductors. Solid conductors may not be used for control wiring.

Insulated conductors shall not be bunched in large numbers, to avoid heat accumulation within the core of the bunch or damage to healthy circuits in the event of fault.

If bunching of conductors is unavoidable, the conductors should be de-rated in accordance with the relevant table of the SANS Code of Practice for the Wiring of Premises.

Conductors must be rated for an ambient temperature of at least 40°C.

The insulation of the conductor shall not be stripped beyond the leading edge of the terminal in which it has to be accommodated. Stripping shall be carried out without damage to the conductor, preferably by means of a cable stripper.

All cable and wire ends to be terminated on bolted connections to have crimping lugs and ferrules fitted and crimping shall be carried out using the proprietary tool. Hexagonal crimps must be employed for conductors 4 sq.mm or larger. Cable and wire ends due for termination on circuit breaker, contactor and non-lugged type terminations shall have the exposed copper strands bound with copper wire to prevent splaying when the connection is tightened.

The wiring shall be carried out neatly along perpendicular lines and it shall be accommodated in enclosed wireways or trunking which upon completion of wiring shall have a 20 % spare capacity. The wireways are to be positioned so that wiring is taken into the wireways within a short distance of the terminals on the device. If a loom is necessary, suitable metal standoffs will be required for fixing and forming of the loom. Stand-offs shall either be screwed or epoxy glued to the board – double-sided "mirror" tape will not be acceptable.

The wiring shall not preclude the removal or block the access to any component. The wiring must be arranged and the devices spaced so that the labels which are fixed to the mounting plate are not obscured by the wiring.

All cables and wiring is to be identified by numbered ferrules at every termination according to the schematic diagram and tables. Wrap around or "stick on" ferrules are not acceptable.

Neutrals shall be numbered so as to clearly and easily identify each neutral with its corresponding phase conductor.

Cable colours for wiring purposes shall be as indicated in the following. Colour coding shall be discussed with the Employer's Agent, when foreign equipment, wired to different standards, is to be incorporated in the installation :

a) Single phase distribution boards shall be wired in red and black PVC insulated conductors.
b) Three phase distribution boards shall be wired in red, white and blue PVC insulated conductors.
c) General control wiring shall be orange and be taken from the blue phase. Phase sensitive control wiring is to be wired in the phase colour.
d) Unearthed and DC control wiring shall be grey for negative and purple for positive.
e) Neutral connections shall be black and this colour must not be used for any other connection.
f) Earth connections only shall be striped green-yellow PVC insulated conductors.

A terminal strip of the "Klippon" or similar type, if required for external connections, shall be conveniently and horizontally positioned and located no less than 100 mm above the gland plate. The terminal mounting rails shall be made longer than required to allow a 20 % future expansion. Wiring connected to such a terminal must be fitted with pin ferrules. Bare conductors are not to be directly inserted into the terminal connectors.

Where 50 V d.c connections are carried out in 1/0.9 mm telephone cable, multi-core coverings conforming to P&T Standards or equivalent may be used.

All control connections and instruments and relay wires shall be provided with numbered ferrules at each terminal. Groups of numbers on a single ferrule shall not be used. All circuit diagrams and detailed wiring diagrams shall be clearly marked with the numbers which are shown on the ferrules of the individual cores.

The same ferrule numbers shall not be used on wires in different circuits on the same panel. Corresponding wires on all panels shall have identical numbers. Ferrules shall be of insulating material and shall be provided with a glossy finish to prevent the adhesion of dirt. They shall be clearly and durably marked and shall not be affected by damp or oil. Stranded wires shall be terminated with tin (not solder) "Ross Courtney" or other approved claw or crimped lugs, separate lugs being used for each wire. Flag terminals shall not be used. The size of the lugs shall be suited to the size of the wire terminated. Alternatively, wires may be terminated in insertion type terminal blocks With pressure plates of an approved type. Wiring shall, in general, be accommodated on the sides of the cubicle and the wires for each circuit shall be separately grouped. Back-of-panel wiring shall be arranged so that access to the connecting stems of relays and other apparatus is not impeded. Wires shall not be joined or teed between terminal points and no terminal point or stem shall have more than two wires connected to it. Bus wires shall be fully insulated and run separately along the top or bottom of the cubicle.

Wherever practicable, all circuits in which the voltage exceeds 125 volts shall be kept physically separate from the remaining wiring. Where access is from the rear, all wiring diagrams for control and relay panels shall be drawn as if viewed from the rear, and shall show the terminal boards and wiring exactly as arranged in service.

Multicore cable tails shall be so bound that each wire may be traced without difficulty to its associated cable. The spare cores of all multicore cables shall be numbered and terminated at the top of the terminal block in the cubicle. Where cables are terminated in a junction box, and the connections to a relay or control cubicle are continued in conduit, an approved number of spare cores shall be taken through the conduit and terminated in the cubicle. Where panels are mounted side by side to form a single suite, connections between the panels will be run in bus wiring by the Contractor.

5.8.1 *Terminal boards*

All terminal boards shall be mounted vertically at the sides of the cubicles in such a way as to give easy access to terminations and to enable ferrule numbers to be read without difficulty. Terminal boards shall not be less than 100 mm apart and shall be mounted at least 230 mm clear of the floor. Terminal boards shall be provided with stud terminals or insertion type terminals with pressure plate of an approved type. All connections shall be made to the front of the terminal boards. Current shall not be carried through the boards by the studs. Terminal boards shall have pairs of terminals for incoming and outgoing wires and not more than two wires shall be connected to any one terminal. Insulating barriers and the spacing between terminals shall be such as to give adequate protection while allowing easy access to terminals.

Covers of transparent insulating material shall be provided on terminal boards, the fixed portion of which shall be clearly labelled as to the function and voltage of circuits. No live metal shall be exposed at the back of the terminal boards. Where specified by the Employer’s Agent, means shall be provided for terminating 1/0.9 mm telephone type conductors associated with the repeat alarm indications and remote control equipment by the use of special terminal blocks; such blocks shall be made up of pairs of terminals of which one shall be of the normal stud type for taking multistrand wire whilst the other shall be suitable for terminating telephone type cable cores by means of a soldered connection. Disconnecting links between pairs of terminals are not required. Adequate terminals shall be provided to permit the lead and return for all external devices to be carried in the same external cable, and to allow all active and non-active cores in the external cables to be terminated.

Plastic "chocolate block" terminals with pinch screws will not be acceptable.

5.9 Typical Arrangement Drawings

In pricing and Employer's Agenting the boards, cognizance must be taken of the actual constraints imposed due to the location of the board within the building, manner of installation, number and size of the circuits, cable entries and access and routing limitations within the building.

Notwithstanding anything to the contrary, where the successful tenderer has tendered on main and sub distribution boards manufactured by non-recommended suppliers, acceptance of the tender shall be subject to the non-recommended supplier providing equipment, material, workmanship and standards equal to or better than the recommended suppliers and to the approval of the Employer's Agent.

5.10 MARKING AND LABELLING

The requirements of SANS 10142-1 and SANS 10142-1 must be complied with.

The assemblies shall be fitted with identification labels engraved with the reference logos indicated on the wiring diagrams. The labels shall be affixed to the front of the panels or in a similar prominent position, by drive screws or other approved method.

All components shall be identified as per their designation on the schematic diagrams by engraved plastic laminated labels mounted above the component. The letters should be at least 8 mm high, black on white background.

All busbar chambers to be clearly marked with the following information: service voltage, current carrying capacity and fault level and duration.

Each individual item of equipment installed in the panels shall be identified by a label engraved with the corresponding diagram reference. The label is to be secured immediately below or close to the device it is identifying, but not on the device itself. The label must not be covered by the wiring. Self-adhesive tape labels will not be considered suitable for this purpose.

Each wiring termination of a motor control panel and all control wiring in other assemblies shall be fitted with a solid concentric cable marker engraved with the corres¬ponding diagram reference number. Clip on and stick on cable markers will not be considered suitable for this purpose.

Where an outgoing terminal block is provided, each individual terminal shall be marked with the corresponding diagram reference number.

Purpose made labels shall describe the various sections or functions of the panels, to facilitate the identification of the equipment and relate it to the diagrams.

The usual warning labels, marker's label and rating plate shall be affixed in suitable positions. A copy of the wiring diagram and spare parts list shall be stored in a plastic envelope within the enclosure, unless otherwise directed by the Employer's Agent.

Legend card holders are to be made of metal with a clear PVC front and welded to the front of the board (without doors) in a suitable position or to the inside of a door.

The description on the legend card must clearly indicate the location of the circuit as well as the circuit type, e.g. "Plugs : North Classroom".

All switchboards and distribution boards shall be fitted with a standard bilingual label

"IN CASE OF ACCIDENTAL CONTACT ISOLATE MAIN SWITCH"

mounted directly below the main isolating switch and the size of the cable supply.

All sub distribution boards shall have a label fixed below the main switch which shall indicate the source of the main feeder cable supply and the size/cores of the cable.

5.11 Switchgear & Protective Devices

5.11.1 *Air Circuit Breakers (ACB's)*

Air circuit breakers must comply with SANS 60947-2. The rated service short circuit breaking capacity (Ics) shall be equal to, or greater than, the specified required fault level of the switchboard in which it is to be used.

ACB's shall be of utilisation category "A" and have a short circuit withstand capacity of one second.

Withdrawable ACB's must be provided with an interlock on the cradle which prevents a closed ACB from being withdrawn from, or inserted into, the power circuit. The cradle must clearly indicate "Service", "Racked Out" and "Test" positions.

ACB's must be provided with at least the following overloads:

a) An adjustable thermal overload with at least a range of 0,5 to 1,0 of the rated current.
b) A short circuit overcurrent delay, adjustable both in time in at least steps of 0, 0,1, 0,2 and 0,3 seconds and in current up to 10 times the rated full load current of the ACB.

5.11.2 *Moulded Case Circuit Breakers (MCCB's)*

A MCCB is defined in this specification as a large frame circuit breaker with at least 3 poles and with a breaking capacity of greater than 10 kA at 400 V.

MCCB's must at least comply with SANS 156. In addition, for breaking capacities of 30 kA at 400 V, or higher, the devices must also comply with IEC 60947-2. The rated service short circuit breaking capacity (Ics) shall be at least equal to 50% of the specified required fault level of the assembly in which it is to be used.

5.11.3 *Miniature circuit breaker (mcb)*

Mcb's are defined, in terms of this specification, as small frame circuit breakers of 1, 2, 3 or 4-pole type with breaking capacities up to 10 kA at 400 V or up to 50 kA at 400 V for current limiting types.

Mcb's shall at least comply with SANS 156.

5.11.4 *Earth leakage circuit breakers (ELCB's)*

The earth leakage personnel protective relays and circuit breakers shall operate on the core balance principle and energize the trip coil by means of a static switching device of simple design.

The sensitivity and response of the relay shall cause the instantaneous tripping of the isolator when the earth leakage current reaches 30 mA.

The relay is to be fitted with integral test facilities and shall be compensated for ambient temperature variations and severe earth fault currents.

Earth leakage relays protecting installations against earth leakage damage shall be of similar design and cause the isolator to trip when the total earth leakage current reaches 250 mA.

Earth leakage relays supplying 3-phase, 4-wire supplies, shall be of the 4-pole type.

Earth leakage relays shall comply in all respects with SANS 767.

An earth leakage relay shall be fitted to all circuits that feed socket outlets, except those for special applications, and all circuits that supply water pumping equipment.

5.11.5 *Combination Fuse Switches (CFS's)*

Combination fuse switch units shall be triple pole devices fitted with neutral links and shall comply fully with SANS 60647-3.

The fuse switches shall be of the on-load type capable of carrying the rated current continuously, making and breaking rated current and tested to IEC 60947 for making and breaking capacity.

The units shall be of the double air-break, quick-make, quick-break type with an arc chamber. The mechanism shall be driven by springs on both sides.

The unit shall consist of a fixed contact assembly, heavy duty mechanism, moving contact carriage and a retractable operating handle mounted on a rigid frame. The contacts shall be of high quality material, e.g. silver plated.

The fixed contacts shall be shrouded.

When the fuse switch is in the open position, the double air break shall fully isolate the HRC fuse links, permitting fuse replacement in safety.

Interlocks shall be provided to prevent the cover from being opened when the switch is "ON" and to prevent the switch from being operated when the cover is open, unless purposely defeated.

The cartridge fuses used in the units shall comply with SANS 60269-1 or the equivalent BS, DIN and VDE Standards. The category of the duty shall be suitable for the voltage level and the fault level at the point where the fuses are installed. Time/current characteristics shall be matched to the equipment supplied and protected by the switch.

Fuse gear carrying the HRC fuses on the cover, the cover also forming the operating lever, is regarded as a fuse isolator and is not acceptable.

5.11.6 *Cartridge Fuses and Fuse Holders*

This section covers cartridge fuses and holders used for the protection of distribution and power system equipment up to 600 V:

5.11.6.1 Types

The following fuse and fuse holder types are acceptable for use in distribution and power systems :

(a) A cartridge type fuse link which fits into a fuse carrier together with a fuse base with fixed terminals. The fuse can be removed by taking out the fuse carrier and then removing the fuse from the carrier.

(b) A cartridge type fuse link which fits into a fuse base with fixed terminals. In this case a fuse puller is required to disengage the fuse from the base. These fuses are only acceptable on equipment imported with these fuses as a standard item. One puller shall be supplied for each board or box in which these fuses are used. The fuse puller shall be mounted in a spring clamp inside the board.

Rewirable fuses are not acceptable and shall not be used.

Fuses shall normally be installed in moulded plastic fuse holders or rigid isolating barriers shall be installed between the fuses. Sufficient spacing to prevent accidental contact when inserting or withdrawing fuses shall be maintained. The covers or barriers shall be manufactured for the specific fuses to be used.

Striker pin fuses shall be equipped with an alarm contact so that the contact closes and remains closed when the striker pin operates.

5.11.6.2 Standards

All fuses used for distribution systems shall comply with the following standards :

(a) Fuses : SANS 50172, SANS 60269-1 or BS 88, Parts 1 and 2.

(b) Holders : SANS 60269-1.

(c) Fuses of the types described in para G.11.6.1 above and complying with the relevant DIN (49510, 49511, 49515, 49522, 49360, 49367) and VDE (0635, 0660) Standards are also acceptable.

5.11.6.3 Ratings

(a) Fuse ratings shall be accurate to within +5% of the published value for unused fuses and shall not vary significantly after long periods of service.

(b) Fuses shall be derated for ambient temperatures above 25°C in accordance with the manufacturer's recommendation. If no such recommendation exists, a derating factor of 1% per □C above 25°C shall be applied.

(c) Fuses shall be derated for elevations of more than 1000 m above sea level in accordance with the manufacturer's recommendation. If no such recommendation exists, a derating factor of 1% per 300 m above 1000 m above sea level shall be applied.

(d) Time/current characteristics shall be chosen to suit the application :

Cable Protection	:	The fusing shall not exceed 1,5.
Motor Circuits	:	Time lag characteristic so that the starting currents will not cause deterioration of the fuse.
Capacitor Circuits	:	Fuses shall be chosen to withstand a higher than normal full-load current (1,5 times rated capacitor current) to allow for harmonics and shall not deteriorate due to the high transients at switch-on.
Distribution Systems	:	The total operating I2t let through by secondary (minor) fuses shall be less than that of primary (major) fuses in any specific branch.

(e) It shall be ensured that the rupturing capacity of a fuse chosen for a specific application shall be adequate, both as far as short circuit current and applied voltage are concerned.

5.11.7 *Triple Pole On-Load Switches*

This section covers switches suitable for panel mounting for use in power distribution systems up to 600 V, 50 Hz. Switches for motor isolation are included.

The switches shall be of the triple-pole, hand operated type, complying with SANS 60947-3.

The switches shall have a high speed closing and opening feature.

The switches shall be suitably rated for the continuous carrying, making and breaking of the rated current specified. The through-fault current capacity must be at least equal to the specified prospective fault level for one second.

To distinguish the switches from circuit breakers the operating handles shall have a distinctive colour and/or the switch shall be clearly and indelibly labelled "ISOLATOR".

5.11.8 *Contactors*

Contactors shall be of the totally enclosed, four, three or two pole, electro mechanically operated air break type, suitable for 400 V / 230 V supplies and comply with SANS-IEC 60947-4.

Contactors shall be of modern design with the following characteristics :

(a) Enclosed coil easily replaceable.

(b) A permanent air gap in the magnetic circuit to prevent sticky operation.

(c) Provision for quick and simple inspection of contacts.

(d) Clearly marked main and auxiliary terminals.

All parts shall be accessible from the front.

Contactors which are not located in switchboards shall be housed in enclosures which comply with IP.54 of SANS 60529.

The current rating of the contactor shall be as specified for the circuit with a switching duty in accordance with the following utilisation categories of SANS IEC60947-4 :

(a)	AC 1	:	Resistive heating.
(b)	AC 3	:	Starting indication motors;
		:	Switching fluorescent and incandescent lighting circuits.
(c)	AC 6(b)	:	Capacitor switching.

In MCC's or switchboards where the prospective fault level is 20 kA or higher, contactors must be selected to give Class 2 co-ordination to SANS-IEC 60947-4.

The magnetic system of the contactor shall be carefully designed and all laminations tightly clamped to ensure that when the armature is closed and full voltage at normal frequency is applied to the coil, the contactor will not emit more noise than the hum associated with any properly constructed laminated core with tightly clamped laminations. Noisy contactors will not be accepted.

Latched contactors shall be provided with a trip coil and a closing coil. The contactor shall remain closed after de energising the closing coil and shall only trip on energising the trip coil.

Contactor operating coils shall have a voltage rating as required by the control circuitry and shall have the limits of operation and temperature rise as specified by SANS IEC60947-4. Latched contactors shall be capable of being tripped at 50% of the rated coil voltage. Coils operating on 230 volts would be preferred.

Contactors for normal/standby changeover circuits shall be electrically and mechanically interlocked. Contactors shall also be electrically interlocked in star delta starters.

Contactors shall have the provision to add auxiliary contacts and convert auxiliary contacts on site. Contactors with permanently fixed auxiliary contacts shall have at least 1 x N/O and 1 x N/C spare auxiliary contact in addition to the contacts specified for control purposes and in addition to contacts required for self-holding operations or economy resistances. Where the number of auxiliary contacts required is greater than the contacts that can be accommodated on the contactor, an auxiliary relay or additional contactor shall be provided to supply the additional contacts.

It shall be possible to replace main contacts without disconnecting wiring.

Auxiliary contacts shall be capable of making, carrying continuously and breaking 6 A at 230 V AC, unity power factor for contactors used on 400 / 230 V systems.

Auxiliary contact functions required, e.g. "lazy" contacts, late make, late break, make before break, etc., shall be inherent in the contact design. Under no circumstances may these functions be improvised by bending contacts, loading contacts, etc. These functions shall be available in all contactors.

Spare auxiliary contacts shall be wired to numbered terminal strips in the switchboard and shall appear on the switchboard drawings.

Not more than one core of either internal or external wiring shall terminate on any outgoing terminal. Where duplication of terminal blocks is necessary, suitable solid bonding links shall be incorporated in the design of block selected.

Where required and at the Contractor's expense, samples of all wiring and terminations shall be submitted for approval within three months of the contract award date.

Each wiring for instrument cases and to all apparatus shall be insulated and coloured green. All wiring shall be arranged so that access to any apparatus or connection point is not impeded. Wiring for future equipment shall be secured as far as possible and no wire left with bare ends.

Wiring carrying low-level d.c. signals shall be segregated from a.c. circuits and screened if recommended by the manufacturer of the associated instrument. The maximum potential between any two points within the panel shall not exceed 250 volts.

Any panel-mounted device to which connections are made by means of a plug and socket instead of a terminal block shall be wired in flexible cable of adequate rating between the "free" plug or socket and a fixed terminal block.

Identification ferrules shall be fitted at both ends of all wires not otherwise permanently identified, and the numbers or letters used shall correspond with the appropriate wiring diagram. The ferrules shall be of insulating material with permanent black characters on a glossy white or yellow background unaffected by oil or water. They shall be so arranged that they can be read logically from left to right when viewed normally.

Each wire connected to a stud-type or screw-type terminal in panel-mounted equipment shall be terminated in a "Ross-Courtney" or crimped-on ring terminal.

All cubicle wiring shall, unless otherwise approved, conform to SANS 10412-1 standard colour codes:

5.11.9 *Overload Relays for Contactors*

All overload relays are to comply with SANS IEC60947-4-1 and must provide protection against both overload and single phasing conditions.

Thermal overload relays must be temperature compensated and provide galvanically isolated auxiliary contacts for tripping and indication. Both manual and auto-reset facilities must be provided.

Electronic overload relays must be used for all motors, unless otherwise specified. The relay must have the facility to set the starting time of the drive and must trip instantaneously in the case of single phasing.

5.11.10 *Electronic Motor Protection Relays*

Electronic motor protection relays must comply with SANS IEC60947-4 as applicable and be suitable for use on 400/230 V systems.

The relay must be provided with a sealed cover, behind which the settings of the unit are made. A reset button must be accessible without removing the cover.

The relay must provide indication by means of LED's or LCD display, of the cause of the trip out and also indicate the operational readiness of the unit.

At least the following protection facilities must be provided:

- Thermal overload
- Anti-Single phasing
- Stall protection
- Phase sequence protection
- Earth fault protection

5.12 INDICATING INSTRUMENTS

5.12.1 *General Requirements*

All electrical equipment for a particular application shall be supplied from the same manufacturer, shall be splash-proof and dust-proof and have the same face dimensions. The face dimensions shall be square and not less than 96 x 96 mm. Anti-static impact resistance glass shall be used on the face.

All instruments shall conform to BS.89 and/or SANS 62053, SANS 799.

Instruments shall be rated for 2 kV insulation resistance to earth.

Instruments shall be capable of withstanding overloads of continuous or short duration in accordance with IEC.6051 (1,2X / 10X).

Instruments shall be provided with either recessed or shrouded studs for rear connection. All rear connections shall conform to at least IP 20.

Instruments shall be sufficiently resistant to vibration that may be encountered.

5.12.2 *Kilowatt-Hour meters*

Unless specified to the contrary, kilowatt hour meters shall be suitable for operation on 240/400 V, 50 Hz, systems.

The meter shall be of a digital type and designed to carry the rated current continuously. The meters maybe direct reading or CT driven depending on the application

Kilowatt hour meters shall comply with the relevant parts of SANS 62053 or SANS 1799. The integrating period on maximum demand meters shall be 30 minutes unless specified to the contrary.

The meter must be able to display the kWh consumption on an LCD display. Kilowatt hour meters shall be graded and calibrated for the specific application to avoid the application of multiplication factors where possible. Where multiplication factors are unavoidable this shall be clearly indicated in unit form and not as a combination of several factors. Current transformer ratios shall be incorporated in the factor

Unless specified to the contrary, the meters shall conform to accuracy Class 0.5, as specified in SANS 62053 or SANS 1799.

Facilities for a security seal shall be provided on the fixing screws of the cover.

kWh meters with pulsed output are to be single or 3-phase units as applicable. A 6-digit cyclometer display is to be provided and the one-tenth digit may be omitted. A maximum error of 2% is to be provided. The pulse output, which is to be provided by voltage free contacts, must correspond to 1 kWh/pulse.

5.12.3 *Voltmeters and selector switches*

For LV applications, all voltmeters shall be scaled from 0 500 volts, unless otherwise specified.

Voltmeters shall be of the moving iron type, Class 1.5 accuracy as specified in SANS 62053 or SANS 1799. Zero adjustment screws shall be provided.

Unless otherwise specified, a single voltmeter shall be used with a selector switch. The voltage selector switch shall have an "OFF" position and positions for indicating readings between each phase and neutral and between phase and phase.

The voltage selector switch shall be cam actuated or of the air break type with two breaks per pole.

5.12.4 *Ammeters*

Ammeters shall have a moving iron element to indicate instantaneous values as well as a zero adjustment screw for the indicating arm.

Ammeters may be direct reading up to a maximum of 60 amps. Current transformer operated ammeters shall have the CT ratio indicated on the face plate and shall be rated for 5 amps full scale reading actual primary circuit currents.

Where combined maximum demand and indicating ammeters are detailed, a bi metallic spiral element shall be provided in the same housing to indicate mean value over a 15 minute period.

The bi metal element shall drive a residual pointer to indicate maximum mean current between resettings. This pointer shall operate on the main scale and shall be of a distinctive colour. The pointer shall be resettable from the face of the meter.

The bi metal element shall be designed to compensate for limits of ambient temperature between (0°C and 70°C).

Full load or rated current shall be clearly indicated, preferably with a red line. Unless specified to the contrary, a 100% condensed overscale shall be provided for instantaneous reading instruments and no overscale for combined maximum demand ammeters.

The intrinsic error, expressed in terms of the fiducial value in accordance with SANS 62053 shall be Class 1.5 for the instantaneous readings and Class 2.5 for the mean maxima.

Where saturation current transformers are required, these shall be an integral part of the meter. Separate saturation current transformers will not be permitted.

5.12.5 *Frequency meters*

Frequency meters may be of the vibrating reed type or the direct indicating type consisting of a moving coil milli-ammeter and a current/frequency transducer.

Unless specified to the contrary, the indicating range shall be 45 Hz - 55 Hz.

The accuracy class shall be Class 0,5 in accordance with SANS 62053 unless otherwise specified.

Where required, an adjustable speed alarm contact shall be provided, adjustable over the complete scale length.

5.12.6 *Running hour meters*

Running hour meters shall be of the electrically operated cyclometer type, suitable for flush mounting.

Numerals shall be clearly defined White on a Black background.

The range of hour meters shall be five digits, the fifth digit indicating one tenth of an hour, i.e, from 0 to 9999,9 hours.

The accuracy class shall be Class 1 in accordance with SANS 62053 unless otherwise specified.

5.12.7 *Current transformers*

5.12.7.1 General

Current transformers shall comply with the requirements of SANS IEC60044-1.

All current transformers shall come complete with a label on which the following information is indelibly stamped :

- Manufacturer
- Serial Number or Type
- Rated primary and secondary current
- Rated frequency
- Rated output and accuracy class
- Highest system voltage
- Rated insulation level

Current transformers shall be capable of withstanding the dynamic forces and thermal stress resulting from the maximum through-fault current which may be encountered at the point where they are installed. The short time current rating of current transformers shall correspond to the maximum short circuit current at the point of connection flowing for a period of 1 second.

Impulse levels for current transformers used in system voltages up to 660 V shall comply with SANS 60044.

5.12.7.2 Ratings

Current transformers shall be suitable for the primary currents listed hereunder and their decimal multiples : 10, 12.5, 15, 20, 25, 30, 40, 50, 60 and 75

The preferred values are : 10, 15, 20, 30, 50 and 75

Current transformers shall have secondary ratings of 1 A or 5 A, with 5 A being preferred.

Current transformers shall have standard outputs of 2.5, 5, 10, 15 or 30 VA as applicable, in terms of the burden of the instruments and inter-connecting wiring. The current transformer output shall match the actual instrument burden as closely as possible in order not to introduce unnecessary errors.

5.12.7.3 Accuracy class

(a) For metering applications, accuracy classes 0.5 are applicable. Where no accuracy class has been specified, the following table is to be adhered to :

/Application	**Class**
Indicating instruments	1
Metering applications	0.5
Precision metering applications and bulk metering	0,5

(b) Where ring type current transformers are specified, the aperture shall not be unnecessarily large as accuracy is thereby reduced.

(c) The classes for protection are 5P, 10P, 15P, 20P or 30P with 5P and 10P being standard. Turns compensation shall not be employed on protection current transformers for ratios greater than 150/5.

(d) Protection transformer will have an accuracy limit factor (ALF) of 5, 10 or 20. With an ALF of 10 or 20 being preferred.

5.13 MISCELLANEOUS CONTROL EQUIPMENT

5.13.1 *Indicator lights*

Indicator lights may only be of the neon or LED types. Lamp voltages shall suit the supply or control voltage. Lamps shall be de rated for continuous duty by using economy resistors or using input voltages at least 20% lower than the rated lamp voltages.

Where LED's are used as indicators on main supply voltages a suitable current limiting capacitor and reverse voltage protection diode must be used. For low AC or DC voltages (± 24 V) a current limiting resistor will suffice.

Indicator lights shall conform to BS.1050 0r SANS 60947 where applicable.

Indicator lamps shall consist of inter changeable lenses, lamp base, suitably rated and accessible terminals and a chromed screw on retaining ring. All indicator lights for a specific application or switchboard shall be from the range of one manufacturer and shall preferably be of the same size and shall use the same lamp types.

It shall be possible to replace lamps from the front of the panel without the use of tools.

Surface mounted indicator lights shall be housed in purpose made boxes with suitable cover plates.

Indicator lights shall be equipped with standard removable legend plates. Alternatively, the function shall be clearly indicated by means of labels or by engraving on the lenses.

The following are the preferred colours for indicator lights :

RED	Abnormal State of Motor OFF
YELLOW (or AMBER)	Attention or Caution or Motor Tripped
GREEN	Motor Running
WHITE (or Clear)	Circuit Live or Circuit Operating Normally
BLUE	Any function NOT covered above

5.13.2 *Panel mounted push buttons*

All push buttons on a specific switchboard shall be of the same physical dimension (round or square) and shall be fully inter-changeable as far as possible. Push buttons must preferably be inter changeable with indicator lamps, key switches, etc.

Push buttons shall be designed for long life, low contact bounce and constant contact resistance. Mechanisms may be of the mechanical type with spring control and a clutch or catch frame or of the solid state type operating on the principle of a non contacting, inductive proximity switch.

All push buttons shall be provided with replaceable lenses with a variety of symbols for insertion and for removable and inter changeable legend plates. Legend plates shall be clear and versatile.

Push button terminals shall be suitable for the application with regard to spacing, conductor capacity, etc.

Screw type, soldered or connector type terminals shall be chosen to suit the specific application with regard to good contact, ease of removal or alteration, rigidity, etc. Terminals shall be suitable for conductor sizes to be used. Push button assemblies mounted on doors of control boards shall be enclosed to prevent inadvertent contact with the terminals.

Push buttons shall be suitable for the environmental conditions to be encountered, e.g. moisture, excessive temperatures, mechanical shock, vibration, etc.

Contact duty shall be chosen to suit the application. Wiping contacts shall be used for low voltages and currents and snap action contacts for high voltages and currents. Contacts shall be constructed of high quality material such as silver tipped or gold laminated contacts.

Illuminated push buttons may employ neon or LED lamps. Lamp voltages shall suit system control voltages. Lamps shall be derated when used for continuous duty, e.g. using 20 V supply on 28 V rated lamps. External resistors shall be used with LED lamps to avoid excessive current.

Push buttons may be grouped together in purpose made stations, suitable for the environment in which it is to be installed.

push buttons shall be supplied with duplicate keys. The removal action of the key shall suit the application.

Push buttons shall comply with the applicable requirements of BS.3955 Part 3 and SANS 60947.

5.13.3 *Rotary CAM switches*

This section covers rotary cam switches used for control functions in switchboards, motor control circuits, etc., up to 1 kV AC.

The switches shall be equivalent to KLOCKNER MOELLER Type T rotary cam switches and shall conform to SANS 60947-5-1 and VDE.0113, where applicable.

The switches shall be of the cam actuated type with two breaks per pole, the required number of poles and number of control functions provided by the assembly of switching units on a common spindle.

The spindle shall be operated by a control handle suitable for the method of installation of the switch. The control handle shall be located by a keyway on the spindle.

The switches shall be provided with a suitable face place, indicating the angle of throw and the switch positions. The latching mechanism shall ensure positive positioning in accurate relation to the positions indicated on the faceplate.

The switches shall be suitable for use with the supply voltage level. The contacts shall be silver plated or gold laminated and shall be suitably rated for the switching functions intended.

For normal applications the making capacity of the switch shall be at least three times the normal current rating. For AC.4 duties (inching, reversing, plugging), the rated current of the switch shall be at least equal to the stalled rotor current of the motor.

Special contacts, e.g. late making, early breaking, etc., shall be inherent in the design and shall not be improvised by loading or bending contacts, etc.

5.13.4 *Motorised Time Switches*

Time switches shall be of the single pole type, suitable for 230 V systems, with contacts rated for the duty to be performed with a minimum AC1 rating of 16 A. Contacts shall be of high quality material, e.g. silver plated or solid silver. The time switch shall be rated for operation in the temperature range -10°C to +50°C

The clock shall be driven by a crystal controlled stepping motor, keeping accurate mains time. All clocks shall have a 72-hour rechargeable battery reserve in the event of mains failure.

The motor shall be separately protected by a correctly rated single pole MCB.

A manual bypass switch shall be provided to permit the circuit to be switched "ON" or "OFF" manually without affecting the operation of the time switch.

Daily time-switches shall have a 24 hour dial, with day and night indication, that can be set with a minimum accuracy of 30 minutes unless specified otherwise.

Weekly time-switches shall have a 7-day dial, with clear indication of the days of the week that can be set to a minimum accuracy of 4 hours.

Switches intended for incorporation into distribution boards must be suitable for rail mounting.

The switch intended for wall mounting shall be housed in a dust tight moulded plastic or metal case, consisting of a plastic clip on front cover and a moulded plastic or metal base and be provided with a suitable positioned 20 mm conduit knock out.

When required, motorised time-switches are indicated as either "T" or "MT" on the schematics or schedules.

5.13.5 *Digital Time Switches*

Digital time switches shall be of the single channel type, suitable for 230 V systems with contacts rated at least 16 A, 230 V, AC1.

The switch shall be microprocessor based with at least a 100 hour battery reserve. The operating temperature range shall be at least –10°C to +45°C.

The switch is to be provided with a liquid crystal display for indicating time and/or the settings. The time stability shall be at least 1 second/day. The display must also indicate the operating condition (ON/OFF) of the switch.

Daily time switches shall have a setting capacity of 12 programme steps (6 programme pairs).

Weekly time switches shall have a setting capacity of at least 128 switching times.

The minimum switching time is to be not more than 1 minute.

Switches are to be provided with a clip for DIN rail mounting and must be enclosed in an IP 52 box, if wall mounted.

5.13.6 *Programmable Electronic Timers*

Timers must be of the plug-in module construction. Each timer is to be housed in a dust tight housing with the timing range clearly marked on the front and must be provided with a calibrated setting knob.

The timer must be suitable for either 230 or 400 V operation, as applicable, and have a contact rating of 10 A/230 V AC1 for single pole or 5 A/230 V AC1 for double pole. Contact life is to be at least 100 000 operations at full load.

The operating temperature range is to be at least –10°C to +50°C.

The time adjustment range must be at least 12:1.

The front of the timer must be provided with a small indicating light to show the relay is energised.

5.13.7 *Micro gap switches*

Microgap switches shall be suitable for ratings up to 400 A at 660 V (triple pole) and may be used for main and distribution switches in domestic applications, offices, small factories and similar applications.

Double pole switches shall be suitable for voltages up to 250 V.

The switches shall comply with SANS 1671-6 and SANS 60947-3.

Microgap switches may be used on AC circuits only.

Metal clad and moulded casings are acceptable.

Microgap switches shall be capable of carrying rated current continuously and making and breaking rated current.

Heavy, fully accessible, brass terminals with two screws each shall be provided to facilitate easy wiring. Contacts shall have large contact surfaces, made from high quality material such as solid silver.

The "ON" and "OFF" positions and the rating of the switch shall be clearly and indelibly marked.

5.13.8 *Indoor Surge Arrestors*

Surge arrestors shall be of the gapless metal oxide type and shall comply with the requirements of SANS-IEC 60099-4 or SANS-IEC 61643-1 or VDE 0675.

Low voltage surge protection devices shall be fitted to each phase and neutral of all distribution and motor control boards, irrespective of the lightning ground flash density of the area.

Arrestors intended for use on 230 V systems must have a rated voltage of not less than 270 V.

Arrestors shall at least have a rated nominal discharge current of 5 kA. The residual voltage at a 5 kA discharge current shall be less than 1 kV.

Surge arrestors shall be suitable for installation at altitudes of up to 1800 m above sea level.

The unit shall be supplied complete with a galvanised steel mounting bracket for convenient mounting onto the metalwork or tray of a switchboard.

Alternatively, the unit shall be of the type which can be mounted into the clip tray of a switchboard or for DIN rail mounting.

Surge arrestors shall be provided in all cases where a switchboard is supplied directly from an overhead line.

In other cases, surge arrestors, if required, will be specified in the "Detailed Technical Specification".

5.13.9 *Terminal Connectors*

Terminal connectors shall hold the conductor by means of a clamping plate held down by the securing screw.

Connectors shall be of the individual variety which are assembled on to a mounting rail and held in place by means of a securing plate at each end.

The minimum size used must be able to accommodate a conductor in the range 1 to 6 sq.mm².

All connectors and the wires connected to them must be numbered and these numbers reflected on the "as built" drawings.

5.13.9.1 Interposing relays

Multi-contact interposing relays shall be incorporated into panel circuitry where only one pair of initiating contacts is provided for the operation of separate circuits performing different functions simultaneously, e.g. a control initiation with alarm annunciation and data logging. The relays shall be so connected that a failure in any one circuit shall have no effect on any other.

Independent relays shall be employed for this purpose, and the use of spare contacts on interface relays fitted within annunciator units or other secondary circuit equipment, or any other form of cascade operation in which the performance of one circuit is dependent on the correct operation of another, will not be accepted.

5.13.10 *Nuts, Bolts, studs and Washers*

Nuts, bolts, studs and washers for incorporation in the plant shall conform to the requirements of the appropriate approved standard. Bolts shall be of sufficient length that one thread shall show through the nut when in the fully tightened condition.

Washers, locking devices and and-vibration arrangements shall be provided where necessary and shall be subject to the approval of the Employer's Agent.

Where bolts pass through structural members, taper washers shall be fitted where necessary to ensure that no bending stress is caused in the bolt.

Nuts, bolts and screws incorporated in items of plant shall be sherardized.

Where incorporated, items of plant and equipment which are submerged in water, nuts, bolts, screws and other fixings shall be made of nickel-bearing, steel.

5.13.11 *Fabrics and Wood*

Fabrics, cork, paper and similar materials which are not subsequently to be protected by impregnation, shall be treated with an approved fungicide. Sleeving and fabrics treated with linseed oil varnish shall not be used.

The use of organic materials shall be avoided as far as possible, but where these have to be used they shall be treated to make them fire-resistant and non-flame propagating.

The use of wood shall be avoided as far as possible and only when approval has been received by the Employer's Agent. If used, woodwork shall be thoroughly seasoned approved hardwood which is resistant to fungal decay and free from shakes and warp, sap and wane, knots, faults and other blemishes. All woodwork shall be treated to protect it against damage by fire, moisture, fungus, bacterial or chemical attack, unless it is naturally resistant to those causes of deterioration. All joints in woodwork shall be dove tailed or tongued and pinned. Metal fittings shall be of non-ferrous material. Adhesives shall be specially selected to ensure the use of types which are impervious to moisture. Synthetic resin cement only, shall be used for joining wood. Casein cement shall not be used.

5.14 INSTALLATION

LV switchboards and distribution boards and motor control panels shall be erected, installed and commissioned in the positions shown on the drawings. The installation shall be arranged to suit the general installation programme. All floor-mounted switchboards must be bolted securely to the floor.

During transport to site and installation, the boards shall be protected against mechanical damage and vibration.

Boards shall not be moved onto site nor installed until all building services and finishing trade work has been completed in the room or vicinity of where the boards are to be installed.

The boards shall be installed in such a manner as to facilitate extensions, maintenance, testing and repair work with easy access to cable entries/ terminations, current transformers, potential transformers, small wiring terminal boards and relays, and busbar connections.

Prior to the on-site tests, all screws, bolts, joints and cable terminations shall be checked for tightness. Busbar joints and cable terminations must be torqued to the correct tension.

5.15 INSTALLATION / SHOP DRAWINGS, MANUALS AND SAMPLES

5.15.1 *General*

The Contractor shall provide all drawings, manuals and samples as specified below.

Detailed drawings of all equipment shall be submitted to the Employer's Agent in triplicate for approval well in advance of the latest ordering date and in all cases at least 2 weeks in advance of the latest manufacturing commencement date.

Under no circumstances will these requirements be waived. Any delays or increased costs due to non-compliance with these requirements will be for the contractor's account.

The approval of the drawings shall not relieve the manufacturer of his responsibility to the employer to supply the equipment according to the requirements of this specification.

The Contractor is to submit two (2) copies of shop and installation drawings to the Employer's Agent for review.

5.15.2 *Shop drawings*

As a minimum, the shop drawings shall indicate schematic wiring diagrams, symbol legend, equipment schedule and construction drawings showing:

Details of construction, front view, side view and section through board and equipment, dust proofing, access and cable terminations, etc.

The internal arrangement to show details of the housing over, indicating door positions, roof line, etc.

A schedule cross referenced listing all equipment within the board with the total quantities, manufacturer's names, current ratings and time settings.

Busbar and dropper bracing and support details. Where the system fault level exceeds 15ka specimen calculations or test reports of the busbar supports in substantiation of short circuit capacity of the system.

Busbar section and size including selection/sizing criteria and calculations in substantiation of the full load rating.

All labelling information in both official languages on a separate sheet.

5.15.3 *Installation drawings*

As a minimum, the dimensioned installation drawings shall indicate:

Position of switchboard relative to cable trenches, cable trays, adjacent walls and equipment.

Surrounding clear space between walls and adjacent equipment for access and maintenance purposes.

Cable entry details, and cable routing and crossover aspects when entering the board.

Details of supports across trenches and the interface between the cable trench covers and switchboard.

5.15.4 *Samples*

Where switchboards and sub distribution boards are to be provided by manufacturers other than those recommended, the contractor shall provide samples of the equipment, material, quality and workmanship to be inspected for approval.

These samples may take the form of existing equipment provided by the particular supplier for previous contracts, providing the location of the equipment is local to and within 10 kilometres of the Employer's Agent's offices.

The Employer's Agent may also request physical samples of items of equipment be submitted for approval during the detailed Employer's Agenting phase.

5.15.5 *"As Built" Drawings and Manuals*

The "As Built" Drawings and Manuals shall comprise the relevant final as approved and installed installation and shop drawings. The maintenance and fault finding manuals shall be explicit, shall cross reference to the drawings, schematics and control logic diagrams and shall provide full maintenance details, requirements, methods and schedules for each and every type of device employed. Furthermore, the manual shall contain spare parts lists and numbers for all equipment and the names of the suppliers from whom the equipment is to be obtained.

Manuals must also include all test results and the settings of all protective, control and indicating devices as applicable.

Manuals must be provided in a hard cover loose-leaf file, properly indexed with full page separators between each section.

Full and detailed Technical literature and operating procedures must be provided for all items of equipment. At least one original manual must be provided for each corresponding item of equipment, up to the required number of five (5).

Five (5) copies of the "As Built" drawings and Manuals shall be submitted to the Employer's Agent within two weeks after delivery of the equipment.

5.16 INSPECTIONS, TYPE TESTS, TESTS AND COMMISSIONING

At the time of tender the manufacturer is to demonstrate compliance with item 7.5.1 of SANS IEC 60439 part 1, that assemblies shall be so constructed as to be capable of withstanding the thermal and dynamic stresses resulting from short circuit currents up to the rated values. This will take the form of type test results on similar arrangements or extrapolation from type tested arrangements or agreement to conduct short circuit tests on the completed assembly.

Prior to commencement of manufacture, the contractor shall provide typical samples of the quality of work and finish to be expected from the board manufacturer.

The contractor shall keep the Employer's Agent informed of the manufacturing progress and shall arrange periodic works and site inspections and tests as required.

As a minimum, the final inspections and tests shall include:

The provisions of SANS IEC60439 part 1.

Visual inspection of the board, busbar, joint tightness, switchgear operation, etc.

2 kV AC / 1 min test of all control and power circuits.

Primary injection test of all CT's for use in protection, indication and metering circuits. This test current must be of sufficient magnitude to verify the correct ratio of the CT and the indicating/metering device. Electronic overloads used in ACB's and MCCB's may be tested using secondary injection from a specialised tester provided by the Manufacturer/Supplier.

Operation and testing of all control, indication, metering and protection systems.

Final check of all protection system settings and the co ordination and discrimination between associated devices.

5.16.1 *Energization of the board.*

Check on phase rotation, voltage drop, load balance, earth continuity and resistance.

All test results must be recorded by the Contractor and included in the manuals.

Each distribution or control board that is delivered to site shall be accompanied by a certificate of compliance issued by the manufacturer's accredited person.

5.17 RECOMMENDED MANUFACTURERS AND SUPPLIERS

The user has the final say in specifying the preferred equipment manufacturers. The project specific specification will give guidelines, however it is imperative for the Tenderer to ensure that the equipment quoted is in conformance with the users requirements.

To this end the following list is a guide for the equipment types to be clarified during tender stage as to the preferred manufacturer.

1. Air Circuit Breakers
2. Moulded Case Circuit Breakers
3. Combination Fuse Switches
4. HRC fuses and cartridges
5. Contactors and overload relays
6. Relays and timers
7. Terminal Blocks
8. Push Buttons, selector switches and pilot lights
9. Electric timers
10. Non-metalic Switchboards and distribution kiosks
11. Switchboards
12. Motor control borads,
13. Soft Starters
14. Variable Speed Drives (VSD/VFD)

6 LV CONTROL GEAR & MCCS (200 - 650 VOLTS AC/DC)

6.1.1.1 Panel heating

Each cubicle shall be fitted with one or more thermostatically-controlled tubular heaters to prevent condensation and assist ventilation. The rating shall not exceed 60 watts per linear metre and the surface temperature of any part that may be contacted accidentally shall not exceed 65°C. The heaters shall be so situated that no deterioration can be caused to any of the apparatus or wiring in the cubicle. The heating circuit shall be independently fused, and controlled by a suitably labelled rotary pattern enclosed switch mounted in an accessible position within the cubicle.

6.2 PLANT

6.2.1 *Setting out*

The Contractor may use any acceptable device to control the alignment and installation of electrical plant and equipment

6.2.2 *Temporary supports*

The Contractor shall provide such temporary supports as are necessary, in the vicinity of the permanent supports, to ensure that electrical plant and equipment is installed true to level and alignment.

6.2.3 *Handling and rigging*

The mechanical plant and rigging equipment used by the Contractor for the handling and placing of electrical plant and equipment shall be such that no electric motor, switchgear, instrumentation, panel and control board is overstressed or damaged during any operation covered by the specification.

6.2.4 *Testing*

The Contractor shall provide all the necessary testing equipment for the performance of the tests.

6.3 INSTALLATION AND OPERATING REQUIREMENTS

6.3.1 *Working in the vicinity of electrical equipment*

Any permanent fencing or other safeguards, required to be erected around electrical equipment, shall be completed as far as practicable before connection is made to the electricity

supply, but where this is not practicable the Employer's Agent may permit the use of temporary fencing or other safeguards.

If the work in the vicinity of electrical equipment has to be carried out after connection has been made to the electricity supply the Contractor:

(a) shall put into operation a "Permit to Work" system to the approval of the Employer's Agent; and

(b) shall comply with any "Permit to Work" system approved by the Employer's Agent.

6.4 TOLERANCES

The tolerances specified in BS 4999 : Part 69 shall apply to all rotating electrical machinery.

6.5 TESTING/COMMISSIONING

Where applicable, refer to the detailed specifications.

7 ELECTRIC MOTORS

7.1 SCOPE

This specification deals with constant speed, low voltage (up to and incl. I 000 V), a.c., induction motors and in general terms, for variable speed motors from 1 kW up to 450 kW.

7.2 DESIGN, MATERIALS AND MANUFACTURE

7.2.1 *Electric motors*

7.2.1.1 General

Motors should be designed and manufactured in accordance with the following latest standards but may be superseded by the specifics given in the DETAILED ELECTRICAL SPECIFICATION.

a) SANS 1804-1

b) SANS 1804-2

c) SANS 1804-3

d) SANS 1804-4

All-encompassing standards as noted in the SANS 1084 Parts 1 to 4 standards shall be applicable and applied.

Unless otherwise stated, all motors shall be wound for a three-phase, nominal voltage 400V with a ± 10% variation.

Motors specified to be single phase shall have a nominal voltage of 230 V with a ± 10% variation.

Constant speed a.c. motors shall be of the induction type suitable for operation on a 3 phase supply and shall be capable of operating continuously, at rated torque, at any voltage between ± 10 per cent of the nominal value, nominal frequency ± 2 Hertz, and the altitude specified.

Variable speed motors shall be of a type to be approved by the Employer's Agent

7.2.1.2 Ratings

Motors shall have continuous maximum ratings not less than the following:

20 kW or under, not less than 33% in excess of the maximum load within the operating range.

Over 20 kW and up to 50 kW, not less than 25% in excess of the maximum load within the operating range.

Over 50 kW and up to 100 kW, not less than 15% in excess of the c maximum load within the operating range.

Over 100 kW, not less than 10% in excess of the maximum load within the operating range.

Where operation at other than continuous running duty is required (i.e. short time or intermittent periods as for valve actuators, hoists, etc), motors shall have appropriate rating in respect of output, duty and starting class.

7.2.1.3 Windings

Windings shall be impregnated to render them non-hygroscopic and oil resistant, and shall be braced to prevent any movement of the coils during,- all conditions of service.

Motors operating in an ambient temperature range not exceeding -10° to + 40°C with a 24 hour maximum ambient temperature of +35°C with 95% relative humidity shall be insulated to BS 2757 Class F. Where the motor temperature may be appreciably affected by conducted heat, motors shall be designed to have a Class B temperature rise but shall have Class F insulation. The end of each phase winding shall be brought out to the stator terminal box.

Unless otherwise specified, the maximum continuous working temperatures of motors shall be as specified by SANS 1804 PARTS 1 TO 4, BS 4999 : Part 32 and BS 5000 : Part 99 applying to the temperature rise of the windings, as determined by their increase in resistance.

The following maxima shall apply:

	(degrees Centigrade)		
Class	**Rise**	**Ambient**	**Total**
B	80	40	120
F	100	40	140
H	125	40	165

7.2.1.4 Enclosures

Enclosures for indoor use shall afford a degree of mechanical protection not less than IP 44 to BS 4999 : Part 20 and where applicable SANS 1804 PARTS 1 TO 4, and be self-ventilating.

All motors required to operate out-of-doors shall be totally enclosed fan cooled with mechanical protection not less than IP 54.

Cooling arrangements shall be in accordance with SANS 1804 PARTS 1 TO 4, IEC 34-6 and BS 4999 : Part 21 and shall comprise two separate air circuits, to Code IC 01 41.

All motors shall be provided with suitable means of breathing and drainage to prevent accumulation of condensation.

7.2.1.5 Bearings

(a) Type

Bearings shall be plain ball or roller type as appropriate. Vertical shafts shall have approved thrust and guide bearings. Grease-lubricated bearings shall be sealed or re-greasable.

Ball or roller bearings shall be loaded conservatively in order that the grease may be renewed at intervals of not less than one year and they shall not be equipped with grease nipples or cups. If these are supplied, they shall be replaced with threaded plugs.

Care shall be taken that bearings are sealed properly in order to prevent ingress of bearing lubricant into windings and cores. For purposes of maintenance, end-shield bearings are preferred. A minimum bearing life of 40 000 hours is required. Unless otherwise approved in writing, motor bearings shall be designed to allow the motor to run indefinitely when uncoupled from the driven machine.

Subclauses 14.1 to 14.5 of GIBB 002 shall apply where relevant.

(b) Insulation

When necessary, to prevent damage by any shaft currents which may be produced, the bearings and their lubricating and cooling systems shall be insulated from the bedplate or frame.

(c) Flow indicator

A flow indicator and/or pressure switch shall be provided on forced lubricating systems to indicate failure of the system. Adjustable alarm and cut-out contacts shall be provided.

(d) Thermometers

Where specified in the Project Specification, dial type bearing thermometers with adjustable alarm and cut-out contacts shall be provided. Where such thermometers are also provided on the pump, the same type and manufacture shall be used.

7.2.1.6 Anti-condensation heaters

Anti-condensation heaters shall be provided on all motors except those in submersible applications. The heaters shall be suitable for use on a single phase, nominal voltage 220 V + 5%, 50 Hertz a.c. supply and wired to a separate terminal box.

Unless otherwise specified, anti-condensation heaters shall operate continuously whenever the motor is at standstill.

7.2.1.7 Earthing

All motors shall be provided with a machined boss tapped for a bolt of suitable size for earthing purposes.

7.2.1.8 Noise levels

Equipment or a combination of equipment shall not exceed the maximum noise limits in decibels, in each octave band of the 85 dBB sound pressure level is given below.

Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
dBB	-	-	-	-	79	78	78	80
dBC	104	94	87	92	-	-	-	-

Measurement of equipment and equipment train sound pressure levels shall be taken at a horizontal distance of 1 m from all major surfaces and at a height of 2 in above the equipment. Sound pressure measurement procedures shall be guided by the provisions of SANS 10083 and as applicable of ANSI SI.1: “Physical Measurement of Sound”. (Alt. refer to BS 4999 : Part 51 Test Method II.)

7.2.1.9 Balance and critical speed

Motors and couplings shall be accurately and efficiently balanced statically and dynamically so that there will be no unbalanced end thrust, when either new or worn, and to eliminate noise and vibration when running. Where end thrust arises, adequate long-wearing thrust bearings shall be provided. Dynamic balancing shall be done by the removal of parent metal in a manner which does not affect the structural strength of the rotating element.

The use of solder or similar deposits for balancing not be accepted. The operating speed of rotating elements shall be below, and as far removed as possible from, the critical resonant speeds thereof.

Operating vibration levels of all rotating equipment installed shall be to the satisfaction of the Employer's Agent. Strict attention shall be paid to this aspect of the installation.

Peak-to-peak vibration limits shall apply to all horizontal drive machines with anti-friction bearings. These limits shall apply to rotor vibration during shop tests and after installation with the associated pipework, and shall be measured at rated speed and at a capacity Of Within 10 per cent of the rated capacity.

Peak-to-peak vibration limits shall be in accordance with the relevant part of BS 4999.

Notwithstanding the acceptance of the vibration limits during the works test, the Employer's Agent reserves the right to call for a vibration test on the installed equipment, if he considers it necessary, and the Contractor shall be responsible for reducing the vibrations to within the specified peaks.

7.2.1.10 Temperature detectors

All motors > 45 kW and < 132 kW rating shall have, embedded in their stator windings, one PTC thermistor per phase suitable for Class B temperature rise. All motors rated 132 kW and over shall have, embedded in their stator windings and bearings, one platinum RTD of type PT1OO per phase and per bearing. The bearing detectors shall touch the outer bearing race, shall be spring loaded and shall be of the screw type. The characteristics of these temperature detectors shall match the thermal limitations of the motor electrical insulation.

The wires of all detectors shall be wired to a terminal strip in a suitable terminal box.

7.2.1.11 Cast Iron

Cast iron shall be to BS 1452, Grade 14, or better.

7.2.1.12 Mild steel

Mild steel plate for fabricated parts shall be of weldable quality in accordance with BS 4360.

No welding, burning in, filling, plugging up or metal deposition to correct defects in any component will be permitted, unless agreed to by the Employer's Agent, in writing, following an inspection of the defect.

7.2.1.13 Terminal boxes

The terminal box for the supply cables shall be suitable for the cables specified and shall be oversized as may be required to accommodate a termination gland one size larger than the size necessary for the specified feeder cable. It shall have a removable cover and gland plate. The degree of protection shall not be less than IP 55. (Hoseproof)

Cable outlets shall be capable of pointing to any of four directions at 90 degree intervals.

Heaters and embedded temperature detectors shall be wired up to separate secondary terminal boxes. These boxes shall be suitable for an an armoured multi-core cable and shall be oversized.

All terminals shall be properly and permanently marked for easy identification.

Terminal boxes shall be on the right hand side when viewed from the drive end, as required by SANS 1804 Parts 1 TO 4, unless otherwise specified in the Project Specification.

7.2.1.14 Interchangeability

All similar parts shall be made accurately to dimensions, and shall be interchangeable With each other, so that a spare part, or any part of another similar motor, can be, used satisfactorily in the relevant position on a motor without recourse to additional machining or filing.

7.2.1.15 Rotation

The standard direction of rotation shall be clockwise looking on the shaft, as required by SANS 1804 Parts 1 to 4.

All a.c. motors shall be capable of having their direction of rotation reversed, merely by interchanging the supply leads. a.c. motors fitted with unidirectional fans, and therefore not capable of being easily reversed, shall where necessary be supplied with a double-ended shaft, and the holding-down bolt holes shall be symmetrical about both centre lines. This will permit the motor to be rotated through 180 degrees and coupled up to the load, giving an opposite drive. The above arrangement also requires that two motor terminal boxes are provided diametrically opposite each other. The correct direction of rotation of a unidirectional motor shall be indicated in a permanent manner on the frame.

The normal rotation of the motors shall be coordinated by the Contractor with the supplier of the driven equipment

7.2.1.16 Double shaft extensions

The unused shaft extensions of a double-ended shaft motor shall be covered with an approved rust preventative after the motor is commissioned. A suitable cover shall be provided for the unused bare shaft extension.

7.2.1.17 Mounting

The motors shall be mounted as required by the driven equipment supplied.

Horizontally mounted motors shall be mounted on a common base-plate with the driven equipment unless this is impossible e.g. installation of flywheel between motor and driven equipment. When uncoupled from the load, it shall be possible to lift the motor clear without Withdrawing the rotor and with the minimum amount of dismantling.

7.2.1.18 Nameplates for motors

The nameplates shall be made of corrosion-resistant metal and shall be permanently attached to the motor.

In addition to the information required by SANS 1804 Parts 1 to 4 the following shall also be marked on the nameplates of motors > 110 kW:

- Year of manufacture
- The order number
- Total mass of motor in kg
- Diagram indicating the number, type and positions of heaters and temperature detectors.
- Bearing types and sizes.
- Bearing grease interval or bearing replacement interval where pre-packed bearings are used.

7.2.1.19 Couplings

Subclause 20 of GIBB 002 shall apply.

7.2.2 *Type of motor*

7.2.2.1 Squirrel cage induction motors

Squirrel cage induction motors shall be suitable for direct-on-line starting at full voltage. The starting current of motors shall not exceed the limits specified in IEC 947. For two speed motors, the starting current shall not exceed 6,0 times the full load current of the high speed rating. All motors shall be capable of starting against the associated load with a minimum accelerating torque of not less than 5 per cent of full load torque when the voltage at the motor terminals during starting is reduced to 80 per cent of the nominal value.

7.2.2.2 Slipring induction motors

The slipring and brushgear shall be separately ventilated; brush dust shall not be drawn into the machine windings. The brushgear shall be of substantial design constructed with a view to minimising maintenance. Brush holders shall be designed so that adjustments of brush pressure are easily made and so that brushes can be easily removed and replaced. Removable covers shall be fitted to provide safe and easy access to the brushgear.

7.2.2.3 Borehole submersible electric motors

The motors shall be of the three phase squirrel cage wet type suitable for a nominal voltage 380 V + 5%, 3 phase, 50 Hz, a.c. supply. The motor casing shall be of steel double surface protected. The bolts and nuts shall be 316 stainless steel. The stator windings shall be completely surrounded by water. The insulation shall be very reliable, as thin as practicable, and manufactured in either polyamid or polyethylene. The resistance shall be at least 100 megohms and shall be tested at 2 x Uop + 1000 V. (Uop = operating potential). Unless otherwise specified the motor shall be wired for direct-on-line starting.

The connections between the single windings shall be absolutely watertight. The stator and rotor shall have special protection against corrosion.

An approved overheat protection sensor shall be provided in the motor, with appropriate connections for external monitoring.

The bearings shall be of the journal type made of bronze or rubber adequately sized for the motor to operate in a vertical position to take the axial thrust and shall be water-lubricated. The thrust bearing shall be made of special synthetic material and shall have mechanical and electrical properties of at least 316 stainless steel.

The motor shall be protected against sand and dirt by means of a mechanical seal in the coupling casing. The shaft shall be of at least 316 stainless steel.

To compensate for change in volume with different temperatures in the lower part of the motor, compensating devices shall be fitted.

The pump and motor shall be direct coupled.

7.2.2.4 Portable submersible motors

The stator shall be designed at least to temperature Class F (140'C). The insulation material employed shall be extra moisture-resistant. An approved overheat protection sensor shall be provided in the motor and a leakage detector shall be fitted to the stator casing. The systems shall be provided with appropriate connections for an external monitoring unit, in which over temperature of the motor or leakage shall cause the motor to trip and trigger an alarm.

The motor shall be completely sealed by an oilbath lubricated, double, self-adjusting, mechanical seal on the shaft The seal shall preferably be of tungsten carbide or other material possessing great resistance to abrasion. The motor enclosure shall be at least IP 68 an the cable entry shall be triple sealed.

7.2.3 *Corrosion protection*

Painting of the motors shall be in accordance with GIBB 007 for motors specified in 7.2.2.1 and 7.2.2.2. The motors specified in 7.2.2.3 and 7.2.2.4 shall either be made of non-corrodible materials, or shall be painted in accordance with GIBB 007

7.3 PLANT

7.3.1 *General*

The Contractor shall provide all plant that is necessary to installs test and commission all items of equipment covered in this Specification.

7.4 INSTALLATION AND OPERATING REQUIREMENTS

7.4.1 *Insulation resistance*

Before energising any of the motors covered by this Specification for the purpose of commissioning, the Contractor shall measure the insulation resistance of each motor between phases and to casing by means of a 500 Volt “Megger” instrument and the values shall be recorded and forwarded to the Employer’s Agent for information. If any of the readings for a particular motor are lower than 1,5 megohms that motor shall not be energised until it has been dried out by the Contractor by a method to the Employer’s Agent’s prior approval. Until the lowest of the insulation resistance measurements on that motor exceed 1,5 megohms the motor shall not be energised.

The method adopted for drying-out shall be by applying heat, preferably by circulating current through the windings or, alternatively, by means of space heaters located in and around the machine.

Insulation resistance measurements and temperature readings shall be taken regularly every half hour at the start of dry-out until the motor attains an even temperature and thereafter every hour. The characteristic dry-out curve of insulation resistance versus temperature shall be plotted and dry-out may be considered complete four hours after the resistance readings have started to rise from the steady minimum value, providing that the winding temperatures have remained steady during this period.

All equipment, and the personnel required for the drying-out operation, shall be provided by the Contractor. The onus remains on the Contractor to satisfy himself that a motor is dry before it is connected to the supply. Any motor which fails as a result of being commissioned in a damp condition shall be repaired free of charge by the Contractor.

The Contractor shall liaise with the contractor commissioning the motor control equipment.

7.4.2 *Borehole submersible electric motors*

The motor shall be filled with clean filtered water as part of the installing operation.

7.4.3 *Erection and commissioning*

7.4.3.1 Erection

Where practicable, motors of 110 kW or larger shall be erected by the motor supplier. Care shall be taken to ensure that adequate tolerance margins are made available to ensure interchangeability with replacement motors. In particular a minimum of 10 mm of packers shall be provided under the motor frame or motor bed-plate to allow for adjustments in height.

Before holding-down bolts are grouted in, the motor shall be lined up and the bolts shall be properly centred in the hole of the bed-plate.

The Contractor shall satisfy himself that the motors are properly installed, aligned and sufficiently protected, and shall check the settings of all motor protection gear before any motor is switched on.

The Employer's Agent shall be notified at least 7 days in advance of any commissioning or testing to enable him to be present.

7.4.3.2 Alignment

After erections the alignment of the half-coupling between the motor and the driven machine shall be measured. In the case of a pedestal bearing motor, the air gap clearance between the rotor and the stator shall also be measured. A record shall be kept of these figures and they shall be submitted to the Employer's Agent for approval.

A horizontal sleeve bearing or limited end-float roller bearing motor shall be run uncoupled from its load to ensure that it rotates at the axial position indicated on the shaft and that the rotor is free to move to either side of this position. Particular attention shall be paid to ensure that the free running- position and the rotor end-float are in agreement with the axial movement of this flexible coupling.

Refer also to **GIBB 002** as relevant.

7.4.4 *Drawings and information for approval*

The following drawings and information shall be submitted for approval before manufacture of motors of 132 kW or larger commences:

(a) Dimensioned outline and required foundation drawings of the motors. (Shaft diameter, shaft height and motor mass to be clearly shown).

(b) Cross-sectional dimensioned drawings of the cable terminal boxes.

(c) Detailed drawings of the motor base plate showing full constructional details with dimensions.

7.4.5 *Inspection of manufactured equipment*

7.4.5.1 General

The Employer's Agent, or his appointed representative, reserves the right to inspect the motors or associated parts at any stage of manufacture.

The Contractor shall ascertain whether inspection is required and the Contractor shall then give the Employer's Agent not less than seven days notice of when the inspection may be undertaken.

7.4.5.2 Bearing Inspection

The Employer's Agent reserves the right to inspect any motors fitted with ball/roller bearings. The grease in the bearings must not be hard. Providing that no roughness is felt when the shaft is rotated by hand, and that the motor runs without undue noise or vibration, the bearings will be considered acceptable. Should the bearings fail or exhibit symptoms of brinelling during the guarantee period, they shall be replaced by the Contractor, free of charge and without delay.

7.5 TOLERANCES

7.5.1 *General*

The tolerances specified in BS 4999 : Part 69 shall apply, where relevant.

7.6 TESTING/COMMISSIONING

7.6.1 *Routine tests*

Motors shall be tested at the maker's works, and test certificates shall be endorsed to the effect that the motors are properly balanced and free from vibration and comply where applicable with SANS 1804 Parts 1 to 4 for Routine Tests. Tests shall include a locked rotor test to establish the maximum starting current.

In addition to the routine tests specified in SANS 1804 Parts 1 to 4, all the resistances of temperature detectors and heaters shall be measured.

7.6.2 *Type tests*

With each motor an appropriate manufacturer's Type Test certificates as described in SANS 1804 Parts 1 to 4, shall be submitted.

7.6.3 *Test Certificates*

Four copies of all test certificates, showing the results of all tests performed, shall be supplied at a date not later than the delivery date of the motors.

7.6.4 *Cast iron*

Cl shall be tested in accordance with BS 1452.

7.6.5 *Noise level tests*

The provisions of Subclause 7.3.1.9 shall apply.

7.7 MEASUREMENT AND PAYMENT

7.7.1 *General*

Measurement and payment shall be in accordance with the Relevant Clauses of the Specific specifications.

7.7.2 *Type tests*

The cost of Type Tests, as described in Subclause 7.7.2, shall be included in the tendered rates or sums which cover the supply of the relevant motors.

8 LV & MV CAPACITORS FOR P-F CORRECTION

8.1 SCOPE

This section covers the manufacturing, installation and testing of indoor capacitors used for improving the power factor of 3 phase motors and other large equipment installations with voltages up to 11 000 volts. It does not cover small capacitors, such as those used in luminaires or single phase motors.

8.2 STANDARDS

All materials and apparatus shall be new and of the best quality and shall comply with the relevant current specifications of the SANS, BS1 or IEC and as stated in this document.

The following standards are to be used as a guide but must not be regarded as a complete list:

IEC Publication No 60831; 60871; 60931
NEMA Publication CP1
BSI 1650
ANSI C55.1
VDE 0560
Occupational Health & Safety Act No 85 of 1993

8.3 Construction Requirements And Finish

8.3.1 *Standard Sizes*

A standard size of kVAr rating that is available ex stock shall be used for each individual capacitor unit. Intermediate sizes or purpose made capacitor units shall be avoided unless specifically specified. Capacitor units shall be of modular design enabling multiple units to be connected together to form a bank of units.

8.3.2 *Housing*

The complete capacitor can, including the terminal cover, shall be made of 3CR12 steel or primed and painted to the manufacturer's recommendations with either enamel or epoxy paint. The final paint colour shall be as specified in Section 9

The capacitor can shall be of the enclosed DEAD CASING design and include an earth terminal.

Each capacitor can shall be fitted with a nameplate with information as listed in the IEC specifications.

8.3.3 *Dielectric and Internal Construction*

The design of construction should be to reduce losses and to increase the repeated switching withstand ability of the capacitors.

Capacitors up to 22kV should employ a wettable film dielectric situated between aluminium foils with folded foil edges to reduce stresses or an acceptable alternative construction.

Medium voltage capacitors of 33kV and above should employ a plastic film and low loss paper situated between aluminium foils or an acceptable alternative construction.

8.3.4 *Impregnation*

Under no condition shall capacitors impregnated with PCB (Poly Chlorinated Biphenyls) be used.

Impregnants used shall be fully bio degradable.

The impregnant liquid shall be non inflammable, non toxic, highly stable and allow low loss and long life.

An important characteristic of the impregnant is that it permits a partial discharge of the capacitor upon disconnection.

8.3.5 *Dielectric Losses*

Dielectric losses will vary depending upon the size of the capacitor and the ambient temperature, but nevertheless should be designed for minimum loss.

For performance comparisons the following are listed :

An all film medium voltage capacitor should have an initial loss of less than 0,2% of the reactive power (less than 0,2 watts per kVAr) at 20% and reducing with operating time and ambient temperature.

A MV capacitor employing a plastic film and low loss paper between aluminium foil should have an initial loss of less than 0,1% of the reactive power (less than 1 watt per kVAr) falling to 0,05% after 500 operating hours.

8.4 DISCHARGE RESISTORS

All capacitors shall be fitted with discharge resistors mounted externally or internally to reduce the voltage when disconnected.

Discharge resistors used on LV capacitor systems shall reduce the voltage to 50 volts in less than one minute of disconnection.

Discharge resistors used on MV capacitor systems shall reduce the voltage to 50 volts in less than five minutes of disconnection.

With automatic switching systems where a rapid discharge of less than ten seconds is required to suit the load condition, discharge reactors shall be fitted inside the same chamber as the current limiting series reactors attached to the capacitor bank of each step.

8.5 FUSE PROTECTION

Each capacitor unit or bank of capacitors shall be provided with suitable protection.

Unless otherwise specified, fuses for medium voltage capacitors may be located either internally or externally. The fuse protection shall be carefully rated to avoid a gas build up or the capacitor case rupturing.

Where an automatic step controller is used for banks of capacitors, and to ensure reliability of the system, individual separate fuses shall be provided for each control circuit step. Should a fault

develop within one step then the control fuse for that faulty step should blow to enable the other steps to function normally.

8.6 ELECTRICAL OVERLOADS AND TOLERANCES

Notwithstanding the requirements of the various standards, capacitors shall be rated to accept the following overloads :

20% excess voltage continuously
40% excess current continuously
20% excess kVAr continuously

The above overloads are applicable at an ambient temperature of 40°C conti¬nuously or 45°C for a continuous 6 hour period within 24 hours.

Where large single phase medium voltage capacitors are used in large banks in a star point unbalance protection system, it is important that the capacitors are manufactured to close matching tolerances to ensure any unbalance current is kept to the desired minimum value refer to IEC 60871 & IEC 60931.

8.7 MOUNTING RACK FOR MULTIPLE CAPACITOR CANS

The mounting rack design shall facilitate inter connecting capacitor cans into a composite bank which is to be easily extendable for future capacitors and suitable for a single cable entry. The rack shall also incorporate a cubicle for the switching surge inductors and all necessary control systems.

All live parts shall be fully enclosed. The design of the enclosure shall in no way reduce the cooling of the capacitor units.

8.8 TESTING

Factory tests shall include the following and where applicable, shall comply with the various tests listed in IEC 60831; 60871; 60931.

1. Leak test.
2. Initial capacitance test.
3. AC high voltage test to case (two or three busing units only) refer IEC 60871 Test Tables.
4. Terminal to terminal over potential test at 4.3 times rated voltage for 10 seconds DC test.

5. Discharge test. One shot 500 1000 times rated current.
6. Terminal to terminal discharge resistor test.
7. Final capacitance measurement.
8. Power factor at elevated temperature and rated voltage to detect correct impregnation.
9. Sonic corona to detect presence of internal discharge. This is a sensitive test to detect full impregnation of the capacitor unit.

The above test results shall be tabulated and shall indicate the manner in which the tests were performed. Full test results shall be submitted to the Employer's Agent prior to installation of the equipment on site.

On site tests and inspections shall include the testing of protection equipment, automatic switching controllers and interlocks mentioned elsewhere in the specification.

8.9 SWITCHING SURGE INDUCTORS

Surge inductors or series reactors (air cored chokes) are to be provided in series with each bank of medium voltage capacitors.

The series reactors are to be designed to limit the inrush transient currents when energising the capacitor bank to a safe value so as to protect both the capacitors themselves and the vacuum contactor or other switching device that may be used. This limiting value should be less than 100 times the rated capacitor r.m.s. current, or 8 kA whichever is the lower.

The design of the system shall be co ordinated with the capacitor switching panels so as to limit the back to back switching surges to that permitted by the capacitors and contactor manufacturer to ensure optimum reliability of all HRC back up protection fuses in the circuit.

If iron cored reactors are used, attention should be paid to possible saturation and overheating of the core by harmonics in the system.

The series reactors should be mounted in a separate panel attached to the capacitor bank.

9 COLOUR CODING, LABELLING AND NUMBERING

9.1 Colour Coding

The colours for identification colour marking of equipment shall be as indicated in the table below where a colour code is not available, the SANS10140 system must be used.

COLOUR	CODE	COLOUR	CODE
Arctic Blue	F28	Light Stone	C37
Black	GH19	Middle Brown	B07
Brilliant Green	H10	Pastel Grey	G54
Canary Yellow	C61	Primrose	C67
Cornflower	F29	Pastel Blue	E70
Crimson	A03	Salmon Pink	A40
Eau de nil	H43	Signal Red	A11
Emerald Green	E14	Strong Blue	F11
Golden Brown	B13	Verdigris Green	E22
Golden Yellow	B49	Water White (Blue)	F29
Jacaranda	F18	White	HG100
Light Grey Green	H40		
Light Orange	B26		

9.1.1 Electrical

ITEMS		COLOUR
Panels and Distribution Boards		
Low Voltage Panels:	Indoor	Light Orange
	Outdoor	Light Orange
Medium Voltage Panels:	Indoor	Admiral Grey
	Outdoor	Admiral Grey
Normal Supply LV Distribution Boards		Light Orange
The standby power sections of DBs		Signal Red

Any Panel which can be supplied by Standby power	Signal Red
Uninterruptable Power Supply/Solar Panel DBs or such sections within composite boards	Water White (Blue)
Small domestic and shop type DBs and boards in open kitchen areas	White
Panel Accessories (Gland Plates, Back Plates, Interior)	White
Other Uninterruptable Power Supply Equipment	Water White (Blue)
Transformers and Distribution Kiosks	Light Stone
Any Transformer which can be supplied by Standby power	Signal Red
Normal Transformer	Light Stone
LV Distribution Kiosks, Mini Subs	Light Stone
Motors	Light Orange (unless required otherwise by plant requirements See GIBB 007)
Standby Electrical Equipment (Permanently Powered)	Signal Red
General Outdoor	Light Grey Green
All Equipment – Interior	White
Surface Conduit Installations (Industrial)	
Electrical	Light Orange
Instrumentation	Pastel Blue
Fire Alarms	Signal Red
Communications and Data (including CCTV)	White
Trunking Wire ways	
Wiring Trunking	The colour code appropriate to the service.
Lighting Channel	Galvanised no colour
Power Skirting and Dado Height Trunking	Galvanised no colour
Cable Ladder-Racks and Trays	Galvanised no colour
Supports, etc	Galvanised no colour
Switched Socket Outlets	As per SANS 10142-1
Non Standard Socket Outlets	As per SANS 10142-1
Plug Tops	To suit circuit (otherwise White)

9.1.2 Fire Extinguishers, Fire Hose Reels, Electrical Distribution Boards and other "Keep Clear" Areas

The demarcation shall be symmetrically 300mm greater than the maximum width of the equipment and extend 500mm from the supporting wall or fixture. An eighty millimetre wide black line, within the demarcated area shall be painted as a border to the demarcation. The remaining inner area shall be painted.

Golden Yellow and the words "KEEP CLEAR" and/or "UNGABEKI" stenciled in the yellow block. The lettering shall be 50mm high where possible.

On expanded mesh or similar perforated floor areas a solid metal plate shall be placed below the equipment on which the demarcation shall be painted.

No separate payment shall be made for painting and corrosion protection. Payment for the requirements of this Section will be included in the payment item for the particular item supplied including painting or corrosion protection.

10 INSPECTION AND TESTING OF WORKS

The Contractor shall attend upon the Employer's Agent as reasonably required for Work inspection. Normally, inspection of Work in progress will take place on the same day as the general site meeting, or such other times as the Employer's Agent may reasonably require. Handing-over inspections will be done at the completion of the Contractor's testing, issuing of the Certificate of Compliance by the Contractor's accredited person, livening the installation by the Supply Authority, commissioning of the installation and upon making a written request for the Employer's Agent to carry out an initial handover inspection.

Where the installation is to be switched on and taken over in portions, the Certificate of Compliance shall be limited to that particular part of the Work. New Certificates of Compliance shall be completed for remaining phases of the project as applicable and the Supply Authority's permission formally obtained to switch electricity to those areas.

The Contractor shall, prior to requesting the Employer's Agent to undertake an initial handover inspection, do a full, complete and proper inspection of his Work to ensure that everything is absolutely complete and in accordance with the Documentation. Following this inspection, and rectification of any faults in parts of the installation that may be required, the Contractor shall make a written request to the Employer's Agent for a handover inspection. Any faults still found in the installation shall be listed by the Employer's Agent and handed to the Contractor who shall attend to all faults within a reasonable period as decided by the Employer's Agent except that this period will in no circumstance exceed 14 days. Once all listed faults have been rectified, the Contractor shall again request the Employer's Agent in writing to carry out a final handover inspection.

Upon the successful completion of a handover inspection and the issuing of a handover certificate by the Employer's Agent, the responsibility for the security of the installation, or part thereof, shall be deemed to be with the Employer.

Under no circumstances will any inspection by the Employer's Agent and/or, if appointed, the Electrical Clerk of Works of Resident Employer's Agent, relieve the Contractor of his obligations in terms of the Documentation.

On completion of the installation, or such part thereof as may be determined by the Employer's Agent, the Contractor shall carry out installation testing and inspection in accordance with the OHS Acts (Act 85 of 1993) Electrical Installation Regulations; SANS 10142-1 and SANS 10142-2 and/or any other relevant Standard as noted in this Contract.

The result of these tests, duly certified by the Contractor, shall be submitted to the Employer's Agent in the form of a typed test-result certificate. No testing for acceptance purposes will be carried out by the Employer's Agent until this is received.

Upon receipt of the test certificate, the Employer's Agent will arrange to carry out acceptance tests and to witness commissioning procedures, including but not limited to pressure testing of MV cables, direct injection testing of relays, indirect testing of relays and CT's, micro ohm testing of bus bars, partial discharge testing of terminations and cables, live phasing of cables, polarity, earth leakage, load-balance, earth resistance, insulation resistance, earth loop impedance, prospective short circuit (PSC), no load voltage, full load voltage, phase rotation, tests etc. Bonding and labelling checks shall also be carried out. If any faults are found in the installation, a list of those immediately noticed will be handed to the Contractor by the Employer's Agent. The Contractor shall forthwith rectify such faults and issue a further test certificate endorsed "RE-TEST" with all reasonable despatch whereupon the Employer's Agent will carry out further check-tests.

Any list of faults issued by the Employer's Agent shall not be regarded as final, but given only for the assistance of the Contractor who will be bound to exercise all necessary diligence in their rectification and to check for any other faults and to rectify same.

The Contractor shall supply all necessary testing instruments for carrying out tests, including, but not limited to: insulation tester, earth resistance tester, PSC/earth loop-impedance tester, clip-on ammeter (e.g.: for load-balance testing), earth-leakage tester, etc. Where there is reason to doubt the accuracy of the instruments, the Contractor shall arrange for tests to check their accuracy.

Where cast-in conduit is installed, the Contractor shall thoroughly check his layout, fastness etc, well before any concrete is poured. The Employer's Agent shall be informed by the Contractor

in writing that he is ready for a check-inspection, giving the Employer's Agent not less than 5 working days' notice (per email and per mobile phone SMS). A qualified operative of the Contractor shall stand by at all times when concrete is being poured so that any conduits or boxes that may become loose, displaced etc. can be refixed.

If it is necessary for the Employer's Agent, his agents or assigns, to spend extraordinary time in respect of checking, testing, inspection or any other matter due to the Contractor's default or unsatisfactory attendance all costs of the Employer's Agent in obtaining remedy shall be for the Contractor's account. For example, if the Contractor failed to carry out his own prior testing in a reasonable and diligent manner, or to check cast-in conduits properly before calling the Employer's Agent to undertake a check-inspection, thus necessitating further visits and/or extra time incurred, costs of the Employer's Agent will be charged to the Contractor. These costs will be deducted from the Contractor's claims, or shall be claimed by submission of an account. Employer's Agent's claims for wasted time, including disbursements, shall be based on the applicable SAACE Form of Agreement for Consulting Services.

HARRY GWALA DISTRICT MUNICIPALITY

CONTRACT NO: HGDM746/HGM/2021

CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM: CIVIL, MECHANICAL & ELECTRICAL

PARTICULAR SPECIFICATION

GIBB 012 – BUILDING WORKS

REV 1.1

Table of Contents

Note: Where a contradiction exists between this Particular Specification and the drawings; the drawings will take precedence.

1 SCOPE

This section of the Specification covers all aspects of brickwork including building in of various items, reinforcing of brickwork etc as well as the supply of all materials and labour.

The Normative Reference is the SANS 10400, The Application of the National Building Regulations as well as the particular specification that covers the various construction activities associated with the erection of buildings with SANS 1200, Standardized Specification for Civil Engineering Construction.

In addition where SANS 10400 refers to other standards and publications, the various construction activities associated such standards and publications shall form part of the Contract only in so far as they are referred to.

2 MATERIALS

2.1 Standards

All materials used shall comply with the following standard specifications, the latest of which shall be held to apply:

SANS 28	:	Metal ties for cavity walls
SANS 227	:	Burnt clay masonry units
SANS 50197	:	Cement
SANS 1090	:	Aggregates
Concrete Masonry Assoc	:	The Masonry Manual
BS 952	:	Glass for glazing
BS 1199	:	Building sands from natural sources
BS 1387	:	Screwed and socketed steel tubes and tubulars and plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads
SANS 22	:	Glazed ceramic wall tiles and fittings
SANS 121	:	Hot dip galvanized coatings on fabricated iron and steel articles - Specification and test methods
SANS 226	:	Water taps (metallic bodies)
SANS 227	:	Burnt clay masonry units
SANS 248	:	Bituminous damp-proof courses
SANS 266	:	Gypsum plasterboard
SANS 460	:	Plain-ended solid drawn copper tubes for potable water
SANS 497	:	Glazed ceramic sanitary ware
SANS 523	:	Limes for use in buildings
SANS 542	:	Concrete roofing tiles
SANS 545	:	Wooden doors
SANS 581	:	Semi-flexible vinyl floor tiles
SANS 673	:	Mixtures of copper - chromium - arsenic compounds for timber preservatives
SANS 679	:	Zinc chromate primers for steel
SANS 680	:	Glazing putty for wooden and metal window frames
SANS 685	:	Fibre-cement sheets (flat and profiled)

SANS 723	:	Wash primer (metal etch primer)
SANS 727	:	Windows and doors made from rolled mild steel sections
SANS 786	:	Flexible vinyl flooring
SANS 791	:	Unplasticized poly (vinyl chloride) (PVC-U) sewer and drain pipes and pipe fittings
SANS 803	:	Fibre-cement boards
SANS 903	:	Aluminium alloy corrugated and troughed sheets
SANS 920	:	Steel bars for concrete reinforcement
SANS 927	:	Precast concrete kerbs, edgings and channels
SANS 929	:	Plywood and composite board
SANS 952	:	Polyolefin film for damp- and waterproofing in buildings
SANS 967	:	Unplasticized poly(vinyl chloride) (PVC-U) soil, waste and vent pipes and pipe fittings
SANS 1215	:	Concrete masonry units
SANS 1349	:	Phendic, amino plastic and one-part polyurethane resin adhesives for the lamination and finger-jointing of timber, and for furniture and joinery
SANS 1783	:	Sawn softwood timber
SANS 10005	:	The preservative treatment of timber
SANS 10062	:	Fixing of concrete interlocking roofing tiles
SANS 10070	:	The installation of resilient thermoplastic and similar flexible floor covering
SANS 10096	:	The manufacture of finger-jointed structural timber
SANS 10107	:	The design and installation of ceramic tiling
SANS 10142	:	The wiring of premises
SANS 50197	:	Cement Part 1: Composition, specifications and conformity criteria for common cements

2.2 Masonry Units

2.2.1 General

Bricks shall be free from cracks, chips or other defects and at least one end of 20% of the bricks shall have the same general colour and texture as the faces.

Special care shall be exercised in loading, stacking and handling facebricks as no damaged bricks shall be used and bats may only be used where required to obtain bond.

General-purpose stock bricks or common bricks shall have a minimum average compressive strength of 7 MPa unless otherwise specified. Where stock bricks are required for load bearing walls, free standing walls, retaining walls or foundations then the compressive strength shall be 14 MPa.

Facing bricks shall be of the type, origin and colour specified in the Schedule of Quantities or on the drawings and shall be selected for uniformity of dimension and colour.

Satisfactory proof of load bearing capacity of bricks offered shall be submitted before deliveries are made to the site.

For samples, 6 units of each type of brick shall be submitted to the Engineer for approval. All subsequent deliveries shall be to the standard of the approved samples.

All bricks which, in the opinion of the Engineer, do not comply with the abovementioned requirements, shall be removed from the site forthwith at the Contractor's cost.

2.2.2 Burnt Clay Bricks

Burnt clay bricks shall comply with SANS 227 and :

Facing bricks shall have a minimum average compressive strength of 14 MPa. Bricks shall be clay, and pressed to wire cut. Water absorption after a 24-hour test shall not exceed 12% by mass. Bricks shall have sharp, clean and well defined arises.

General purpose stock bricks or common bricks suitable for general building work shall be clay, pressed or wire cut, even in size, smooth in texture and with sharp well defined arises. Water absorption after a 24-hour test shall not exceed 14% by mass.

2.3 Cement

Cement used in masonry shall comply with the requirements of SABS 471, SANS 50197.

2.4 Fine Aggregate (Sand)

Fine aggregates used in mortar shall be naturally occurring sand or consist of crushed rock or gravel, or a combination thereof with naturally occurring sand being hard, clean and free from dust, shale, clay, loam roots and other impurities.

Fine mortar aggregates shall comply in all respect with SANS 1090.

2.5 Water

Water shall be clean and free from injurious amounts of acids, alkalis, sugar and other organic substances. Water suitable for drinking purposes shall be acceptable. If so required by the Engineer, the suitability of water shall be proved by tests carried out by an approved laboratory.

2.6 Mortar

Mortar shall, unless otherwise specified, be Class I and for all load bearing walls, free standing walls, retaining walls or foundations shall be Class II in accordance with the SANS 10400 part K and the SANS 2001-CMI. The ingredients shall be measured in proper gauge boxes on a timber or steel-mixing platform with water added and thoroughly mixed in to obtain a uniform consistency throughout. Alternatively, mixing may be by means of an approved mechanical batch mixer.

Cement mortar shall be used within two hours of the first contact of the cement with water. No mortar which is older than two hours or has begun to set shall be used.

2.7 Wall Ties

Metal wall ties in brickwork and blockwork shall be galvanised and comply in all respects with SABS 28. Single wire type wall ties will not be permitted.

Ties for cavity walls shall be PWD butterfly type formed of 4mm diameter steel wire galvanised class A for coastal conditions and to such lengths that no less than 75mm can be built in at each end.

Wall ties will be required as follows as a minimum unless specified otherwise:

Element	**Number**
Grouted Cavity Walls	4 per m²
Cavity Walls:	
General	3 per m²
Within 200 mm of Joints Through Wall	300 mm vertical Centres

2.8 Reinforcement

Wall reinforcement shall consist of two 3.55 mm diameter longitudinal wires at appropriate centres for the thickness of the wall and with 2.80 mm diameter cross wires welded to the longitudinal wires at 300 mm centres. All wire used shall be of high tensile steel.

Brickforce used as wall reinforcing will as per the following minimum requirements unless otherwise stated:

Element	Requirement
Foundation Walls	Every Course
Walls above Foundation	Every 4th Course
Wall Openings	First 5 courses above and where applicable 2 courses below openings continuing 600 mm past opening. In addition 4 x 5.6 mm diameter rods required on 1st and 5th course above opening
Control Joints	Brickforce to be continuous through control joints

2.9 Concrete To Brickwork Ties

End of junctions of brick walling to concrete are to be tied to the concrete by means of 1.6 x 32 x 500mm galvanised hoop iron ties.

Brick linings to concrete are to be tied with 4 mm diameter crimped galvanised wire ties to SABS 28.

2.10 Filling Material

Filling material shall be approved G5 material complying with the relevant requirements of the SANS 1200, Standardized Specification for Civil Engineering Construction and compacted as specified in SANS 1200.

2.11 Harcore Filling

Where shown on the Drawings or instructed by the Engineer, hardcore filling shall be 150 mm thick unless otherwise specified, and shall be formed with hard broken stone or brick of 75 mm maximum size and blinded with clean river sand. No clay, rubbish, tins, wood or vegetation or other debris shall be used in hardcore filling.

2.12 Damp Proofing

Damp proofing between filling or blinded hardcore filling and the underside of ground floor slabs or surface beds shall be 500 micron thick polyethylene sheeting that complies with SANS 952, i.e. USB Green co ex 500 ® or equivalent approved. All joints shall be overlapped with a 100mm seam and sealed by adhesive pressure-sensitive tape.

The damp-proof course in the brickwork shall consist of BRICKGRIP DPC 375 ® bearing AGREMENT 2001/284, or equivalent approved, well lapped at joints and intersections and bedded and joined in cement mortar.

2.13 Sills

Where external sills are required to be of masonry, the units shall be clay face bricks and the units laid on edge. They shall be hard-burnt of approved colour and manufacture, true and even in thickness and in shape and colour, with good appearance, free from all defects and blemishes.

2.14 Mortar

Lime shall be best quality pressure hydrated type A2P and shall comply with SANS 523. It shall be well slaked and properly hydrated. Cement for mortar shall comply with SANS 50197-1 as specified for concrete.

The sand shall be clean pit sand free from clay or other impurities, and shall be properly screened and washed if directed by the Engineer.

The water shall be approved quality fresh water

2.15 Air Bricks

External wall 'Air Bricks' shall be approved 'terra cotta' with vermin proofing copper gauze at back, built in on the outside face of walls. On the inside face 225 x 150 mm square pattern fibrous plaster air gratings with vermin proofing copper gauze at back shall be built in.

2.16 Construction Timber

Unless otherwise specified, all timber work for constructional purposes shall be in "stress graded" timber, complying with the requirements of SANS 1783-2, except that no finger joints within 500 mm of the end of any member, and not more than one finger joint per 3 m length will be accepted. Timber shall be ordered in the nominal cross sectional dimensions and to the nearest 0.3 m length in which it is to be used, except that finger jointed timber made according to SANS 10096 will be permitted. All construction timber shall bear the mark of the South African Bureau of Standards and the test 'stress grade' for which it complies.

All timber shall be treated against insect and other wood damaging infestation according to the recommendations of the Department of Entomology, SANS 673 and SANS 10005.

All timber used shall be of good sound quality thoroughly seasoned, straight, sawn square and free from sap and reasonably free from shakes, large, lose or dead knots, sapwood and diminishing edges.

All timber to be built into walls and wall plates shall, in addition to the above, receive two coats of Solignum, Carbolineum or other approved wood preservative, or be wrapped in 250 micron polythene sheeting.

All timber battens and branderings shall comply with the requirements of SANS 1783-4.

2.17 Roofing

The type of roofing shall be as scheduled or shown on the Drawings. Roof sheeting shell be IBR profile Aluminium sheeting 0.8 mm thick and shall comply with SANS 903.

Fascia boards, barge boards, flashings, closures and trimmings shall be of Aluminium sheering shaped to the suitable profile with 'drip detail' and water proofing fasteners as scheduled or shown on the Drawings.

Roofing underlay Polyethylene sheeting complying with the requirements of SANS 952, Type E, having a nominal thickness of 250 micron.

2.18 Ceilings

Ceilings shall be 6 mm thick fibre cement cellulose ceiling board complying with SANS 803 or 6.4 mm thick gypsum ceiling board complying with SANS 266, and shall be fitted to brandering of approved dimensions depending on the truss/rafter spacing.

Cove cornices shall be fitted to all ceilings. For fibre cement ceilings the cornices shall be 55 mm radius x 6 mm thick fibre cement cove cornices and for gypsum board ceilings they shall be 75 mm gypsum cove cornices.

Joints between ceilings boards shall be covered with 25 mm half-round hardwood cover strips.

2.19 Doors, Windows and Vents

All steel and iron work shall be delivered clean and free from rust, pitting or other defects. Shop primers shall be applied before delivery and shall consist of a coat of red oxide paint, or any other approved anti-rust paint on all surfaces.

Unless otherwise specified, all materials shall conform at least to the appropriate SABS or BS standards where such standards apply to ironmongery, or steel, cast iron and any other related materials.

2.19.1 Pressed-steel door frames

Pressed-steel door frames shall comply with SABS 1129 and shall be manufactured from 1,6 mm thick mild-steel sheeting, pressed to the required shapes, properly mitred, welded and reinforced, with all welding neatly cleaned off.

Frames shall be of the widths required to suit the thickness of the walls into which they are built and shall be fitted with suitable tie bars and braces at the bottom. Three lugs to be built into the brickwork shall be provided on each jamb.

Rebates in frames and transoms for doors shall be of the widths required to suit the thicknesses of the doors and shall be fitted with a pair of approved steel butt hinges set flush into recesses in the frames. 4,5 mm thick reinforcing plates shall be welded to the backs of the frames at hinge positions.

Heads of frames over double doors shall be drilled where required to form keeps for bolts and shall be fitted with one rubber buffer for each leaf of the door.

Frames for single doors shall be fitted with approved chromium striking plates and an adjustable striking-plate keeper boxed in at the back of the frame by a welded-on sheet-metal box. The frames shall be fitted with a minimum of two rubber buffers.

Frames shall be protected against twisting and damage during transit and erection.

2.19.2 Pressed-steel doors

Pressed-steel doors shall be manufactured from 1,6 mm thick steel plate. The doors shall be of standard design, pressed to shape with 40 mm reveals all round. The doors shall be strengthened with full-length vertical V-shaped or other approved sectional strengthening ribs projecting to the outer face. Two horizontal stiffening rails shall also be welded to the inner face of the doors.

A door shall be hung on a pair of 100 mm long steel butt hinges with loose pins. The leaves of the hinges shall be welded to both the door and the door frame, and a 1,6 mm thick steel plate shall be welded to the inner face of the door to protect the lock.

One leaf of double doors shall be fitted at the top and bottom with approved 150 mm cast brass barrel bolts in an approved manner and the other leaf shall be fitted with a lock, the striking plate of which shall be fixed to the first leaf.

Where indicated on the drawings, doors shall be fitted with louvred ventilation grills of approved design, backed with insect and vermin-proof gauze screening.

2.19.3 Steel window frames

All steel window frames shall comply with SABS 727 and shall be of the types and sizes shown on the Drawings.

Standard industrial types of steel window frame shall be constructed from rolled mild-steel industrial sections, 35 mm wide by 3 mm thick, with opening sections constructed from standard residential sections, 25 mm wide by 3 mm thick, welded at angles and properly jointed at intersections.

2.19.4 Aluminium doors, windows, etc

The Contractor for the manufacturing and installations of the aluminium doors and windows is to submit proof of AAAMSA membership and doors and windows shall comply with AAAMSA design criteria.

The following certificates shall be provided prior to commencement of site work:

A copy of the relevant AAAMSA Performance Test Certificate from the manufacturer/contractor supplying the architectural aluminium product.

A Certificate of Conformance confirming that anodizing or powder coating has been processed in accordance with SANS 999 and SANS 1796 respectively.

A Certificate of Conformance confirming that glazing has been installed in accordance with SANS 10137, ensuring that safety glazing materials have been installed in the mandatory areas and that each individual pane of safety glazing materials has been permanently marked.

A warranty from the manufacturer of the laminated safety glass and/or hermetically sealed glazing units guaranteeing the products against delamination and colour degradation for a period of not less than five years.

The successful tenderer shall provide full shop drawings for the approval by the Engineer prior to the manufacturing of any work.

2.20 Ironmongery

All Ironmongery shall be of a robust hard wearing industrial quality, of stout design and durable construction. The type, size, material and orientation shall be as scheduled and shown on the Drawings. Samples of each item of ironmongery shall be submitted for approval before any particular item is ordered and fixed.

All external doors shall be fitted with one and a half pairs of hinges. Hinges doors shall be 100 mm loose pin hinges. All screws shall be appropriately sized and of metal similar to the article to be fixed.

2.20.1 Door locks and handles

All door locks shall comply with the requirements of the relevant SABS specification and shall be of approved manufacture and pattern. All locks shall be supplied with two keys. Keys shall be distinctly numbered with consecutive numbers and each key shall be stamped with the same number as that of the lock which it controls. No two locks in any one building may have the same key.

External doors shall be fitted with master-keyed four-lever heavy duty mortice locks or cylinder locks as indicated with brushed chromium plated furniture. All locks shall be provided with two keys, and all locks shall differ so that the key of any lock will open no lock other than the one to which it belongs. A suitable stop shall be fitted to prevent the door knob from damage against the walls. (unless otherwise shown on the drawings or specified in the bill of quantities).

All internal doors shall be fitted with 2-lever mortice locks complete with brushed chromium plated furniture and locking plates.

All locks shall be properly installed and, after completion, striker plates shall be adjusted and the locks serviced.

Door handles shall be of cast zinc of approved manufacture and pattern.

2.20.2 Miscellaneous fittings

All retaining devices for doors and windows as well as fittings such as coat hooks, retaining hooks, etc shall be of solid brass unless otherwise indicated. All fittings shall be secured by screws or set screws of the same material and finish as the fitting.

Fittings to be fixed to plastered walls, masonry or floors shall be fixed direct by means of patent plastic or fibre plugs fitted into drilled holes.

Door stops shall be provided at every door and shall be 40 mm diameter rubber stops.

Patented precast concrete window surrounds or blocks shall be as scheduled in the bill of quantities.

2.21 Glazing

Glazing to conform with the provisions of SANS 10400 – O, and unless otherwise stated, windows shall be glazed with clear sheet glass of the best quality and free from bubbles, scratches or other defects. Obscure glass shall be used at windows to showers and toilets.

2.21.1 Glass

Glass shall comply with the requirements of CKS 55. The quality of all window glass shall be such that surface deterioration will not develop after glazing.

All glass shall be free from bubbles, waviness, scratches, stains or other imperfections.

Unless otherwise specified, sheet glass for glazing shall be flat-drawn clear glass of ordinary glazing quality and of the thicknesses indicated below:

For panes not exceeding 1,5 m^2 in area: 4 mm

2.21.2 Putty

All putty shall comply with the requirements of SABS 680.

Putty shall not be too hard or soft or caked when used, and shall dry evenly without crazing or cracking.

Defective putty shall be cut out and replaced by the Contractor at his own expense, and any broken glass shall also be so replaced and putty so repainted.

2.22 Plaster

Plaster for walls shall be prepared by mixing in parts complying with SANS 2001 – EMI: 2007 (shall be composed of 4:1 sand/cement) or approved by the engineer.

2.23 Screeds

Screeds shall be composed of 3:1 sand/cement mortar with a controlled moisture content.

2.24 Granolithic

Granolithic floors shall be made from:

Cement	:	1 parts
Sand	:	1.25 parts
Coarse aggregate	:	2 parts

The coarse aggregate shall consist of granite or other approved chippings which shall pass a 10 mm sieve and be retained on a 5 mm sieve.

2.25 Floor tiles

Glazed floor tiles shall be best quality of approved manufacture, comply with SANS 22 and be true and regular in shape and free from cracks and all other defects.

Suitably matching aluminium corner and edge strips shall be used around window and door openings and along visible tile edges.

2.26 Plumbing and Drainage

All materials used for plumbing and drainage shall comply with SANS 10400, The Application of the National Building Regulations.

Above ground water supply piping shall be in Class 1, Copper Piping with capillary fittings; Delcop or similar approved. Pipe work to be wall mounted, straight and plumb and fastened at 1m $^{c}/_{c}$ or less when changing direction with Master Bats or similar approved.

All valves conforming to SANS 460 and SANS 226 respectively.

Underground water supply piping shall be Class 16, HDPE Piping with imperial stranded compression fittings. Piping shall be laid underground as per the relevant requirements specified in SANS 1200, trenching, bedding, laying and backfill of water pipe.

Kitchen sinks and baths shall have 40 mm PVC-U traps and waste pipes with cleaning eyes fitted to each bend and trap and complying with SANS 967. Vent pipes shall be 110 mm PVC-U pipes to SANS 967.

Fittings for fixing waste and vent pipes to walls shall consist of approved pressed steel holder bats plugged to walls.

Drain pipes and fittings shall comply with SANS 559 for vitrified clay or SANS 791 for PVC-U. Unless otherwise listed in the Bill of Quantities, sewer and drain connections shall be in vitrified clay pipe with rubber ring or factory applied resilient plastic joints.

2.27 Sanitation Fittings

Sanitary fittings shall comply with SANS 497 and shall be subject to selection and approval.

When scheduled in the Bill of Quantities or shown on the Drawings,

Rainwater and Surface Water Channels

Channels for rainwater and surface water drainage shall be 150 mm half round precast concrete units 1.0 m long, complying with SANS 927.

2.28 Painting

All paints and stains, etc., or materials used in their preparation, shall be of the best quality of their respective kinds and shall comply with the relevant SANS specification. The paints and stains, etc., their colours and shades, shall be approved as to brand and manufacture, and the Contractor shall submit samples in their respective colours to the Engineer, for approval, at least 28 days before they are required.

2.29 Carpentry and Joinery Timber

All timber used for structural purposes shall be of merchantable grade and shall comply with the requirements of SABS 563 and SABS 1245. Structural timber shall be carefully selected and of the best quality, free from large or dead knots, shakes, waney edges or other defects. Purlins and brandering shall comply with the requirements of SABS 653. Finger-jointed

structural timber shall comply with the requirements of SABS 096 and laminated timber with the requirements of SABS 1089.

All timber used for joinery shall be best quality, specially selected, treated against insects as specified in Clause 46.3.5.1, and shall be of good sound quality, well kiln dried and free from sap, large loose or dead knots, shakes, diminishing edges or other defects or blemishes such as flower grain. Solid shelving shall comply with SANS 1783-3.

The glue used shall be compatible with the treatment applied against insect attack and shall comply with SANS 1349. In the case of external doors, an approved waterproof glue shall be used.

Hardwoods and softwoods for joinery shall comply with SABS 1099 and SABS 1359 respectively and suitable species shall be used for the various purposes.

Unless otherwise specified, all materials shall conform to the appropriate SABS or BS Specification where such standards exist for nails, screws, bolts, adhesives, etc.

2.29.1 Preservative treatment

All structural timber shall be given a preservative treatment suitable for the duty for which the timber is intended in accordance with SABS 05, and no untreated timber shall be used. The preservative treatment shall not impair the final finish. The timber shall be impregnated throughout. When surface coating is specified, the compounds applied on the surfaces of the timber shall form an unbroken film.

2.29.2 Priming

The jointing surfaces of all joints exposed to the weather and built-in portions of frames shall be thickly primed except where adhesives are specified.

Carpentry and joinery items which are prepared for painting by the manufacturer, shall be knotted and primed before being dispatched to the Site.

Primed surfaces shall be touched up where necessary during the progress of the work or where site adjustments have been made.

2.30 Plumbing

All materials shall be of the best quality and shall be approved by the Engineer before installation. Cracked, chipped, dented or faulty items or materials shall be replaced at the Contractor's expense. Glazed ceramic sanitary ware shall comply with the requirements of SABS 497 and all other materials shall comply with the standards as specified, scheduled or shown on the Drawings.

2.30.1 Water closet (WC) suites

WC suites shall unless otherwise specified or scheduled consist of a glazed vitreous china closet with an S or P trap and seat lugs, a 14 litre low-level matching flat-bottomed flushing cistern placed and fixed on the closet, or a suspended enamelled cast-iron cistern with the flush pipe connected to the flushing rim of the closet with rubber cone joints, and a solid heavy-duty plastic seat with cover, hinges and buffers.

2.30.2 Urinals

Urinals shall be of the type specified or scheduled, of glazed vitreous china, wall mounted, with an automatic or a manual flushing system, and chromium-plated fittings.

2.30.3 Wash-hand-basins

Wash-hand-basins shall unless otherwise specified or scheduled be of glazed vitreous china or enamelled cast iron, wall mounted on a pair of cast-iron brackets, and fitted with chromium-plated fittings consisting of two taps, outlet and chain, and supplied with a plug and an anti-siphon trap.

2.30.4 Sinks

Sinks shall comply with the requirements of SABS 242 and shall be complete with cabinet, chromium-plated outlet, anti-siphon trap, plug, chain and two bib taps or one mixer tap, all as detailed or as scheduled.

2.30.5 Pipes and tubing

Cast-iron and steel pipes used in plumbing work shall comply with the requirements of SABS 746 and SABS 62 respectively. Copper tubing shall comply with the requirements of SABS 460 and malleable cast-iron fittings with SABS 509.

2.31 Painting

No paint shall be applied to any surface containing traces of dust, grit, grease, oil, loose rust, millscale or corrosion products of any kind or to any surface that is not free from moisture. Where necessary, surfaces shall be thoroughly washed to remove all traces of soluble salts and/or corrosive air-borne contaminants prior to painting, and the surfaces shall be dried and painted immediately thereafter.

Welding shall be completed in so far as it is possible before painting commences, but in cases where welding can be done only at a later stage, no paint shall be applied to within 75 mm of the proposed weld position unless otherwise specified. Welds and adjacent parent metal shall be abrasive blasted and/or ground and all contaminants such as flux shall be removed prior to painting.

Surfaces of members which are to rest on concrete or other floors or which will be otherwise inaccessible after erection shall receive the full paint system prior to erection.

Damaged paint areas on metal surfaces shall be cleaned, rust spots removed where applicable and the surrounding paint which is still intact shall be feathered for a distance of 20 mm beyond the damaged area. Spot priming and repair shall consist of all the coats previously applied and shall overlap the damaged area.

Damaged galvanised areas shall be cleaned and any rust spots and any flakes of the coating surrounding the damaged area removed. The coating shall then be restored by zinc spraying or soldering, or painting with a zinc-rich paint, as may be approved by the Engineer.

Where the shop coat is allowed to age for a few months before the final painting is done, light sanding or rubbing with steel wool or scrubbing with clean water using a bristle brush shall be carried out.

Steel to be embedded in concrete shall not be painted below 50 mm from the final level of the concrete.

Each priming coat and each undercoat of paint shall be inspected and approved by the Engineer before any subsequent undercoat or finishing coat is applied.

All finishing colours shall be as shown on the Drawings, or as directed by the Engineer.

Paints shall comply with the requirements of the appropriate Specifications below:

2.31.1 Primers

SABS 678 : For wood

SABS 679 : Zinc chromate for steel

SABS 723 : Etch-wash primer for metals

SABS 912 : Calcium plumbate for galvanized iron

SABS 926 : Zinc-rich epoxy for steel

2.31.2 Undercoats

SABS 681 : For all undercoats

2.31.3 Finishing coats

SABS 515 : For interior use, flat and egg-shell finish

SABS 630 : For interior and exterior use, high-gloss enamel

SABS 631 : For interior and exterior use, oil gloss paint

SABS 633 : For interior use, emulsion paint

SABS 634 : For exterior use, emulsion paint

SABS 684 : For exterior use on structural steel

SABS 801 : For interior and exterior use, epoxy-tar paint

SABS 802 : For interior and exterior use, bituminous aluminium paint

SABS 887 : For interior use, glossy and egg-shell varnish

The Contractor shall furnish the Engineer with the following information and details regarding the paints and decorative materials for the painting system he proposes to use, for written approval:

a) The name of the manufacturer and trade name

b) The brand, type or grade of paint and the appropriate SABS Specification

c) Manufacturer's data sheets, colour references, instructions for use, including surface preparation, sealers, primers, undercoats, finishing coats, coat thicknesses and curing periods, which shall all be considered as being part of these Specifications if approved by the Engineer

d) Safeguards to protect the applied paint from damage until the work is accepted by the Engineer

e) The shelf or pot life of materials, if applicable

f) An undertaking that the proposed paint system is suitable for its intended use and that the various coats of paint are compatible with one another

Where proprietary brands are used, the manufacturer's priming and all subsequent coats of paint suitable for that particular brand shall be employed in accordance with the manufacturer's instructions.

No other materials of a similar nature and quality or from another manufacturer may be used instead of those approved, unless written permission to do so has been obtained from the Engineer.

All materials shall be brought onto the Site in containers sealed by the manufacturer. Paints of a different quality, type, brand or colour shall not be mixed, or thinned and shall not be adulterated in any way, but shall be used as supplied by the manufacturer. Any mixing or tinting required shall be carried out by the manufacturer.

Tinting of paint on the Site by the Contractor will only be allowed with the written permission of the manufacturer and the Engineer.

2.31.4 Inspection and Preliminary Work

Before commencing paintwork, the Contractor shall carefully inspect the surfaces to be painted to satisfy himself that the surfaces are in a satisfactory or acceptable condition to receive the paint system specified.

All metal fittings and fastenings shall be removed where applicable before the preparatory processes are commenced. On completion, the metal fittings and fastenings shall be cleaned and refitted in position.

2.32 Storage of Materials

Cement and aggregates shall be stored in such a manner as to prevent deterioration or contamination by foreign matter, damp and chemicals spilled on the ground or which may settle out of the atmosphere.

Perishable materials likely to be damaged by exposure shall be stored under cover.

3 EQUIPMENT

The Contractor shall provide and maintain in good working order, adequate equipment for carrying out the required work in accordance with this specification in a sage efficient manner.

4 CONSTRUCTION

4.1 Brickwork

4.1.1 Brickwork Generally

All brickwork shall be laid in stretcher bond, plumb and true to line. Mortar beds shall be 10 mm thickness, unless otherwise described, and are not to exceed 12 mm in thickness, and no four successive joints shall rise more than 40 mm (for 10 mm joints). Clay bricks are to be well wetted (saturated in hot weather) with water before being laid and the course of bricks laid last shall be well wetted before fresh bricks are bedded upon it. Bricks shall be well buttered and laid on a full bed of mortar and joints shall be flushed up. Bricks in foundation walling are to be extra hard. Beam filling is to be built to waves 106 mm thick and the space between beam filling and roof covering shall be filled with a stiff mixture of 1 to 3-cement mortar tightly pressed in. The brickwork shall be carried up in a uniform manner, no one section being raised more than 1 200 mm above another section at one time and no brickwork is to be carried more than 4 courses above immediately adjoining or intersecting brickwork. Block bonding or toothed and keyed construction will only be allowed in alterations to existing work.

Cavertiy Walls (270 mm) and One-brick walls (230 mm) built stretcher bond in two skins shall be tied together with galvanised wall ties staggered not more than 1 m apart horizontally and every fourth course vertically with extra ties at reveals and openings etc. as may be necessary. Brick linings to concrete walls shall similarly be tied together, while galvanised hoop iron ties cast into concrete columns, shall be built into the joints of butting brick walls as specified. Where specifically required the outer face of the inner skin of all external one-brick walls above damp course level shall be waterproofed before the outer skin is built up. The face to be treated shall be bagged over until all crevices are filled. When thoroughly dry the face shall be twice coated

with an approved liquid bituminous compound and worked around wire ties to produce an unbroken waterproof coating.

Where called for on the drawings wall and concrete ceiling surfaces shall be bagwashed with a wet sack dipped in liquid cement grout whilst the mortar in the brickwork joints is still soft until all joints and crevices are eventually filled. Projections of concrete shall be rubbed off and any defects shall be made good in cement mortar.

4.1.2 Reinforced Brickwork

Brickwork over door and window openings shall be reinforced with welded wall reinforcement placed in each course of brickwork over openings for a minimum of 4 courses or as shown on the drawings. Reinforced brickwork shall continue at least one and a half bricks on either side of the opening. Where two of more openings are less than 675 mm apart, the reinforced brick lintels shall be continuous over all such openings and their dividing piers, plus 1½ brick bearing at both extreme ends.

Brick lintels in cavity walls, which are exposed to the weather, shall have a continuous damp-proof bourse built into the outer skin of the wall immediately above the lintel to cover the top of the lintel, raked up one course and carried through the inner skin.

Where called for on the drawings, brickwork shall be reinforced with wall reinforcement laid in every fourth course of all brick walling or as directed by the Engineer. The reinforcement shall be built in truly central to the wall and all longitudinal laps shall not be less than 450mm. Reinforcement in half-brick walls shall be built 106 mm into main cross walls.

4.1.3 Face Brickwork

All facings shall be kept clean during the progress of the work and face-brick surfaces with mortar spattering will not be accepted. Unless otherwise specified, the horizontal and vertical joints shall be pointed and finished with a round key joint and both rubbed smooth as the building work proceeds.

The various colours of the face bricks shall be selected and mixed at random to prevent portions of the face work showing a preponderance of one colour. Where sufficient storage is available on site the full quantity of face bricks required for the works (or such quantity as to keep supply well advanced of construction) shall be delivered to site.

4.1.4 Fairface Brickwork

Where called for on the drawings and in the Schedule of Quantities, internal walls shall be of smooth stock-bricks, built fair and kept clean during construction and jointed as in Clause 4.3.

4.1.5 Key for plaster

Joints of all brickwork receiving plaster shall be raked out, or the brick surfaces shall otherwise be prepared with an acrylic slurry or any other approved bonding agent.

4.1.6 Damp-proofing

A damp-proof course shall be laid over the full width of all the walls at a minimum height of 150 mm above the final ground level or wherever else it may be required, and it shall be lapped for at least 150 mm at angles and joints. A damp-proof course shall also be laid and stepped up under all external sills.

4.2 Precast Pre-Stressed Concrete Lintels

Approved precast prestressed concrete lintels of suitable size of the thickness of the wall and the width of the opening shall be used over openings in plastered and bagged walls.

Wherever possible, the minimum bearing for precast prestressed lintels, at their ends and over intermediate supports, shall be:

g) for openings not exceeding 600 mm - ½ brick (115 mm)

h) for openings exceeding 600 mm - 1 brick (230 mm)

Where this requirement necessitates a total lintel length exceeding 6.6 m, a joint may be introduced centrally over an intermediate pier in a position to be approved by the Engineer. Such joints shall be stiffened by the introduction of welded wall reinforcement as specified in 4.2, and extending a minimum of 300 mm on either side of the joint, i.e. 600 mm minimum total length.

4.3 Concrete / Brick Ties

At end on junction of brick walls with concrete columns or walls brickwork is to have galvanised hoop iron ties built into the joints of each ½ brick skin at maximum 8 course height intervals alternately to each skin or at 4 course height intervals if single skin only.

Ties are to be cast into concrete at course heights by tacking L-shaped ties to inside face of shutters and bending down ends for building in after shutters are stripped, or shot fixed to concrete with approved nails and strength of shot to provide adequate fixing.

Galvanised crimped wire ties for fixing of brick linings to concrete are to be cast a minimum 75mm deep into concrete at brick course eights (four per square metre staggered), bent down after shutters are stripped and built into brickwork.

4.4 Plasterwork

4.4.1 Plaster coats

A plastered finish shall consist of a single coat, comprising one application of a 1:6 cement sand mixture with a wood or steel-float finish except where otherwise indicated.

4.4.2 Thickness

The total thickness of the plaster finish shall be 13 mm minimum and 20 mm maximum.

4.4.3 Workmanship

All plasterwork shall be finished smooth and ready to receive paint. Plaster shall be flush with the faces of all switch and plug boxes, the interiors of which shall be kept free from plaster. Plastered surfaces shall be plumb and jambs and reveals shall be formed square

The plasterer shall cut out and make good all cracks, blisters and other defects and leave the plasterwork, on completion, in a state which is acceptable to the Engineer.

4.5 Floor Screeds

Floor screeds shall have a mix proportion by mass consisting of one (1) part Portland cement and three (3) parts (1:3) fine aggregate. A minimum amount of water is to be used, but it shall be sufficient to allow adequate compaction.

Screeds shall be laid on clean hardened bases in panels not exceeding 14 m^2 and shall be steel-trowelled to a true and smooth finish. In monolithic construction, the panels shall not exceed 30 m^2. Joints in screeds shall coincide as nearly as possible with joints in the bases. The thickness of screeds shall be as shown on the drawings or as directed by the Engineer.

The entire screed surface shall be free from loose or raised particles of aggregate, trowel marks or any irregularities, humps or depressions exceeding 5 mm when measured from a 3 m long straight edge.

Screeds shall be cured for three (3) to seven (7) days as may be directed by the Engineer, and shall be protected from damage.

No moisture-sensitive floor finish shall be laid on screeds unless a reliable moisture test shows that the screed is sufficiently dry to receive the covering.

4.6 Doors

4.6.1 General

All built-in door frames shall be set straight, plumb and level, and shall operate to the satisfaction of the Engineer after fixing has been completed.

Fittings shall be either removed, or wrapped and protected from damage, until all rough trades have been completed

4.6.2 Timber Doors

Timber for doors shall be selected, well-seasoned kiln dried Red Meranti and shall be treated with an approved oil soluble preservative. The following preservative is recommended: 5% Pentachlorophenol in a vessel consisting of 50% white spirits and 50% power paraffin or 100% white spirits. The Contractor shall obtain and submit to the Engineer a certificate from the merchant supplying the timber or doors to the effect that the timber has been treated as required.

After erection doors shall be well sanded and prepared and then coated with two coats of an approved penetrating sealer compatible with the treatment applied to the timber.

4.7 Windows

4.7.1 General

All built-in window frames shall be set straight, plumb and level, and shall operate to the satisfaction of the Engineer after fixing has been completed.

Fittings shall be either removed, or wrapped and protected from damage, until all rough trades have been completed

4.8 Glazing

Glass shall be cut in panes to suit all glazed openings with sufficient clearance all round to prevent cracking by expansion, contraction or vibration.

In all cases the glass shall be well bedded and back-puttied and installed as specified in SABS Code of Practice 0137.

All putty shall be carefully trimmed, cleaned off and neatly finished off straight with smooth surfaces and sharp mitres. A paint primer shall be applied as soon as the putty has dried out sufficiently to prevent shrinkage cracks from forming.

The entire glazing operation shall be cleaned before the premises are handed over for occupation.

4.9 Louvres

Louvres and frames shall be manufactured from aluminium. All work to be in accordance with the recommended performance requirements of the Association of Architecturual Aluminium Manufacturers of South Africa.

4.10 Sundries

- Rough and fair cutting shall be performed as required and the brickwork fitted around structural steelwork. Face brickwork shall be carefully cut and fitted when next to the finishings.
- Chases shall be left or formed in brickwork for edges of concrete floors, roofs, staircases, etc. Vertical chases shall be provided in brickwork and blockwork wherever required for pipes, conduits, switch boxes, distribution boards, etc.
- Timber doorframes and windows to be built into walls shall be primed before building in and set plumb and true. The underside of each vertical to the doorframes shall be provided with a 12 mm diameter steel peg projecting 75 mm from the bottom of the frame and these pegs shall be securely grouted into the floor threshold. 2 mm thick hoop iron cramps 40 mm wide, screwed to frames shall be built 450 mm into walls with ends turned up, four cramps to each jamb. At flush junctions of walls and frames a V-joint shall be ruled between frame and wall rendering. The junctions between timber frames or windows and face brickwork or unrendered concrete on external faces shall be sealed by pointing around the timber frames with an approved polysulphide based waterproofing compound finished off in a neat and workmanlike manner.
- Damp proof courses shall be formed in the walls as described by building three consecutive bedding joints and all vertical joints between solid walls in 2:1 cement mortar with an approved waterproofing compound added in accordance with the manufacturer's instructions.

4.11 Carpentry Work

Carpentry work shall be carried out in a manner consistent with good workmanship and in compliance with the Drawings.

The carpenter shall perform all cutting away and making good in attendance upon all other trades and he shall provide and maintain temporary coverings required for the protection of any finished work that might be damaged if left unprotected during the progress of the work.

4.11.1 Dimensions

Unwrought timber shall be as sawn and shall be to the dimensions and within the tolerances specified in the relevant SABS Standard Specifications mentioned in subclause 5.1 (1).

4.11.2 Jointing

Unless otherwise specified, all joints shall be secured by means of a suitable type and a sufficient number of approved connectors. All joints shall be carefully made in such a way that they will not impair the strength and stiffness of the beams or members.

4.11.3 Timber roof construction

The plates, joists, rafters, purlins, brandering and other pieces used for the construction of the roof and trusses shall be of the dimensions, spacing and construction as shown on the Drawings.

All the joints in the framework shall be of the most appropriate type, accurately formed and adequately secured with fasteners as specified.

4.12 Joinery Work

Joinery work shall consist of the manufacture, delivery to the Site, and fixing in the buildings, of all joinery shown on the Drawings.

Except where a special finish is specified, the Contractor shall have all stairs, landings, doors, shelves and other joinery work cleaned and scrubbed down and shall leave all his work in a good order to the satisfaction of the Engineer.

4.12.1 Dimensions

All wrought timber shall be sawn, planed, drilled or otherwise machined or worked to the correct sizes and shapes shown on the Drawings.

Reasonable tolerances shall be provided at all connections between joinery works and the building structure to compensate adequately for any irregularities, settlements or any other movements.

4.12.2 Manufacture

The joiner shall perform all the necessary mortising, tenoning, grooving, matching, tonguing, housing, rebating and all the other works necessary for correct jointing. He shall also provide all metal plates, screws, nails and other fixings that may be necessary for doing the specified joinery work properly.

4.12.3 Joints

Where joints are not specifically indicated, they shall be the recognised forms of joints for each position. The joints shall be so made as to comply with Part 2 of BS 1186.

4.12.4 Doors and frames

Door frames, linings, panel doors, framed, ledged and braced doors, flush doors, sliding doors, etc shall be supplied or made by the joiner and shall be installed, fitted or hung as detailed on the Drawings.

All timber shall be wrought and prepared for oiling, staining, varnishing or painting.

4.12.5 Skirtings, cornices, etc

Skirtings, cornices, etc shall not be installed until after the wall coverings have been applied, the flooring laid and ceilings installed, unless otherwise specified.

4.12.6 In-situ joinery

In-situ joinery work shall not be executed until after all floor, wall and ceiling surfaces have been formed or constructed, unless otherwise instructed.

4.12.7 Ceilings

Ceilings shall unless otherwise specified of scheduled consist of plaster board or fibre-cement panels as shown on the Drawings and shall be nailed to the brandering or suspended from the roof structure. The panels shall be separated by exposed tees and insulated with a 50 mm thick fibreglass wool blanket where shown on the Drawings.

4.13 Plumbing

Plumbing shall be carried out strictly in accordance with the Drawings and with the National Building Regulations, with specific reference to Government Notice R1875 dated 31 August 1979.

Steel pipes and their malleable cast-iron fittings shall be joined with red lead and hemp, lead pipes shall have wiped soldered joints, and cast-iron pipes shall be joined by caulking with hemp and metallic lead.

Soil pipes from WC's shall have an internal diameter of at least 100 mm and shall be fitted with a pan connector and an access bend (or an access junction where a vent pipe is used), and

carried through walls and into the ground for connection to the sewer. Vent pipes shall be fitted with approved balloon gratings.

Waste pipes from basins and sinks shall have an internal diameter of at least 32 mm and shall discharge into gulleys. Bends for waste pipes shall incorporate cleaning eyes.

Cisterns, basins and sinks shall be connected to the pipe system with 12 mm diameter copper service pipes, and chromium-plated stopcocks shall be installed for isolation and maintenance purposes.

4.14 Painting

Paint may be applied by spray, brush or roller depending on the materials used, the surface to be painted, and the manufacturer's instructions.

Every coat of paint, irrespective of the method of application, shall be adequately and permanently keyed or bonded to the base material or previously applied coat, and shall be evenly distributed, continuous, free from sags, runs, brush marks, pin holes or other imperfections, and shall dry to a smooth finish.

An approved water trap and air-regulating valve shall be furnished and installed on all equipment used in spray painting.

Before painting the interiors of buildings they shall be cleaned and the floors shall be washed and kept free from dust during the progress of the interior work.

The Contractor shall protect all nearby surfaces against disfigurement by spatters, splashes and smirches of paint or paint materials. The Contractor shall be responsible for any damage by paint or dirt caused by his operations to vehicles or property or injury to persons and he will be required to provide protective measures to prevent any such damage or injury and make good, where required, at his own expense.

If passing traffic creates dust which may harm or spoil the appearance of external painted surfaces, the Contractor shall sprinkle the adjacent areas with water, at his own cost, for a sufficient distance on each side of the location where painting is being done.

Undercoats shall be tinted by the manufacturer to distinguish between successive coats.

The final coats or finishing coats of paint shall be applied after all the other work in the vicinity has been completed.

The painter shall keep some of the final paint in reserve in the event of his having to make good any patching which may be required as a result of damage or unforeseen circumstances.

Upon completion, the Contractor shall, in the case of buildings, clean all glass, remove all paint spots from walls, floors and fittings, and leave the premises clean and fit for occupation.

All inflammable materials, comprising solvents, thinners, wiping cloths, etc, shall be placed in tightly closed containers and properly disposed of.

4.14.1 Painting Of Plaster, Concrete or Brick Surfaces

a) Surface preparation

Surfaces for painting shall be prepared by sandpapering, scraping or wire-brushing to remove loose material, dust, laitance, scum or other deleterious materials or high spots. Defective areas shall be cut out where necessary and made good with an approved non-shrink filler. Cracks shall be cut out, suitably keyed, and given a coat of an approved bonding agent before the filler is applied. All patches shall be rubbed down to an even surface. Surfaces shall be washed and allowed to dry.

Surfaces shall be treated with neutralising liquid for walls, and if the surface is coarse or textured, either one full coat of pigmented wall sealer or one full filler coat shall be applied in addition to the neutralising liquid.

b) Paint application

Prior to the emulsion paint being applied, the surface shall be sealed with an approved clear sealer and primed with an undercoat diluted to 50%. Emulsion paint (PVA or acrylic) shall then be applied in two finishing coats.

Egg-shell finish (alkyd oil-based), oil gloss paint or enamel gloss paint shall be applied as follows: one coat of universal undercoat shall be applied and it shall be followed by one coat of a mixture comprising 50% of the undercoat and 50% of the paint to be used for the finishing coat. A finishing coat of semi-gloss eggshell, or oil gloss paint or enamel gloss paint shall then be applied.

4.14.2 Painting of Woodwork

a) Surface preparation

The surfaces shall be cleaned, sandpapered and rubbed down to a smooth, even face before painting. The moisture content of the timber shall not be more than 20% at the time when the first coat is applied. All cracks, shakes or scars shall be filled flush with a filler approved by the Engineer before painting. The surface shall then be washed with cleaner and allowed to dry.

b) Primer application

One coat of an approved wood primer shall be applied.

After open-grained timber has been prepared and primed, the grain shall be stopped and filled with synthetic filler and rubbed down with water paper.

All new woodwork shall be properly primed on all surfaces and edges before being fixed in position. All woodwork not previously painted shall be given a prime coat, well brushed in.

c) Paint application

One coat of universal undercoat shall be applied followed by one coat of a mixture of 50% of the undercoat and 50% of the paint to be used for the finishing coat. A finishing coat of oil gloss paint or enamel gloss paint or semi-gloss egg-shell (alkyd oil-based) paint shall then be applied.

d) Varnish finish

Two coats of gloss varnish or egg-shell varnish shall be prepared, stopped and applied.

4.14.3 Painting of Metal Surfaces

Wherever possible, all painting shall be done at the manufacturer's works, but where this is not feasible, the Engineer may permit the application of the undercoat and finishing coats to be carried out on the Site, in which case a prime coat shall be applied at the manufacturer's works prior to the members being despatched to the Works.

a) Surface preparation

The preparation of metal surfaces shall comply with SABS Code of Practice 064 and shall receive the greatest care to ensure rust-free conditions prior to the paint system being applied.

All surfaces shall be prepared by removing loose paint, rust, plaster, scale, dust, dirt, grease, etc and by repairing or patching defective paint surfaces before painting or repainting. Damaged shop-primed surfaces shall be thoroughly cleaned of rust and patched with a prime coat.

b) Paint application

a. Iron and steel work

All iron and steel work shall be properly primed with a red-lead-based primer where steel work is likely to be exposed to the elements for longer than 30 days. Zinc-chromate primer may be used where overpainting will be completed within 30 days of priming. Metal-etch wash primers may be used under dry conditions where overpainting will be completed within 24 hours of priming. The dry-film thickness of the prime coat shall not be less than 0,300 mm.

After priming, one coat of universal undercoat shall be applied. If necessary, the undercoat shall be tinted to a shade just lighter than the desired finish with approved liquid stainers. The dry-film thickness shall not be less than 0,250 mm.

The two finishing coats shall either be of alkyd resin-based synthetic enamel, gloss or matt oil paint, or as specified elsewhere. The dry-film thickness shall not be less than 0,250 mm per coat.

When mating surfaces are brought together, both surfaces shall have been given the full treatment specified, but where this cannot be done, each surface shall be given a copious coating of primer and the surfaces drawn together while the paint is still wet.

The portion of structural steel members to be buried in soil, and all bases to a height of 500 mm shall be given two coats of an epoxy-tar primer instead of the zinc-chromate primer specified for other surfaces.

The surfaces of steel and cast-iron articles, such as floor gratings, grids and manhole covers, shall, after a thorough brushing to remove loose rust, be painted with two coats of epoxy-tar paint, each at least 0,230 mm thick.

b. Galvanized iron and steel

All traces of protective coating shall be removed with galvanized iron cleaner, and two coats of calcium plumbate primer shall be applied. One coat of tinted universal undercoat and two finishing coats of alkyd resin-based synthetic enamel gloss paint shall be applied.

c. Non-ferrous metals

Surfaces of aluminium, copper, etc shall be prepared and cleaned, and one coat of self-etch zinc-chromate wash primer shall be applied. One coat of universal tinted undercoat and two finishing coats of enamel gloss paint shall then be applied. Where non-ferrous metals are not to be painted, the surfaces shall be cleaned, polished and two coats of lacquer applied.

4.14.4 Painting of Floor Screeds

Where chemicals could cause damage to floors, such floors shall be painted with an approved epoxy paint. The type of paint to be used will be shown on the Drawings and will depend on the types of chemical that are used.

The preparation of such floor screeds for painting and the subsequent application of paints shall be carried out strictly in accordance with the manufacturer's instructions.

4.14.5 Paint Thickness

Unless otherwise specified, all coats of paint, whether prime coat, undercoat or finishing coat, shall have a dry-film thickness of not less than 0,200 mm, irrespective of the method of application.

4.14.6 Inspection

The Contractor shall provide the necessary equipment to establish whether the primers, undercoats and finishing coats have been applied to the correct thickness according to the correct applications. The Engineer may take samples of the paints during painting operations for testing and quality control.

5 TOLERANCES

Tolerances for clay brick dimensions, strength, warpage and efflorescence shall be as SANS 227.

Permissible deviations in the final finished surfaces to the degree of accuracy required will be applied to linear dimensions, position, verticality, level, squareness and bow.

The degree of accuracy required is Class II:

Table 1: Table of Permissible Deviations

Item	Classification Finish	Degree of Accuracy ||| mm	Degree of Accuracy || mm	Degree of Accuracy | mm	Brick Guide
Stock Brickwork					
	against earth	20	15		NFX
	to receive plaster	17	10	7	NFP
	to be bagged	13	8	5	NFP
	fairfaced	8	5	3	FBS
Faced brickwork with bricks					
	generally uniform in shape and size	8	5		FBS
	high degree of uniformity in shape & size	5	3		FBX
	non-uniform in shape	13	8		FBA
Out of alignment with					
	Adjoining finishes on projecting Items(windows & door	4	3		FBS
	frames)	3.5	2.5	1	FBX
		5	3.5	2	FBA
Out of verticality of perps					
	(dependent on bond)	40	15	5	
Out of alignment					
	horizontally top edge to top edge adjoining bricks	2.5	2.0	15	FBS
		2.0	1.5	1	FBX
		3.0	2.5	2	FBA
Out of trueness vertically					
	top edge to lower edge of next course	2.5	2	15	FBS
		2.0	1.5	1	FBX
		3.0	2.5	2	FBA
Squareness of rooms					
	measured on the diagonals*	20	10	5	
Out of square or true of a comer or angle					
	measured 300 mm from the angle*	7	4	2	

*A similar degree of accuracy will be required to irregular shaped rooms. The governing factor shall be the general appearance and it may be necessary or acceptable to depart from the above guidelines if required.

6 TESTING

6.1 Compressive Strength

Determination of the minimum average compressive strength of clay bricks shall be in accordance with SABS 227 at frequencies required by the Engineer.

6.2 Costs of Tests

Costs of Tests described above shall be borne by the Contractor who shall be deemed to have included these costs in the scheduled rates for brickwork.

7 MEASUREMENT AND PAYMENT

7.1 Brickwork

Thickness, type and class indicated ……Unit: Area (m²)

The unit of measurement shall be the square metre of each type of brickwork built, calculated from the leading dimensions of the brickwork. Areas of pipes, louvers, windows, doors, etc built into brickwork shall not be included in the areas measured. At corners and intersections common to more than one brick wall, the areas shall be measured only once.

The tendered rates shall include full compensation for the construction of the brickwork complete as specified, including pointing, the building-in of conduits, beams, lintels, pipe sleeves, doors, windows, louvers, the raking-out of joints, weepholes, wall ties, brickforce reinforcement as specified, as well as plasterwork, facings, paintwork, etc where scheduled.

7.2 Plasterwork

Thickness of plaster and finish indicated ……Unit: Area (m²)

The unit of measurement shall be the square metre of each type of coat completed as specified.

The tendered rates shall include full compensation for the construction of the plasterwork, including supplying all materials, mixing, applying, finishing, forming reveals, joints, narrow widths, rounded angles, V-joints, etc complete as specified.

7.3 Floor Screeds

Description and thickness indicated ……Unit: Area (m²)

The unit of measurement shall be the square metre of floor screed laid, as specified, on floors, steps or areas shown on the Drawings or as designated by the Engineer.

The tendered rates shall include full compensation for constructing the floor screeds, including supplying all materials, mixing, laying, finishing, and forming nosings, reedings, skirtings, etc.

7.4 Doors and Windows

Type and size indicated ……Unit: Number (No)

The unit of measurement shall be the number of doors and windows installed complete as specified.

The tendered rates shall include full compensation for manufacturing and installing steel or aluminium doors, windows, and frames complete with hinges, handles, locks, barrel bolts, door closers, retaining devices, door stops, stays and any other work or ironmongery necessary to complete the work as specified or as shown on the Drawings. The tendered rate for doors and

windows shall also include full compensation for glazing, window sills and thresholds as specified, including all necessary timber subframes for aluminium doors and windows, etc

7.5 Ceilings and Bulkheads

Plaster-board ceiling (type and thickness indicated):

Fixed ceiling **……Unit: Area (m²)**

Suspended ceiling **……Unit: Area (m²)**

Fibre-cement ceiling (thickness indicated):

Fixed ceiling **……Unit: Area (m²)**

Suspended ceiling **……Unit: Area (m²)**

for other types of ceilings

Bulkheads (description of material and indication of vertical or horizontal) **……Unit: Area (m²)**

Cornices (description) **……Unit: length (m)**

The unit of measurement shall be the square metre of fixed or suspended ceiling or bulkheads installed complete as scheduled. The unit of measurement for cornices shall be linear metre.

The tendered rates shall also include full compensation for the construction of the ceilings, bulkheads and cornices including the exposed tees, grids, frameworks, hangers, trap doors, insulation blanket and brandering as specified, as well as the suspension system where applicable.

7.6 Joinery

Doors (type and size indicated) **……Unit: Number (No)**

Skirtings (type and size indicated) **……Unit: Length (m)**

The units of measurement shall be the number or metre of each type and/or size of joinery item specified.

The tendered rates shall include full compensation for supplying all materials, and manufacturing, cutting, wasting, fixing and installing the joinery items. Tendered rates for doors shall also include for all ironmongery applicable to the specific doors as specified and indicated on the door and ironmongery schedule drawings, including fixing, installing, testing, etc.

7.7 Miscellaneous Work

Paintwork **……Unit: square metre, meter, Lump Sum (m²,m,Sum)**

Plumbing **…… Unit: metre, number, sum (m, No, Sum)**

The unit of measurement shall be as scheduled.

The tendered sums or rates shall include full compensation for the supply of all materials, delivery to site, storage, all equipment and labour, preparation, application, installation, testing, all temporary work and safety precautions, replacement of defective work, protection of completed work and clean-up after completion.

7.8 Miscellaneous Items

Items measured by area:

Description of Item **……Unit: Area (m²)**

Items measured by length:

Description of Item **……Unit: metre (m)**

Items measured by number:

Description of Item **……Unit: Number (No)**

The unit of measurement shall be the number, linear metre and square metre as applicable to each item.

The tendered rates shall include full compensation for all labour, plant, equipment, transport, etc, manufacturing or providing and installing each item complete as scheduled and shown on the Drawings, and shall include all corrosion protection where applicable.

HARRY GWALA DISTRICT MUNICIPALITY

CONTRACT NO: HGDM746/HGM/2021

CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM: CIVIL, MECHANICAL & ELECTRICAL

PARTICULAR SPECIFICATION

GIBB 020 – MECHANICAL AND ELECTRICAL PROJECT SPECIFIC PUMPING STATION PERFORMANCE SPECIFICATION

REV 1.0

Table of Contents

Table of Appendices

Revision	Date	Change Detail	Editor
1.0	June 2021	Initial Release	M.Funnell
1.1	July 2021	edited	M.Holmes

1 GENERAL

This specification is a performance and quality specification, which covers all the requirements relating to the selection, design, supply, installation and commissioning of pumping equipment complete with appurtenant works and includes all associated instrumentation, control and electrical work. The pumps supplied for the main pump installations (i.e. main delivery pumps and the dewatering sump pump) may be manufactured by different pump manufacturers.

THE GENERAL PROVISIONS OF ALL TECHNICAL PROJECT SPECIFICATIONS, STANDARD SPECIFICATIONS, AND PARTICULAR SPECIFICATIONS PERTAINING TO THE DESIGN OF THE WORKS SHALL APPLY UNLESS STATED OTHERWISE BELOW.

This contract requires the selection, design, supply, installation and commissioning of:

a) Two (2) centrifugal submersible pump and motor sets, in a one (1) duty one (1) standby configuration complete including all controls, instrumentation and electrical installation. The pumps at the Abstraction Works will pump river water from a wet well in the Abstraction Works to a raw water reservoir

b) One (1) Submersible sump pump and motor set complete including all controls, instrumentation and electrical installation, for manually dewatering of the abstraction works.

1.1 Abstraction Submersible Pumpsets – Overview, Arrangement and Scope

The preferred mechanical equipment arrangement of the required abstraction submersible pumps is shown on drawings **J-40044-400 to J-40044-404**. The building layout and the configuration of the suction and discharge pipework is also shown on drawings **J-40044-300 to J-40044-303**.

Initially only two (2) pumpsets will be installed at the abstraction works servicing the current demand through a one duty with one standby (1D + 1S) arrangement. The submersible pumpsets shall also be designed to accommodate the 25-year demand through a two duty with one standby (2D + 1S) arrangement utilising the same pumpset being installed at a later stage.

The layout of the pumps and pipework above have been prepared based on a particular pump model. The contractor shall prepare the final layout drawings to suit the pump units supplied under the contract, which may require minor changes in pipework position and dimensions to suit the pump house structural constraints. These changes, if necessary, will be deemed to have been included in the tendered price should alternative pump sets be accepted.

The pumping equipment proposed by the Contractor shall be compatible with the other mechanical equipment and pipework.

In addition to this, the scope shall also include the design and installation of the following:

- MCC for each pump
- Starter described in Section 2.1.1
- Pump and motor ancillary components including controls.
- Pump and motor instrumentation.
- Instruments specific to pump line.
- Instrumentation common to all abstraction submersible pumps.
- Electrical and Instrument cabling for pump, pump control panel and MCCs
- Baseplates, duck foot bend supports, guide rails, holding-down bolts and anchors.
- Seal flushing systems (if applicable).
- Bearing cooling systems (if applicable).
- Pump cooling system interfaces (if applicable).

- Essential Spares (if applicable).
- Programming
- Level control
- Emergency Stops
- Commissioning and testing requirements

Full details of each component of the scope are provided later in the specification.

1.2 Abstraction Sump Pumps – Overview, Arrangement and Scope

The preferred mechanical equipment arrangement of the required sump pump is shown on drawings **J-40044-400 to J-40044-404**.and shall comprise complete installation.

The submersible sump pumpset at the Abstraction Works shall be designed in a 1 duty configuration servicing the draining of the wet well.

The contractor shall prepare the final layout drawings to suit the pump unit supplied under the contract. The extent of the mechanical works for this installation includes a sump pump and all delivery pipework, up to and including delivery pipe items cast into the wall of the abstraction building, as shown on the drawings.

In addition to this, the scope shall also include the design and installation of the following:

- MCC for the pump
- Starter described in Section 2.2.1
- Pump and motor ancillary components including controls.
- Pump and motor instrumentation
- Equipment and instrumentation,
- Electrical and Instrument cabling for pump control panel and MCCs
- Baseplates, duck foot bend supports, guide rails, holding-down bolts and anchors
- Programming
- Level control
- Emergency Stops
- Commissioning and testing requirements.

2 MECHANICAL INSTALLATION AND SYSTEM NARRATIVE

2.1 Abstraction Submersible Pumpsets

2.1.1 Required Duties

Table 1: Abstraction Works design requirements

Parameter	Abstraction Pumps
Flow rate (m^3/h)	353 (2 Duty pumps) (Secondary Duty Future) 176.5 (1 Duty pump) (Primary Duty Current)
Number of pumps	2
Duty configuration	1 Duty 1 Standby
Suction Conditions	
Minimum river level (masl)	472.2
MOL (Mean operating level) (masl)	472.2
Maximum river level (flood) (masl)	482
Abstraction Floor elevation (masl)	470.6
Pump invert level (centerline) (masl)	471
Suction Pipework	N/A
Delivery Conditions	
Discharge elevation (masl)	485 m
Static head (m)	River Low - 52.8 MOL – 52.0 River High - 45
Delivery Pipework	DN150 GMS pipework in abstraction 15m Long 355mm OD HDPE 515m long
Friction and local losses (m)	4.64 m (2 Duty pumps) 1.25 m (1 Duty pump)
Total pumping head (m)	56.65 m (2 Duty pumps) 54.56 m (1 Duty pump)
System Curves	Annexure A

The Tenderer shall consider whether the specified pump performance parameters are technically acceptable for the pumps offered with respect to the suction conditions (flow speed in suction pipework, NPSHavailable and NPSHrequired etc.) as well as the operating ranges for the pumps.

The pumps shall comply with the general pump particular specification, unless stated otherwise in this specific specification.

2.1.2 Parameters

Table 2: Abstraction Submersible Pump motor set Parameters

Parameter	
Medium	The water to be pumped will be river water and the temperature is unlikely to exceed 24°C at the pump inlet. Boulders, gravel and some sand will have been screened out of the flow but there will be a Finer solids still present (suspended Sands and clays)
Pump type	Mixed flow, single stage, semi open, centrifugal, Submersible motor pump
Pump model **(suggested)**	**Sulzer ABS XFP 105J-600X** submersible pump and motor
Impeller material	Cast-Iron or other approved
Maximum Speed (rpm)	1480 rpm (4 Pole)
Suction size (mm)	200 mm NB
Discharge size (mm)	100 mm NB
Power required, kW at Duty Point	52.2 kW
Motor rating, kW (estimate)	75 kW The rated power of the motor shall be selected to be not less than 15 % in excess of the designed power requirement of the driven equipment at an ambient temperature of 45 ºC. and suitably de-rated for altitude.
Motor	Rated for operation on a 3 phase, 4 wire, 400V, 50 Hz, AC supply, and suitable for submersible environment and complying with the details provided in the Electrical specification schedules 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 ±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. Motors shall be able to reach full operating speed within 5 seconds
Motor Cable / Tail	Motor to be supplied with flexible cable of sufficient length to reach and be terminated in the MCC. Approximately 15-20 meters.
Minimum efficiencies	The pump efficiency at the guaranteed duty point shall not be less than 60%. Please note that all performance information provided as well as any testing is to be at Grade 1E of SANS 9906 only.
Starter	The motors shall be VFD controlled.

Parameter	
	The motors will be suitable for 6 starts an hour with 2 being consecutive
Seal Type	In accordance with Manufacturers recommendations
Cooling	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. A cooling jacket is NOT permitted.
Bearing	In accordance with Manufacturers recommendations
Impellor Type	Must suit raw water abrasion resistant application In accordance with Manufacturers recommendations Preferably 2 Channel
Impeller material	Minimum Stainless steel 316 or similar approved
Pump housing	In accordance with Manufacturers recommendations
Internal Coating	The internal coating of the pump casing shall be abrasion resistant
External Coating	External corrosion protection shall be to the manufacturer's standard for submerged applications.
Plinth and Base Plate	The Contractor shall design the pumpset plinth, baseplate, duckfoot bend and sliding guide rails in accordance with the general mechanical particular specifications and the general pump particular specifications.
Other notes	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 shall be connected to a securely fastened duck foot bend with guide rail for easy removal, maintenance and replacement. The pump sets shall have lifting eyes for easy removal via overhead travelling crane

2.2 Submersible Sump Pump

2.2.1 Required Duties

The sump pump in the sump shall have a capacity of 1 litre per second to pump deposited sediment as well as act as a manually operated sump pump.

Table 3: Sump Pump design requirements

Parameter	Abstraction Pumps
Flow rate (l/s)	**1**
Number of pumps	1
Duty configuration	1 Duty
Suction Conditions	
Minumum level (masl)	470.7

Maximum river level (flood) (masl)	482
Abstraction Sump elevation (masl)	470.1
Pump invert level (centerline) (masl)	470.2
Suction Pipework	N/A
Delivery Conditions	
Discharge elevation (masl)	474.73 m
Static head (m)	4.63
Delivery Pipework	DN50 PN16 GMS steel pipe 4.5m long
Friction and local losses (m)	Supplier Design
Total pumping head (m)	Supplier Design
System Curves	N/A

The Tenderer shall consider whether the specified pump performance parameters are technically acceptable for the pumps offered with respect to the suction conditions (flow speed in suction pipework, NPSHavailable and NPSHrequired etc.) as well as the operating ranges for the pumps.

The pumps shall comply with the general pump particular specification, unless stated otherwise in this specific specification.

2.2.2 Parameters

Table 4: Sump Pump and motor set Parameters

Parameter	
Medium	The water to be pumped will be river water and the temperature is unlikely to exceed 24°C at the pump inlet. Boulders, gravel and some sand will have been screened out of the flow but there may be a heavy finer solids loading
Pump type	Direct-coupled submersible centrifugal pump. Capable of continuous operation
Pump model **(suggested)**	Grundfos S2 submersible pump
Impeller material	Cast-Iron or other approved
Maximum Motor Speed (rpm)	2840 rpm (2 Pole)
Suction size (mm)	50 mm NB
Discharge size (mm)	30 mm NB
Power required, kW at Duty Point	1.1 kW
Motor rating, kW (estimate)	1.7 kW

Parameter	
Motor	Rated for operation on a 3 phase, 4 wire, 400V, 50 Hz, AC supply, and suitable for submersible environment and complying with the details provided in the Electrical specification schedules 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 ±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. Motors shall be able to reach full operating speed within 5 seconds.
Motor Cable / Tail	Motor to be supplied with flexible cable of sufficient length to reach and be terminated in the MCC. Approximately 15-20 meters.
Minimum efficiencies	In accordance with Manufacturers recommendations.
Starter	DOL
Seal Type	In accordance with Manufacturers recommendations
Cooling	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.
Bearing	In accordance with Manufacturers recommendations
Impellor Type	Must suit raw water abrasion resistant application In accordance with Manufacturers recommendations
Impeller material	In accordance with Manufacturers recommendations
Pump housing	In accordance with Manufacturers recommendations
Internal Coating	The internal coating of the pump casing shall be abrasion resistant
External Coating	External corrosion protection shall be to the manufacturer's standard for submerged applications.
Plinth and Base Plate	The Contractor shall design the pumpset plinth, baseplate, duckfoot bend and sliding guide rails in accordance with the general mechanical particular specifications and the general pump particular specifications.
Other notes	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 shall be connected to a securely fastened duck foot bend with guide rail for easy removal, maintenance and replacement. The pump sets shall have lifting eyes for easy removal via overhead travelling crane

3 INSTRUMENTATION AND CONTROL

3.1 General

3.1.1 Operating and Control Philosophy

The primary function of the control system is to automate the start-up and shut-down procedures for the pumps and to allow staff to focus on other activities, however:

- Despite manual / override control not specifically being discussed it is required for all equipment.
- Manual/Off/Automatic selector switches shall be installed in the MCCs to allow for manual control of the systems.
- Once a device is switched to manual, control of the device (or system where necessary for safety) shall be independent of and unaffected by any other portion of the system.
- Control systems for critical process shall be designed with a level of redundancy such that the system adjusts for and maintains automatic control even following key equipment failures. The contractor is to certify with the Engineer whether a system is deemed to be critical.
- Controls shall be designed such that in the event of a controller failure the system can still be operated manually. Equipment connected to other controllers, but related to the device controlled by the failed controller will automatically compensate for all process variations.
- All equipment shut downs and start-up within safe limits will be automated. For example the pumps shall automatically shut down when operating outside of safe limits, as determined by the manufactures.
- Transmitters and transducers shall be mounted as near as is practically possible to the measurement point, but shall be readily and safely accessible from grade, permanent platforms or fixed ladders to facilitate ease of maintenance.
- All instrumentation shall be designed for continuous function.
- Unless parameters are specifically identified as derived, all monitored information is to be provided directly from the field instrumentation (e.g. where rate of flow is listed, a flow meter must be installed and the information obtained directly from this).
- Detailed pump monitoring, such as temperature and vibration, shall be interlocked with pump control by dedicated integrated electronic motor protection relays.
- Pump Manual/Off/Automatic selectors etc. shall be located either at the MCC or the backup panel location but never at both.
- An operator interface integral to the MCC must be provided.

3.2 Abstraction Submersible Pumps

3.2.1 Pump Control and Monitoring

Table 5: Abstraction submersible pump and motor set Control and Monitoring

Pump Control	**Required Yes/No**
Pump Start (Timer/Auto)	
Timer signal	**(60 min intervals)**
TIMER: Suction River (level sensor) and Discharge reservoir (pressure sensor)	**Yes**
Receive start signal from delay timer SUCTION: Check River level • IF Level sensor < Hi River level THEN Receive start signal from level sensor/switch in Suction River.	

- IF Level sensor > Lo river level THEN Receive start signal from level sensor/switch in Suction River.
- IF Level sensor > Hi River level THEN Signal “River High” light, interlock pump and reset delay timer.
- IF Level sensor < Lo River level THEN Signal “River Low” light, interlock pump and reset delay timer.

DISCHARGE: Check rising main

- IF below static head, signal “Not Primed” light, stop and lockout until manual reset
- IF pressure equal to static head trigger duty pump and all the other logic is met TURN ON.

Pump Start (Manual)

MANUAL: Suction River (level sensor) and Discharge reservoir (pressure sensor)	**Yes**

Receive start signal from push button

SUCTION: Check river level

IF Level sensor < Hi River level THEN Receive start signal from level sensor/switch in Suction River.

IF Level sensor > Lo river level THEN Receive start signal from level sensor/switch in Suction River.

IF Level sensor > Hi River level THEN Signal “River High” light, interlock pump and reset delay timer.

IF Level sensor < Lo River level THEN Signal “River Low” light, interlock pump and reset delay timer.

DISCHARGE: Check rising main

IF pressure equal to static head trigger duty pump start

IF below static head, signal “Not Primed” light, trigger duty pump start. When pressure equal to static head turn off “Not Primed Light”

IF pressure sensor/switch >= 10 meters above dynamic pumping head pump for 10 sec TURN OFF signal “Reservoir Full” light, stop and reset delay timer.

Pump Stop

PUMP STOP: Suction River (based on level sensor)	**Yes**

Pump must be ON for the following logic to work

- IF Level sensor > Hi River level THEN Signal “River High” light, stop pump and start on delay timer.
- IF Level sensor < Lo River level THEN Signal “River Low” light, stop pump and start on delay timer.
- The above triggers pump SHUT DOWN.

PUMP STOP: Discharge Reservoir (based on Pressure sensor)	**Yes**

Pump must be ON for the following logic to work

- IF pressure sensor/switch >= 10 meters above dynamic pumping head pump for 10 sec TURN OFF signal “Reservoir Full” light, stop and reset delay timer.

• The above trigger pump SHUT DOWN.

Rising main over-pressure	**Yes**
• If pressure in rising main exceeds working pressure by more than 10 meters for 10 sec then trigger Pump shut down. • Signal “Over Pressure” light, stop and reset delay timer.	
Manual	**Yes**
• Trigger pump shut down. • stop and start on delay Timer.	
Safety Trip Signal (all faults)	**Yes**
• Trigger pump shut down. • Signal trip reason light and lockout until manual reset. I.e. prevent timer restart.	
Emergency stop button	**Yes**
• Pump shut down (no run down just remove power). • Signal “Emergency Stop” light and lockout until manual reset i.e. prevent timer restart.	
Duty standby configuration	**Yes**
• After each pump shut down the duty pump and standby pumps are to rotate. • If the duty pump fails 3 times to start, the standby pump must start automatically and Signal “Pump Fail” light. • Should non-starting however be caused by any of the safety trips, the motor shall not attempt a second start and shall not be available as a standby set i.e. Pump fail” light to be illuminated, until the fault has been cleared and the system manually reset	
Monitoring and Instrumentation	
SUCTION: Radar Level sensors (low and high level) installed at abstraction building for sensing river level	**Yes**
DISCHARGE: Radar Level sensors (low and high level) installed in delivery reservoir, one for each pump.	**No**
No-flow switches on each pump discharge	**Yes**
Pressure Sensor on each pump discharge	**Yes**
Pressure gauge on each pump discharge	**Yes**
No-flow switch on main discharge pipe	**No**
Pressure Sensor on main discharge pipe	**Yes**
Pressure gauge on main discharge pipe	**Yes**
Delay timer with specific time lock outs in each pump control board.	**Yes**
Magflow meters will be installed on the discharge line. The signal from this is to be fed into the MCC. The signal is to provide flow and velocity readings (to be displayed on the MCC) as well as be used as an additional no flow sensor for the pumps.	**Yes**

Power Meter for each pump included in MCC	**Yes**
Bearing temperature sensors on pumps	**No**
Bearing temperature sensors on motors	**No**
Vibration sensors on pumps	No
Vibration sensors on motors	No
Winding temperature sensors on motors	**Yes**
GSM telemetry for flow data	No
GSM telemetry for safety faults	No
Terminal for SCADA telemetry for flow data	**Yes**
Terminal for SCADA telemetry for safety faults	**Yes**

3.3 Submersible Sump Pump

3.3.1 Pump Control and Monitoring

Table 6: Sump pump and motor set Control and Monitoring

Pump Control	**Required Yes/No**
Pump Start (Manual)	
MANUAL: Suction River (level sensor) and Discharge reservoir (pressure sensor)	**Yes**
Receive start signal from push button SUCTION: Check river level IF Level sensor < Hi River level THEN Receive start signal from level sensor/switch in Suction River. IF Level sensor > Lo river level THEN Receive start signal from level sensor/switch in Suction River. IF Level sensor > Hi River level THEN Signal “River High” light, interlock pump and reset delay timer. IF Level sensor < Lo River level THEN Signal “River Low” light, interlock pump and reset delay timer. DISCHARGE: No Check for rising main	
Pump Stop	
PUMP STOP: Suction River (based on level sensor)	**Yes**
Pump must be ON for the following logic to work • IF Level sensor > Hi River level THEN Signal “River High” light and stop pump • IF Level sensor < Lo River level THEN Signal “River Low” light and stop pump • The above triggers pump SHUT DOWN.	

Rising main over-pressure	**No**
• If pressure in rising main exceeds working pressure by more than 10 meters for 10 sec then trigger Pump shut down. • Signal “Over Pressure” light, stop and reset delay timer.	
Manual	**Yes**
• Trigger pump shut down. • stop and start on delay Timer.	
Safety Trip Signal (all faults)	**Yes**
• Trigger pump shut down. • Signal trip reason light and lockout until manual reset. I.e. prevent timer restart.	
Emergency stop button	**Yes**
• Pump shut down (no run down just remove power). • Signal “Emergency Stop” light and lockout until manual reset i.e. prevent timer restart.	
Duty standby configuration	**No**
• After each pump shut down the duty pump and standby pumps are to rotate. • If the duty pump fails 3 times to start, the standby pump must start automatically and Signal “Pump Fail” light. • Should non-starting however be caused by any of the safety trips, the motor shall not attempt a second start and shall not be available as a standby set i.e. Pump fail” light to be illuminated, until the fault has been cleared and the system manually reset	
Monitoring and Instrumentation	
SUCTION: Radar Level sensors (low and high level) installed at abstraction building for sensing river level	**Yes**
DISCHARGE: Radar Level sensors (low and high level) installed in delivery reservoir, one for each pump.	**No**
No-flow switches on each pump discharge	**No**
Pressure Sensor on each pump discharge	**No**
Pressure gauge on each pump discharge	**No**
No-flow switch on main discharge pipe	**No**
Pressure Sensor on main discharge pipe	**No**
Pressure gauge on main discharge pipe	**No**
Delay timer with specific time lock outs in each pump control board.	**No**
Magflow meters will be installed on the discharge line. The signal from this is to be fed into the MCC. The signal is to provide flow and velocity readings (to be displayed on the MCC) as well as be used as an additional no flow sensor for the pumps.	**No**
Power Meter for pump included in MCC	**Yes**
Bearing temperature sensors on pumps	**No**

Bearing temperature sensors on motors	**No**
Vibration sensors on pumps	No
Vibration sensors on motors	No
Winding temperature sensors on motors	**Yes**
GSM telemetry for flow data	No
GSM telemetry for safety faults	No
Terminal for SCADA telemetry for flow data	**No**
Terminal for SCADA telemetry for safety faults	**No**

4 TESTING

The Contractor shall **NOT** need to arrange for witnessed factory tests of the pumps in accordance with the requirements of the general pump particular specifications; only after demonstrating compliance with project requirements, will the pump be released for delivery.

Onsite testing of the operational conditions and delivery is required to verify performance, each pump individually, and in selected groups up to the maximum of Duty pumps installed under this Contract running together, in accordance with the requirements of the general pump particular specifications. Failure to meet with project requirements will require the cause to be identified and rectified.

5 ELECTRICAL INSTALLATION

5.1 Particular Requirements for Electrical Equipment and Installations

The specification is a performance and quality specification for the supply, installation and commissioning of the Main Incomer Panel and the Motor Control Centre (MCC) and electrical work required at pump stations

This section specifies the standard of workmanship and quality of materials for the electrical installations.

The applicable specification shall be SANS 10142/1/2003. This shall supersede the SABS 0142 specifications listed in this document.

5.2 Compliance with Regulations

The entire electrical installation shall be carried out in accordance with the latest revision and amendments of the following:-

- The Works Information (Specifications)
- The Occupation and Safety Amendment Act (Act Nº 181 0f 1993) including all regulations, compulsory and safety standards promulgated in terms of the Act.
- The Wiring Code SANS 10142/1/2003 as amended, referred to herein as the “Wiring Code”.
- The Municipal By-Laws and any special requirements of the Supply Authorities of the area and district concerned.
- The local Fire Office Regulations.
- Telkom Regulations.

- o A certificate of Compliance shall be issued on completion of the installation.

5.3 Electrical Power Supply Source and Reticulation

A pole mounted ESKOM 315 kVA three phase, four wire 400/230V; 50 Hz power supply is available approximately 250 m away "as the crow flies" from the new MCC to be built. XLPE ECC cable shall be terminated onto the Eskom LV circuit breaker and be installed underground to a structure where the power shall be routed to the new MCC via a 400 V aerial bundle conductor (ABC) circuit mounted on wooden pole structures. A surveyor shall be appointed by the Contractor and shall verify the route and design for which the ABC shall follow. The surveyor shall register a wayleave or servitude for the selected route. The surveyor shall peg out the stay positions and issue stacking tables to the Contractor who shall construct the ABC line accordingly. At the MCC, the ABC shall be terminated onto XLPE cable where its shall be finally terminated onto the new MCC panel. Reference is to be made to the engineers' drawings as to the recommended ABC standards to which the electrical installation should comply.

Where a temporary builder's supply is required, the Contractor shall make his own arrangements and the costs thereof shall be deemed to be included in the rates tendered.

Tenderers shall provide information regarding their proposed lightning protection together with the tender submission.

5.4 Instrument Cabling

All power / distribution cables shall be of the armoured type and in accordance with SANS 1507.

Power / distribution cables shall be installed in ground, ducts or sleeves. Surface mounting is not acceptable with the exception of the ABC cable and the transition from ABC cable to XLPE ECC cable. Instrumentation cables shall be installed in sleeves or conduit and the instrumentation cable must not be buried directly into the ground without being drawn into the sleeves or conduit.

Under no circumstances shall cables be suspended with exception of the ABC cable.

The following suitably rated electrical power supply cables shall be provided by the contactor:

- Main incomer circuit from the Eskom Kiosk supply to the new MCC located in the new Pumping station(400V).
- Feeder cable from the MCC to each pump set (400V);
- Junction boxes, brackets, cable glands, joints as required.

Cabling will be included in the tenderers submitted rates unless measured separately in the Schedule of Quantities.

5.5 Motor Control Centre's (MCC's)

MCC components shall be selected and suitably sized by the contractor to suit the equipment specified. The MCC Shall as a minimum Include all items specified in Electrical Data Schedule 1.

Standard Specification to apply and be read in conjunction with the enclosed. The panel shall be Floor standing, the length of completed distribution boards shall not to exceed 3m in length and 2.2m in height. Finalised length of board to be confirmed with building contractor so that cable trench provision can be finalised.

A Detailed wiring diagram of MCC and if applicable name and contact details of PLC programmer to be “routed” on to adequately sized “Perspex” or similar plastic sheet and permanently fixed to inside of panel doors. Additionally basic operation instructions as agreed with the Engineer to be “routed” on to adequately sized “Perspex” or similar plastic sheet and permanently fixed to outside of panel doors.

5.6 Variable frequency Drives

A Variable frequency drive is required for each pump. In addition to the detail provided in the general specifications the drive is to Include all items specified in Electrical Data Schedule 2 as a minimum.

5.7 Lighting

Lighting and Small power requirements shall be provided in accordance with the drawings and electrical data schedule 3

5.8 Earthing

An earth electrode in the form of a "crows’ foot” shall be installed in a suitable area in close approximately to the new MCC. The selected area where the crows’ foot is proposed to be installed shall require the engineer’s approval. Earth continuity conductors from the earth electrode shall connect to both ends of the earth bar of the new MCC panel.

All earthing and bonding shall comply with the latest SANS 10142-1, SANS 10292, and SANS 10199 standards.

5.9 Lightning Protection

The electrical installation shall be properly insulated against surges and shall be provided with an adequate lightning protection system. Reference shall be made to the engineers’ drawings on the recommended surge protection to be installed.

Tenderers shall provide information regarding their proposed lightning protection together with the tender submission. The building structure and electrical installation lightning protection design shall comply with the latest SANS 10313 Protection against lightning-physical damage to structures and life hazard standard as well as SANS 10142-1. The SANS 10313 “Lighting protection system installation safety report” – “Annexure A” shall be issued to the engineer to form part of the Occupational Health and Safety Acts Electrical Installation Regulations mandatory required electrical certificate of compliance documentation within 3 working days after testing and commissioning has been completed. The tendered amount is to include for installation, testing and commissioning.

6 MEASUREMENT AND PAYMENT

The tendered rates or sums shall cover the cost of anything not specially mentioned, but which an experienced contractor can reasonably foresee as being required to enable the apparatus and equipment to be installed and/or function safely and correctly as specified. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of equipment or part thereof is not specifically mentioned in the Schedule of Quantities.

The term ‘pumpset’ refers to the complete set of pump, motor, shaft, couplings, baseplates, fasteners, holding down bolts and all accessories necessary for a complete functional unit.

6.1 Design, select, supply, handle, deliver, complete with necessary instrumentation, cabling, switches, etc. the following pumps sets

Design, select, supply, handle, deliver, complete with necessary flow switches, pressure switches level probes/ sensors, common instrumentation and inline pipeline instrumentation ect. for the following pumpsets:

[Description of pumps. Describe additional requirements where applicable ……..Unit No. or Sum

This shall include the pump, pump ancillary items, motor, motor ancillary items, and instrumentation required on each pump-line, and all other components, accessories, equipment and civil works necessary for the complete Installation, including but not limited to All equipment, instrumentation, couplings, cabling, and ancillary items and cabling, pipework and valves and supports /mountings etc. It shall include all instrumentation inherent to the pump or the motor and all pipeline equipment and instrumentation such as flow meters, pressure switches ect. and the electrical installation thereof. As detailed below:

Design: The rate tendered shall include full compensation for the design of the complete installation including full design calculations; detail working Drawings for all items; Specifications; schematic diagrams; electrical Drawings and wiring diagrams; layout Drawings, quality control plans, and provision of the above to the Employer's Agent for approval in accordance with the requirements of the Scope of Work.

Supply: The tendered sum shall cover the cost of the supply of the goods, testing as specified, provision of test certificates certifying compliance of the goods with the applicable standards, quality control, corrosion protection, if not scheduled separately, and supply of all special tools and keys required for maintenance and installation. Payment for supply of the relevant equipment will not be effected until the draft copies of the related sections of the Operation and Maintenance Manuals have been submitted.

Delivery: The tendered rate or sum shall cover the cost of preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. Where a rate or sum has been tendered for delivery of goods, which are then, stored, the Engineer at his sole discretion may certify an amount for partial or full payment of the relevant item, if in the Engineer's opinion such a payment is justified by reason of the transportation of such goods to their place of storage.

6.2 Install, test and commission complete with necessary instrumentation, cabling, switches, etc. the following pumps sets

Install, test and commission complete with necessary flow switches, pressure switches level probes/ sensors, common instrumentation and inline pipeline instrumentation ect. for the following pumpsets:

[Description of pumps. Describe additional requirements where applicable ……..Unit No. or Sum

This shall include the pump, pump ancillary items, motor, motor ancillary items, and instrumentation required on each pump-line, and all other components, accessories, equipment and civil works necessary for the complete Installation, including but not limited to All equipment, instrumentation, couplings, cabling, and ancillary items and cabling, pipework and valves and supports /mountings etc. It shall include all instrumentation inherent to the pump or the motor and all pipeline equipment and instrumentation such as flow meters, pressure switches ect. and the electrical installation thereof. As detailed below:

Installation: The tendered rate or sum shall cover the cost of all necessary site oriented activities such as handling at the Site, storing, sorting, erecting, all painting, including all costs of transport of personnel and their erection gear to Site, and the cost of all materials, labour and consumables. Where items of equipment are to be grouted in (such as for anchors and pumpset base plates), the installation sum shall include for such work.

Testing and commissioning: The tendered rate or sum shall cover the cost of pre-commissioning tests, as well as commissioning tests, including putting the Works into operation. All costs of transport to and from Site, and Site accommodation of personnel and their gear shall be included in the tendered rates.

6.3 Design, select, supply, handle, deliver, install, and commission MCC complete as specified including starters, switchgear, ect. for the following pumps sets

Design, select, supply, handle, deliver, install, commission Motor control centre complete as specified including starters, switchgear, contactor, selector, phase angle, control and protection devices, lightning protection and electrical cables as specified ect for the following pumpsets:	
[Description of pumps. Describe additional requirements where applicable	……..Unit Lump Sum

This shall include MCCs complete with integrated control panels, including cabinet, all instrumentation, equipment, switchgear, cabling, and mountings including cabling between the MCC and control panel, programming and the electrical installation thereof.

Design: The rate tendered shall include full compensation for the design of the complete installation including full design calculations; detail working Drawings for all items; Specifications; schematic diagrams; electrical Drawings and wiring diagrams; layout Drawings, quality control plans, and provision of the above to the Employer's Agent for approval in accordance with the requirements of the Scope of Work.

Supply: The tendered sum shall cover the cost of the supply of the goods, testing as specified, provision of test certificates certifying compliance of the goods with the applicable standards, quality control, corrosion protection, if not scheduled separately, and supply of all special tools and keys required for maintenance and installation. Payment for supply of the relevant equipment will not be effected until the draft copies of the related sections of the Operation and Maintenance Manuals have been submitted.

Delivery: The tendered rate or sum shall cover the cost of preparation and packing for transport; transport from place of manufacture to the Site; insurance, harbour dues etc., during transport; loading and unloading; storage under appropriate conditions from date of delivery until commencement of erection; and any other work as specified. Where a rate or sum has been tendered for delivery of goods, which are then, stored, the Engineer at his sole discretion may

certify an amount for partial or full payment of the relevant item, if in the Engineer's opinion such a payment is justified by reason of the transportation of such goods to their place of storage.

Installation: The tendered rate or sum shall cover the cost of all necessary site oriented activities such as handling at the Site, storing, sorting, erecting, all painting, including all costs of transport of personnel and their erection gear to Site, and the cost of all materials, labour and consumables. Where items of equipment are to be grouted in (such as for anchors and pumpset base plates), the installation sum shall include for such work.

Testing and commissioning: The tendered rate or sum shall cover the cost of pre-commissioning tests, as well as commissioning tests, including putting the Works into operation. All costs of transport to and from Site, and Site accommodation of personnel and their gear shall be included in the tendered rates.

6.4 Supply, install and commission complete with necessary cabinets etc. the following Voltage Stabilisers.

Design, select, supply, handle, deliver, install, test and commission complete with necessary cabinets for the following voltage stabilisers:

[Description of voltage stabilisers, location. Describe additional requirements where applicable (State Rated Capacity & Output Current) ……..Unit: Sum

The Rated Capacity and Output Current will be specified separately. Supply, installation and commissioning of the voltage stabilisers shall be measured as Number.

The tendered rate shall include for all plant, labour, materials, transport and all charges and costs necessary to install and commission the voltage stabilisers, all as specified in the Standard and Particular Specifications. Where an outdoor unit is specified, the tendered rate shall include for a suitable weatherproof kiosk and concrete plinth and cable ducts.

6.5 Design, supply, install and commission smaller power installation complete as specified including, lighting, earthing and small power, plugs and electrical cables as specified.

Design, select, supply, handle, deliver, install, test and commission smaller power installation complete as specified including, lighting, earthing and small power, plugs and electrical cables as specified.

[State building area where applicable] ……..Unit: Lump Sum

The design, supply, installation and commissioning of the lighting, earthing and small power, plugs and electrical cables is measured as a Lump Sum.

The tendered rates shall include for all plant, labour, materials, transport and all charges and costs necessary to install and commission of the lighting, earthing and small power, plugs and electrical cables complete as specified. The tendered rates shall also include for all necessary electrical cabling and connections from the electrical supply to the DB/MCC/Incomer

APPENDIX A: SYSTEM CURVES FOR ABSTRACTION SUBMERSIBLE PUMPSETS

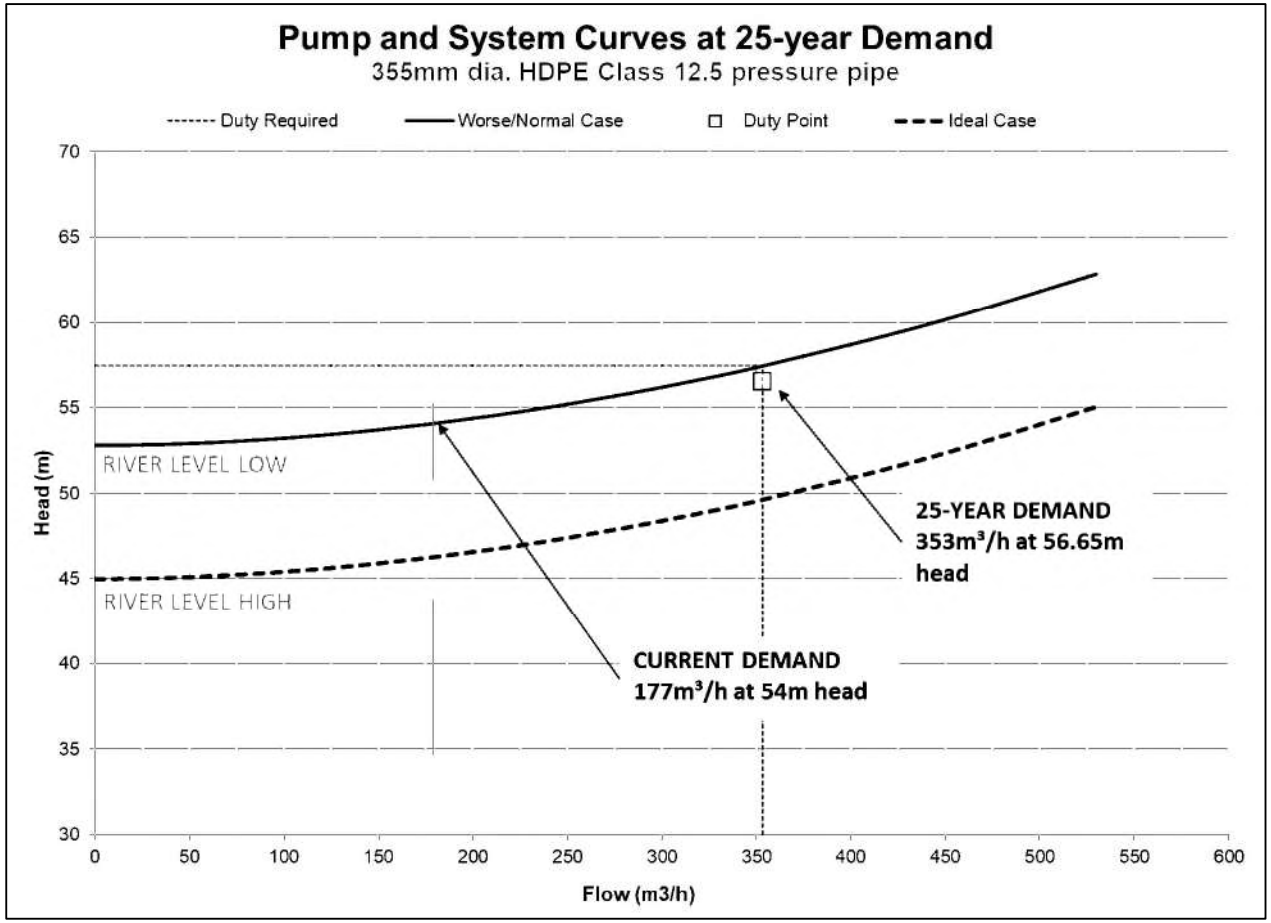


Figure 1: Abstraction system normal river level for current and future demand at 50Hz

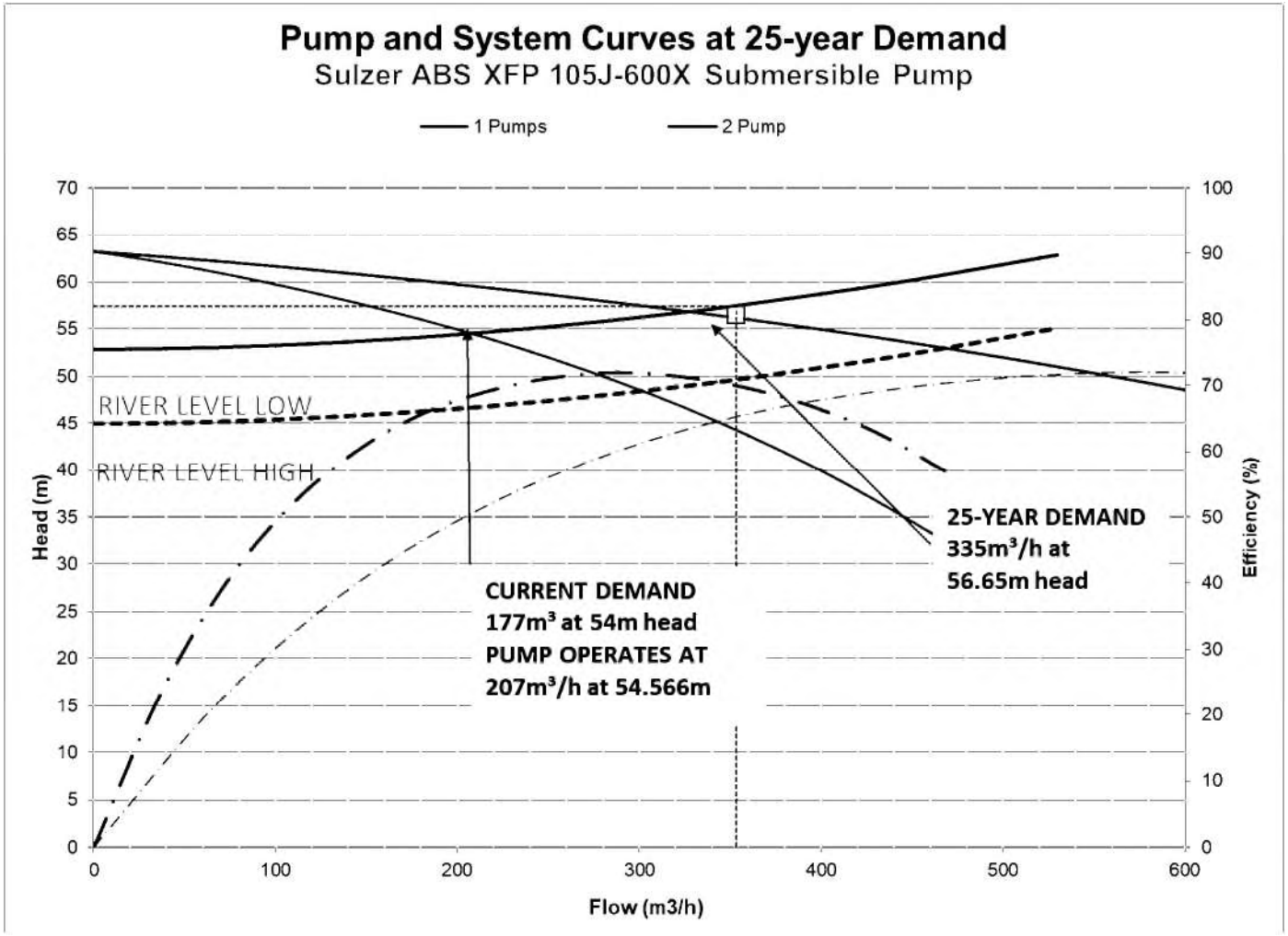


Figure 2: Abstraction system and performance curves for normal river level for current and future demand at 50Hz

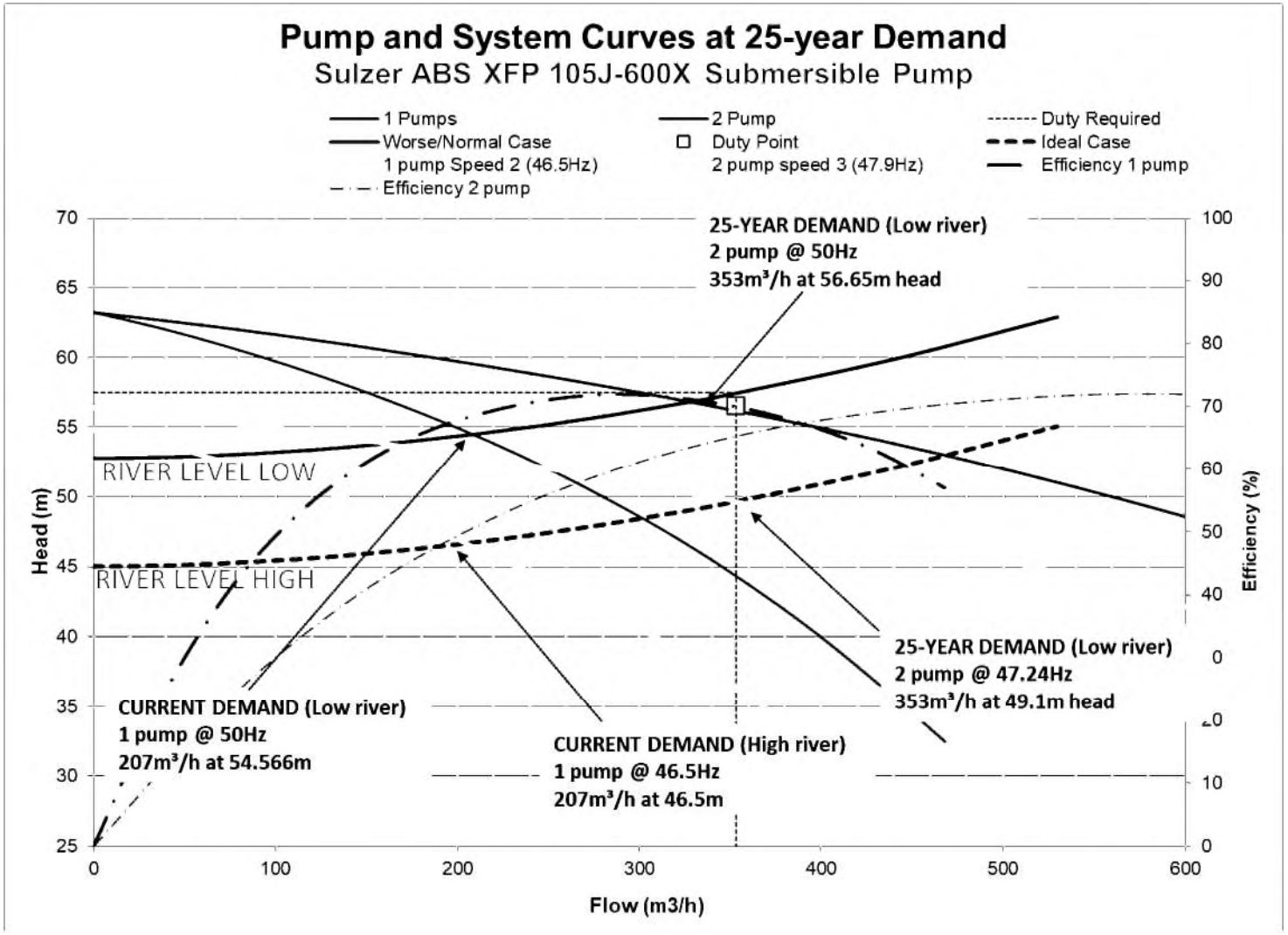


Figure 3: High-Lift system and performance curves for high and low river water levels using varying frequency

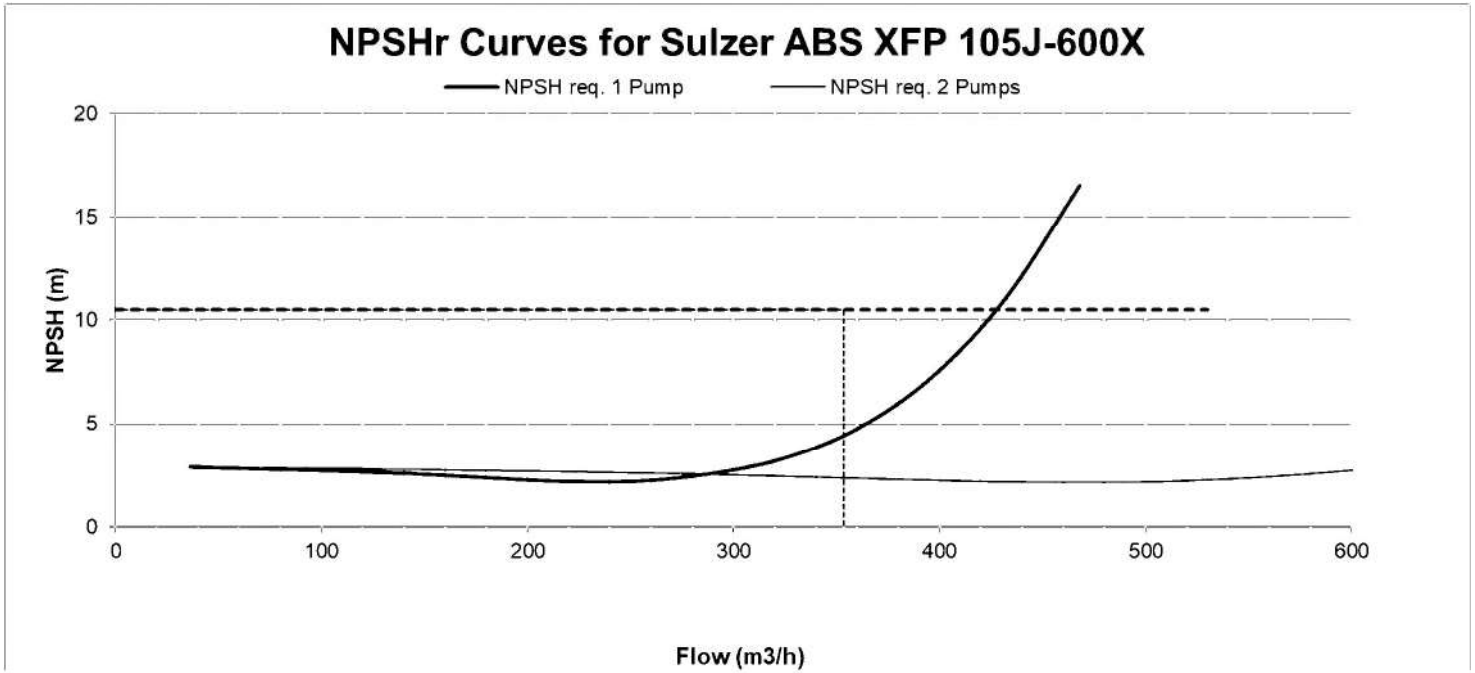


Figure 4: High-Lift NPSH curves

APPENDIX B: ELECTRICAL DATA SCHEDULES

ELECTRICAL DATA SCHEDULE 1 : NEW MCC (page 1 of 5)

Contents		Generator/Motor Information (NEW MCC 1)							Power Circuit - Circuit Breaker							
	Generator/Motor Application Description (As indicated on panel labels and drawings)	SLD Symbol	Generator/Motor Number	Generator/Motor Voltage	kW (Kilo Watts)	Est Amps	Type of Start/Control	Cable Number (Labled both ends)	Circuit Breaker (MCCB)	Circuit Breaker Draw Out	Circuit Breaker Rating	Circuit Breaker kA Rating	1 Padlock Lockable	Auxiliary Feed Back C/O	Status Indication on Main Panel	Number of Poles
	Detail	Detail	Detail	Detail	Detail	Detail	Yes	Yes	Yes	Yes	Detail	Detail	Yes	Yes	Yes	Detail
1	Main Circuit Breaker (Adustable) with shunt trip coil wired to firemans switch and emergency stop.	MCB	MCB	400V	350 Adj	322	N/A	✔	✔	N/A	500	≥ 10 kA	✔	✔	✔	3
2	Pumpset 1	M1	M1	400V	75	137	VSD	✔	✔	N/A	150	≥ 10 kA	✔	✔	✔	3
3	Pumpset 2	M2	M2	400V	75	137	VSD	✔	✔	N/A	150	≥ 10 kA	✔	✔	✔	3
4	Pumpset 3 (Future)	M3	M3	400V	75	137	VSD	✔	✔	N/A	150	≥ 10 kA	✔	✔	✔	3
5	Sump Pumpset	M4	M4	400V	1	1.6	DoL	✔	✔	N/A	10	≥ 10 kA	✔	✔	✔	3
6	Genset 1	G1	G1	400V	350	250	N/A	N/A	✔	N/A	350	≥ 10 kA	✔	✔	✔	4

✔ Indicates the Tenderer to included the item specified to be included as part the design criteria

Note: All transducers to form part of supply on machinary for signal feedback purposes

ELECTRICAL DATA SCHEDULE 1 : NEW MCC (page 2 of 5)

Contents		Emergency Stop				Meters						Communications from Devices
	Generator/Motor Application Description (As indicated on panel labels and drawings)	Emergency Stop	Auxiliary Feed Back (N/O)	Status Indication on Main Panel	Motor Rotation	Analogue Voltmeter meter; 500V with 7 position selector switch	Analogue Ampere Meter inst & 15 min max dmd; with 4 position selector switch		Analogue Ampere Meter inst	Digital Power Meters	Analogue run hour meter	Ethernet IP/hard wired to RIO
		E-stop mouted on wall in MCC Room	Yes	Yes	Forward Only	Yes	Scale: 0-500A	Scale: 0-300A	Scale: 0-5A	Schneider 5330 or approved equivalent	Yes	Yes
1	Main Circuit Breaker with shunt trip	✔	✔	✔	N/A	✔	✔	N/A	N/A	✔	N/A	hard wired
2	Pumpset 1	✔	✔	✔	✔	N/A	N/A	✔	N/A	✔	✔	hard wired
3	Pumpset 2	✔	✔	✔	✔	N/A	N/A	✔	N/A	✔	✔	hard wired
4	Pumpset 3 (Future)	✔	✔	✔	✔	N/A	N/A	✔	N/A	N/A	N/A	N/A
5	Sump Pumpset	✔	N/A	✔	N/A	N/A	N/A	N/A	✔	N/A	✔	hard wired
6	Genset 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

✔ Indicates the Tenderer to included the item specified to be included as part the design criteria

Note: All transducers to form part of supply on machinary for signal feedback purposes

ELECTRICAL DATA SCHEDULE 1 : NEW MCC (page 3 of 5)

Contents		Control of Motor/Generator at Main Panel						Automation, Monitoring and Control	
	Generator/Motor Application Description (As indicated on panel labels and drawings)	Start Buttons (On Main Panel)	Stop Buttons (On Main Panel)	Manual/Auto Selector Switch	Lamp Test Button (on Main Panel)	Remote Start	Remote Stop	PLC	SCADA
		On Main Panel	On Main Panel	On Main Panel	On Main Panel	No	No	Yes	Yes
1	Main Circuit Breaker with shunt trip	N/A	N/A	N/A	✔	N/A	N/A	✔	✔
2	Pumpset 1	✔	✔	✔	✔	N/A	N/A	✔	✔
3	Pumpset 2	✔	✔	✔	✔	N/A	N/A	✔	✔
4	Pumpset 3 (Future)	✔	✔	N/A	✔	N/A	N/A	✔	✔
5	Sump Pumpset	✔	✔	N/A	✔	N/A	N/A	✔	✔
6	Genset 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

✔ Indicates the Tenderer to included the item specified to be included as part the design criteria

Note: All transducers to form part of supply on machinary for signal feedback purposes

ELECTRICAL DATA SCHEDULE 1 : NEW MCC (page 4 of 5)

Contents	Generator/ Motor Application Description (As indicated on panel labels and drawings)	Forced ventilation as per VSD manufactures recommendations	LAMP/LED Indication on Panel (100 000 hrs)									
			Lamps: Power Circuit Breaker ON & Off	Lamps: Emergency Stop Initiated	Lamp: Generator/ Motor Run	VSD/Gen Temp Trip	Lamp: Generator/ Motor Fault Tripped	Lamp: No Flow	Lamp: River High Level	Lamp: River Low Level	Lamp: Reservoir Full	Lamp: Not Primed
1	Main Circuit Breaker with shunt trip	N/A	✔	✔	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	Pumpset 1	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
3	Pumpset 2	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
4	Pumpset 3 (Future)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
5	Sump Pumpset	N/A	✔	✔	✔	N/A	✔	N/A	N/A	N/A	N/A	N/A
6	Genset 1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

✔ Indicates the Tenderer to included the item specified to be included as part the design criteria

Note: All transducers to form part of supply on machinary for signal feedback purposes

ELECTRICAL DATA SCHEDULE 1 : NEW MCC (page 5 of 5)		
ITEM	**PANEL REQUIREMENTS**	
1	OHS ACT Requirements	All required electrical notifications must be inside and outside of sub station
		Install Single Line Drawing of Electrical Main Circuits covered with Perspex
		All labels front, back and inside electrical panels must comply with OHS ACT
		Pump station must have a register of who enters substation
2	Type of Panel	Floor Standing and fixed to back wall and floor
3	Base Plates	Galvanised (no paint) IEC Standard
4	Type and Thickness of Panel Sheets	Type:3CR12; thickness: 2.0 mm
5	IP Rating	IP 55
6	People Access	Front
7	Panel Doors	Hinged Doors: Front
		Opening doors lockable and hinged with mechnical Interlock on MCCB
8	Colour	Signal Red
10	Cables Glanding	Galvanised (no paint) IEC Standard
		Gland plate must be thick enough to support cables
11	Cables on to ACB's	Supported on Bus Bars - fitted from ACB to back of panel in tufnol
12	Cables connections to circuit breakers	Tails of cables to bottom on Circuit Breaker
		All cable entering Panels must be made off with Glands
13	Copper Busbars	Top of Panel / Vertical /Horizontal (Closed)
		Copper Bars in parallel must comply with IEC standard with diversity factor
		Insulated / Covered and Colour Coded
14	Rating in Parallel	Live Bus Bars-As to IEC Standards (NOT DOUBLE AMPERAGE IN PARALLEL)
		Same applies for Neutral bars
15	Neutral Bar Size	Same Size as Live Bars (Must not be 50% of live conductors)
16	Earth Bar Size	Half size of Live Bars
17	Earth Bars Position	Bottom of Panel
18	Labels	Must have the Panel kA rating above Bus-coupler A4 size
		All labels must be screwed on (no glue)
		Label writing must be legible at a distance - 3 meters
		Cables must be labelled at both ends - metal straps
		Must have labels indicating all devices in panel - CB's, relays, contactors, power supplies,
19	Drawing Holder	Panels must have a A4 electrical drawing holder in the door - of main circuit breaker
20	Communication	VSD panels must have an Ethernet connection

ELECTRICAL DATA SCHEDULE 2 : VARIABLE SPEED DRIVE (VSD)		
ITEM	**Description**	**Requirement**
1	**Input**	
1.1	3-Phase supply voltage:	U3IN = 380V – 460 V (-15% .....+10%)
1.2	Input Frequency	50 Hz (±5%)
1.3	Motor Power	≈75 kW
1.4	Motor Torque	Asynchronous- standard
2	**Filter**	
2.1	EMC Filter	Integrated conforming to EN/IEC 61800-3: 2018 category C3 within 50m
3	**Output**	
3.1	Torque	Variable torque
3.2	Frequency	0.0001……0.5 kHz
3.3	Nominal Switching Frequency	2.5 kHz
3.4	Switching frequency	1…….8kHz adjustable
3.5	Allowance for additional I/O cards	1 X digital; 1 X analog and 1 X relay card
3.6	Motor slip compensation	Automatic, adjustable and disabled
3.7	Braking to standstill	By DC injection
4	**Motor Protection**	
4.1	Thermal protection	Required
4.2	Motor phase break	Required
5	**Drive Protection**	
5.1	Thermal protection	Required
5.2	Overheating	Required
5.3	Overcurrent between output phases and earth	Required
5.4	Overload of output voltage	Required
5.5	Short circuit protection	Required
5.6	Motor phase break	Required
5.7	Over voltages on DC bus	Required
5.8	Line supply overvoltage	Required
5.9	Line supply undervoltage	Required
5.10	Line supply phase loss	Required
5.11	Overspeed	Required
5.12	Break on the control circuit	Required
6	**Display unit**	
6.1	Frequency resolution	0.1 Hz
6.2	Analog input	0.12/50Hz
6.3	Extended door mounted control module	Required
7	**Communication**	
7.1	Communication protocol	Modbus serial (open protocols)
7.2	Connector type	RJ 45 for Modbus serial
7.3	Physical interface	2-wire RS 485 for Modbus serial
7.4	Transmission frame	RTU for Modbus serial
7.5	Method access	slave
8	**Analog and Digital Inputs and Outputs**	
8.1	Analog inputs and outputs	≥ 2 (4-20mA)
8.2	Digital Inputs and Outputs	≥ 6 (24V DC (19.....30V)) with overload and short circuit protection and conforming to EN/IEC61131-2
9	**Relays**	
9.1	Fault Relay	NO/NC ≥100000 cycles
9.2	No. 1 Sequence relay	NO ≥100000 cycles
9.3	No. 2 Sequence relay	NO ≥100000 cycles
9.4	No. 3 Sequence relay	NO ≥100000 cycles
10	**Wave factor and efficiency**	
10.1	Fundamental	≥0.98
10.2	Total	≥0.93
10.3	Fundamental (ISU)	1
10.4	Total (ISU)	≥0.99
10.5	Efficiency	≥97%
11	**Ventilation**	
11.1	Fans Torque control:	Torque step rise time:
11.2	Noise level	≤80 dBA
12	**Response**	
12.1	Open loop	<5 ms with nominal torque
12.2	Closed loop	<5 ms with nominal torque
13	**Non-linearity:**	
13.1	Open loop	≈4% with nominal torque
13.2	Closed loop	≈1% with nominal torque
18.1	Speed control:	
18.2	Open loop	≤10% of motor slip
18.3	Closed loop	≤0.01% of nominal speed
19	**Dynamic accuracy:**	
19.1	Open loop	≈ 0.3...0.4%sec. with 100% torque step
19.2	Closed loop	≈ 0.1...0.2%sec. with 100% torque step
20	**Environmental and Ambient Conditions**	
20.1	Operation	-5°C to +55°C, no frost allowed

20.2	Transportation and storage	-15...+70°C
20.3	Relative humidity	5 to 95% (no condensation allowed) conforming to IEC 60068-2-3
20.4	Air	Inherent forced ventilation-filters required
205	Altitude	0...1000 m without derating
20.6	Electronic board protection	Electronic boards are to be conformal coated and breathable, allowing trapped moisture to escape while maintaining protection from contamination.
21	**Isolation and Testing**	
21.1	Isolation	Between power and control terminals
21.2	Insulation Resistance	>1MΩ; 500V DC for 1 minute each
22	**Minimum compliance with standards**	
22.1	Electromagnetic compatibility	Electrostatic immunity test level 3 conforming to IEC 61000-4-2 Radiated radio frequency electromagnetic field immunity test level 3 conforming to IEC 61000-4-2 Electrical fast transient/burst immunity test level 4 conforming to IEC 61000-4-4 1.2/50µs-8/20µs surge immunity test level 3 conforming to IEC 61000-4-5 Conducted radio-frequency immunity test level 3 conforming to IEC 61000-4-6
22.2	Pollution degree	EN/IEC 61800-5-1
22.3	Shock resistance	15gn for 11 ms conforming to IEC 60068-2-27
22.4	Environmental characteristics	Chemical pollution resistance class 3C3 conforming to EN/IEC 60721-3-3 Dust pollution resistance 3S3 conforming to EN/IEC 60721-3-3
22.5	Other standards to confirm to	EN 61800-3 Environmental 2 category C3 EN/IEC 61800-3 EN/IEC 61800-3 EN/IEC 61800-5-1 IEC 60721-3
22.6	Marking	CE
23	**Location**	
23.1	Mounting	Inside of MCC Panel (Fans and filters to be fitted onto MCC panel for ventilation as per manufactures recommendations)

ELECTRICAL DATA SCHEDULE 3 : MISCELLANEOUS			
Item	**Description**	**Manufacturer**	**Model**
Type A	LED Vapouline	BEKA or equal and approved	LED 4 FT 46W
Type B	Indu Flood Wall/Rail Mounted,with Stirrup Mounting Bracket	BEKA or equal and approved	LED FLOOD 70W
Type C	Wall mounted Self Contained Battery Exit Signs	BEKA Emergency / Voltex, or equal and approved	ARGOS (BEKA) or E10M-2PL9-EXIT (VOLTEX)
Type D	Sump Light	BEKA or equal and approved	LED FLOOD 70W
Type E	Royce Thomson P5 type photo electric cell complete with "Hubbel" type plug set suitable for mounting on and including galvanised pressed steel conduit box and neoprene gasket	Royce Thomson or equal and approved	Royce Thomson P5
Type F	ABB 3 Position Rotary Switch in ABB enclosure complete	ABB or equal and approved	OC25G02PNBN00NU1
Type G	Occupancy Sensor	Schneider Electric or equal and approved	SAE_UE_MS_CSAWE
Type H	Industrial Socket Outlet in surface mount metal box complete (colour electric orange)	CRABTREE CLASSIC or equal and approved	7393
Type I	Twist release emergecy stop inclusive of shroud and enclosure complete	ABB or equal and approved	CE3T-10R-02; MA1-8053; MEPY1-0
Type J	Firemans Switch inclusive of threaded blanking plugs	ABB or equal and approved	KSE325TPN
Type K	Cable glands	LAPP SKINTOP® ST-M or approved equal	
Type L	Terminal Blocks	LEGRAND VIKING™ 3 or approved equal	
Type M	Terminal Marking	LEGRAND CAB™ marking System or approved equal	
Type N	RJ 45 fast connect-robust steel type	LAPP ED-IE-AX-5-PN-20-FC or approved equal	
Type O	Protective SS cable flexible conduit Ø 10mm adapter with cap nut	SILVYN® LGEF-M (stainless steel) 55503200 or approved equal	
Type P	Protective SS cable flexible conduit Ø 16mm adapter with cap nut	SILVYN® LGEF-M (stainless steel) 55503202 or approved equal	
Type Q	Protective SS cable flexible conduit Ø 20mm adapter with cap nut	SILVYN® LGEF-M (stainless steel) 55503203 or approved equal	
Type R	Screened Control Cable	Measured elsware	
Type S	16A Pad lockable IP66 surface mount 2 pole isolator complete	GEWIS GW70401P or approved equal	

Note: All fittings as noted above are to be installed with non-ferrous metal fasteners as per manufactures recommendations

HARRY GWALA DISTRICT MUNICIPALITY

CONTRACT NO: HGDM746/HGM/2021

CONSTRUCTION OF GREATER MNQUMENI ABSTRACTION WORKS, PUMPING SYSTEM: CIVIL, MECHANICAL & ELECTRICAL

PARTICULAR SPECIFICATION

GIBB 021 – ACCREDITED TRAINING

Table of Contents

Revision	Date	Change Detail	Editor
1.0	June 2021	Initial Release	M.Holmes

1 INTRODUCTION

1.1 Scope

This specification covers Accredited On-Site Skills Training for nominated trainees from the local community in skills relating to specific areas related to construction. It is intended that candidates for training will be people who are undergoing, or who have undergone, training at a University of Technology or FET College. Training is described in Section C3.4, Part A.

2 . EMPLOYMENT ARRANGEMENTS

The Employer will inform the Contractor of the number and names of candidates to be trained and confirm the categories of training to be provided (see Section 4 below) and the required timing (date for start of training and duration). The Contractor shall proceed to timeously employ such candidates for the duration of training and shall claim for salary and other validated costs incurred, including agreed mark-up, according to the Training Schedule. The trainees shall be employed according to the Contractor's full and normal conditions of employment for unskilled labour, including registration for Workmens' Compensation.

The trainees shall fall under the Contactor's Health & Safety Plan for the duration of training. However the trainees will not be available for deployment by the Contractor for the duration of training. Upon completion of training the employment contract with each trainee will cease and the Contractor shall have no obligation towards the trainees in respect of further employment. The Contractor may, however, employ the trainees on a permanent, or other basis, on terms to be mutually agreed.

3 TRAINING ARRANGEMENTS

The Contractor shall obtain three quotations from suitable accredited Skills Training Service Providers on the basis of PT4 below. The quotations and responses shall be submitted for the approval and decision of the Employer.

Upon notice of the Employer's approval, the Contractor shall proceed to appoint the selected firm to provide such Accredited Skills Training Facilitator(s) as are required according to the disciplines of training to be provided. The Contractor shall pay the training fees and charges of the accredited trainer according to the agreed fee scales and according to such validated registers of attendance and certificates of performance as are agreed in the training contract to be entered into.

The Contractor shall provide a suitable area for the purpose of training, in proximity to the worksite so as to allow for interaction with the workplace as and when required for training purposes, and shall make available a meeting room, with tables and chairs, for instruction purposes, together with water supply and sanitation facilities for male and female participants.

The Contractor shall be required to provide construction materials for practical training. Any such materials supplied shall be charged as per the Dayworks Schedule.

4 TRAINING CATEGORIES AND OBJECTIVES

4.1 Trench Excavation and Supervision

At the end of training the trainee will be able to and understand why it is necessary to:-

i) Remove and preserve topsoil;
ii) Excavate straight pipe trenches by machine and manual labour;
iii) Excavate the trench invert evenly;
iv) Excavate vertical trench sides;
v) Deposit excavated material a safe distance away from the trench edge;
vi) Be able to work with boning rods;
vii) Backfill around the pipe;
viii) Compact the backfill to the trench;
ix) Understand and apply the Construction Regulations with regard to trench excavation.

4.2 Pipelaying

At the end of training the trainee will be able to:-

i) Understand the principles and functions of a pipeline;
ii) Measure the depth of a trench to establish the degree of bottoming up required;
iii) Supervise, level and prepare the bedding to receive the pipes;
iv) Set up a fishline at the bottom of the trench
v) Excavate a trench to the required depth and width to contain the water main;
vi) Prepare the bedding;
vii) Lay a pipeline using the correct tools, materials and equipment;
viii) Make a connection from the water main to a branch or house connection;
ix) Do initial, intermediate and final backfilling and compaction and ensure correct compaction by testing soil density;
x) Backfill after laying the pipes in such a way that the pipes are protected from movement or damage from external pressure;
xi) Understand and apply the Construction Regulations with regard to pipelaying.

4.3 Steel Fixing

At the end of training the trainee will be able to:-

i) Understand basic structural drawings;
ii) Recognize the different bar profiles and strengths and their purposes;
iii) Interpret shape codes and bending schedules;
iv) Set up steel bars for bending;
v) Select the correct steel bars for fixing;
vi) Fix in place steel bars;
vii) Carry out dimensional checks according to drawing and adjust where necessary;
viii) Understand and apply the Construction Regulations with regard to steel fixing.

4.4 Formwork and Concreting

At the end of training the trainee will be able to:-

i) Understand basic structural drawings;
ii) Set out work and determine placing of formwork;

iii) Fix formwork in place;

iv) Recognize the types of support, propping, etc. and determine the level of support requirements for specific formwork;

v) Understand different prescribed mix and strength concretes;

vi) Understand various concrete constituents and their requirements;

vii) Conduct proportioning for a given prescribed mix concrete;

viii) Mix the concrete and transfer and place on site with minimum wastage;

ix) Conduct a concrete slump test and interpret the result;

x) Understand concrete vibration and its function and limitations;

xi) Understand concrete set – false, initial and final;

xii) Carry out dimensional checks according to drawing and adjust where necessary;

xiii) Understand and apply the Construction Regulations with regard to concreting work.

4.5 Basic Construction Hand

At the end of training the trainee will be able to:-

i) Demonstrate his/her knowledge of tools and equipment needed for excavation and concreting;

ii) Excavate and trim foundations according to specifications;

iii) Mix the concrete to the required proportions and methods, transporting without wasting and place correctly in foundations;

iv) Set up the floor shutter according to specifications;

v) Placing the floor concrete according to specifications and using correct procedures and equipment;

vi) Understand and apply the Construction Regulations with regard to excavation of foundations and concrete work.

4.6 Bricklaying & Blocklaying

At the end of training the trainee will be able to:-

i) Interpret basic drawings;

ii) Demonstrate his/her knowledge of the tools necessary and set up internal dimensions;

iii) Erect a profile on position and plumb;

iv) Select and mix the correct mortar for the work;

v) Build blockwork/brickwork using the correct methods and according to specifications;

vi) Understand and apply the Construction Regulations with regard to blocklaying/bricklaying.

4.7 Finishing Hand

At the end of training the trainee will be able to:-

i) Fix timber supports for roofing according to specifications;

ii) Erect concrete beams to superstructure according to specifications;

iii) Measure and cut roof sheets using correct methods and according to specifications;

iv) Fit a door and align it so that it works correctly;

v) Construct a South African roof truss to specifications and within tolerances required;

vi) Erect and align roof trusses in accordance with the specifications;

vii) Align and fix purlins to take roof sheets;

viii) Clad roof with sheeting/tiles accordance with specifications;

ix) Understand and apply the Construction Regulations with regard to construction and finishing of buildings.

4.8 Task-based Labour Administration

At the end of training the trainee will be able to:-

i) Record tools issued to labourers;

ii) Determine classification of excavation using trial pits;

iii) Set out daily tasks;

iv) Do basic task administration work;

v) Reconcile monthly task sheets to task sheets;

vi) Reconcile monthly task sheets to physical measurements;

vii) Understand and apply the Construction Regulations with regard to labour-intensive construction.

4.9 Understanding the Scope of Works and Engineer's Specifications

At the end of training the trainee will be able to:-

i) Read basic plans and maps;

ii) Understand the Contractor's mobilization requirements;

iii) Understand statutory duties and requirements in Contractor's mobilization;

iv) Analyse the scope requirements and produce a construction programme;

v) Plan tasks according to priorities and specifications;

vi) Understand and apply the Construction Regulations with regard to contractor's mobilization and requirement for Commencement of Works.

4.10 Labour Recruitment and Management

At the end of training the trainee will be able to:-

i) Measure labour requirement using the two factors; time to complete a contract and physical amount of work to be completed;

ii) Learn how to select and employ reliable staff and labour;

iii) Administer labour;

iv) Draw up a simple employment contract for labour;

v) Complete time sheets and maintain records;

vi) Administer payroll functions;

vii) Understand and apply statutory requirements and regulations with regard to employment of staff and labour.

4.11 Contractor's Responsibilities and Requirements

At the end of training the trainee will be able to:-

i) Understand the role of the Employer, Contractor, Engineer, Local and Statutory authorities;

ii) Read and interpret a construction programme;

iii) Programme and plan to complete tasks on time;

iv) Interpret and adhere to specifications;

v) Manage labour;

vi) Plan tool requirements;

vii) Choose correct tools and equipment;

viii) Have a knowledge of contract management;

ix) Facilitate and manage good relationships with all parties involved;

x) Understand and apply the Construction Regulations with regard to construction in general.

4.12 Payroll Management and Implementation

At the end of training the trainee will be able to:-

i) Understand and compile payroll data;

ii) Learn coinage submission;

iii) Prepare a payroll for electronic payment;

iv) Implement the pay;

v) Understand and apply statutory requirements and regulations with regard to employment and payment of staff and labour.

4.13 Basic Tender and Contract Pricing

At the end of training the trainee will be able to:-

i) Recognize and understand Fixed and Time-Related costs and charges;

ii) Read and understand Bills of Quantities;

iii) Apply rates and accurately extend to quantities;

iv) Refer and look up statutory rates and price indices;

v) Accurately Calculate Contract Price Adjustment;

vi) Place orders and negotiate with suppliers;

vii) Understand a Health & Safety Plan and Environmental Management plan and recognize the cost implications of compliance;

viii) Learn contract pricing for future projects;

ix) Understand tender documentation and demonstrate competence in understanding scope and scale of inputs required to complete the contract.

4.14 Community Liaison and Facilitation

At the end of training the trainee will be able to:-

i) Understand the Basic Conditions of Employment and other relevant legislation and regulations;

ii) Understand the role of the Employer, Contractor, Engineer, Local- and statutory authorities;

iii) Understand the role of the Health & Safety Agent, health & Safety Office and Environmental Control Officer;

iv) Understand protocol in engaging and responding to Local- and statutory authorities;
v) Demonstrate competence in engaging and responding to the general public and the local community;
vi) Demonstrate competence in convening and chairing informal and formal meetings;
vii) Lead discussions to a conclusion and take concise and accurate minutes of meeting;
viii) Complete reporting on labour generation and labour issues to EPWP and National Treasury requirements.

5 MEASUREMENT AND PAYMENT

5.1 Appointment of Training Agent

The Service Provider for Skills Training will be paid by the Contractor and the cost recovered via the contract as certified by the Engineer. The Contractor shall apply a mark-up of not more than ten percent (10%) to the training fee to cover administration. The cost of obtaining quotations and appointing the successful Service Provider shall be deemed to be included in the Contractor's administration mark-up. Payment shall be on the basis of validated invoices for approved orders.

A Provisional Sum, plus accompanying item for the Contractor's mark-up, is provided under the Preliminary & General section of the Bill of Quantities.

5.2 Provision of Training Area and Facilities

The preparation of a suitably sized area for conducting training and including a training room with furniture and water supply and sanitation facilities for trainees may be required in the event that on-site training takes place. Requirements will be agreed on site.

A Provisional Sum for provision and maintenance of a training area, training room, ablution facilities and furniture is provided under the Preliminary & General section of the Bill of Quantities to be used in the event that training will take place on site.

5.3 Employment of Trainees

Trainees shall be employed by the Contractor on the same basis as unskilled labour. Separate payroll records shall be kept for trainees. Payments in respect of salary and other validated costs for trainees will be recovered via validated payroll records.

Payment for trainees will be made under the relevant rate for unskilled labour in the Dayworks Schedule.

5.4 Materials for Training

The Service Provider shall be responsible for requisitioning via the Contractor at least one week in advance, the materials required for practical training purposes. The Contractor shall be responsible to obtain these materials and to transport them to the training location at least one day prior to the scheduled training date.

Materials for training shall be paid for under the Provisional Sum allowed for Dayworks Materials.

5.5 Construction Plant used in course of Training

Should any item of constructional plant or tools be required for the sole purpose of practical Skills Training, the Contactor shall keep separate records of the use of this plant for training purposes. The Service Provider shall be responsible for requisitioning the use of constructional plant and tools via the Contractor at least one week in advance. The Contractor shall take

reasonable steps to provide the plant or tools on site at the training location at least one day prior to the scheduled training date.

Use of constructional plant for training shall be paid for under the relevant plant allowances in Dayworks.

C5.2 CONSTRUCTION HEALTH AND SAFETY SPECIFICATION & BASELINE RISK ASSESSMENT

CLIENT HEALTH AND SAFETY SPECIFICATIONS

AS PER CONSTRUCTION REGULATION 5(1)(b), 2014

OCCUPATIONAL HEALTH AND SAFETY ACT, NO. 85 OF 1993

PROJECT:

GREATER MNQUMENI WATER SUPPLY SCHEME (GMWSS)

PREPARED BY

1. BACKGROUND

In terms of the Construction Regulation 5(1)(b), 2014 of the Occupational Health and Safety Act, No. 85 of 1993, the Client, is required to compile a Health & Safety Specification for any intended project and provide such specification to Contractor.

The Project falls within the Umzinkhulu Local Municipality with the water service authority being the Harry Gwala District Municipality (HGDM), Southern Area of KwaZulu Natal, South Africa.

2. SCOPE

The scope is the development of a health & safety specification that addresses all aspects of occupational health and safety as affected by construction work.

The Project scope is the development of a water supply scheme for the villages of Masameni, Mnqumeni, Ndlovini and Ehlanzeni in the Umzimkhulu Local Municipality. The scheme is supplied via a run of river abstraction on the Ibisi River and a 2Mℓ/day Water Treatment Works (WTW) located approximately 450m from the river abstraction site.

Phase 1 – Works which require immediate attention.

- Section A - New River abstraction works and refurbishment of existing WTW
- Section B - Refurbishment of existing pipelines, reticulation, and pumping Stations.

Phase 2 – Works required for the successful operation of the scheme in the short to medium term

- Section A - Water Treatment Works Upgrade
- Section B – New supply to Command Reservoir D
- Section C – Upgrade of existing pumping stations to 15 year demands
- Section D – Upgrade of command reservoirs

Phase 3 – Works required for the successful operation of the scheme in the long term.

- Section A – Upgrade of reservoirs

The Construction Work on project will entail the following:

- Work in various densely populated Rural areas
- Surveying and Setting Out
- Traffic Management
- Clear & Grub
- Excavation Work

- Mass Earthworks & Layer Works
- River Crossing
- Road Crossing
- Construction of Reservoir
- Construction of Abstraction Works
- Installation of Pipes
- Loading & Hauling
- Operating Mobile Machinery
- Loading & Lifting Operations
- Reinforced steel fixing
- Temporary Works (Erecting, Inspection, Use and Removal)
- Concrete works
- General building work (brick laying & plastering)
- Roof works
- Installations of ceilings
- Electrical work
- Plumbing installations
- Painting
- Installation of Support Services for water and sewerage
- Installation of fire protection system
- Symbolic Signage

Also refer to the Design Report and Scope of work as per Bill of Quantities.

3. DEFINITIONS

Act: means the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)

AIA means an Inspection Authority approved by the chief inspector: Provided that an inspection authority approved by the chief inspector with respect to any particular service shall be an Approved Inspection Authority with respect to that service only.

Client: means any person for whom construction work is being performed.

Client's Health and Safety Agent: SHE Group, 5 Walter Sisulu Road, Universitas, Bloemfontein, 9321. Tel. 0514369675

Competent person: means any person having the knowledge, training, experience and qualifications specific to the work or task being performed.

Construction work: means any work in connection with—

- the erection, maintenance, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure;
- the installation, erection, dismantling or maintenance of a fixed plant where such work includes the risk of a person falling;

- the moving of earth, clearing of land, the making of an excavation, piling, or any similar type of work;

Contractor: means an employer, as defined in section 1 of the Occupational Health and Safety Act, who performs construction work and includes principal contractors;

Hazard Identification: means the identification and documenting of existing or expected hazards to the health and safety of persons, which are normally associated with the type of construction work being executed or to be executed;

Health and Safety File: means a file or other record in permanent form, containing the information required as contemplated in these regulations;

Health and Safety Plan: means a documented plan, which addresses hazards identified and includes safe work procedures to mitigate, reduce or control the hazards identified;

Health and Safety Specification: means a documented specification of all health and safety requirements pertaining to the associated works on a construction site, so as to ensure the health and safety of persons;

HCA: Hazardous Chemical Agent (Substances)

MSDS: Material Safety Data Sheet

PPE: Personal Protective Equipment

OREP: Occupational Risk Exposure Profile

Pr. CHSA: Professional Construction Health and Safety Agent

Can. CHSA: Candidate Construction Health and Safety Agent

CHSO: Construction Health and Safety Officer

Medical Certificate of Fitness: means a certificate contemplated in Construction Regulation 7(8);

Occupational Health Practitioner means an occupational medicine practitioner or a person who holds a qualification in occupational health recognized as such by the South African Medical and Dental Council as referred to in the Medical, Dental and Supplementary Health Service Professions Act, 1974 (Act No. 56 of 1974), or the South African Nursing Council as referred to in the Nursing Act, 1978 (Act No. 50 of 1978);

Occupational Hygiene Survey: means a Survey or Analysis on Hazardous Environmental Exposure e.g. Noise, Lead, Asbestos, Airborne Pollutants, Thermal Stress, Hazardous Chemical Agents (Substances), etc. to Persons conducted by an Inspection Authority Approved by the Department of Employment & Labour for the Exposure identified, provided that an inspection authority approved by the chief inspector with respect to any particular service shall be an Approved Inspection Authority with respect to that service only

Occupational Hygiene: means the anticipation, recognition, evaluation and control of conditions arising in or from the workplace, which may cause illness or adverse health effects to persons;

Principal contractor: means an employer, as defined in section 1 of the Occupational Health and Safety Act who performs construction work and is appointed by the client to be in overall control and management of a part of or the whole of a construction site;

Risk assessment: means a program to determine any risk associated with any hazard at a construction site, in order to identify the steps needed to be taken to remove, reduce or control such hazard;

Structure: means any building, steel or reinforced concrete structure

SACPCMP means the South African Council for the Project and Construction Management Professions

Designer: means a competent person who

- prepares a design;
- checks and approves a design;
- arranges for a person at work under his or her control to prepare a design, including an employee of that person where he or she is the employer; or
- designs temporary work, including its components;
- an architect or engineer contributing to, or having overall responsibility for a design;
- a building services engineer designing details for fixed plant;
- a surveyor specifying articles or drawing up specifications;
- a contractor carrying out design work as part of a design and building project; or
- an interior designer, shop-fitter or landscape architect;

Construction manager: means a competent person responsible for the management of the physical construction processes and the coordination, administration and management of resources on a construction site;

Construction site: means a work place where construction work is being performed.

4. OH&S MANAGEMENT

4.1 Notification of Construction Work

The Principal Contractor shall, as the contract meets the requirements laid down in Construction Regulations 4, prior to commencement of the works, submit a Notification of Construction Work to the Department of Employment & Labour.

A copy shall be kept on the OH&S file and the Notification shall be displayed at the Notice Board at the Site Office. No Construction activities may take place before the Department of Employment & Labour has been Notified and the Client / Client's Pr. CHSA has received a copy thereof.

4.2 Structure and Organization of Occupational Health and Safety (OH&S) Responsibilities

4.2.1. *Overall Supervision and Responsibility for OH&S*

- The Client to ensure that the Principal Contractor, is appointed in terms of Construction Regulation 5(1)(*k*), implements and maintains the agreed and approved OH&S Plan.
- The Chief Executive Officer of the Principal Contractor in terms of Section 16 (1) of the Act to ensure that his Employees (as defined in the Act) complies with the Act. Legal Compliance Audit may be used for this purpose.

- Any OH&S Act (85 /1993), Section 16 (2) appointee/s as detailed in his/her/their respective appointment forms

- The Construction Manager, Assistant Construction Manager, Supervisor and Assistant Construction Supervisor/s appointed in terms of Construction Regulation 8. Should provide proof of OHS training and fully understand their duties and responsibilities outlined by the respective appointments.

- The principal contractor shall appoint as a minimum a Full-Time competent Health and Safety Officer that is registered with the SACPCMP.

4.2.2 Further (Specific) Responsibilities for OH&S

The contractor shall note that it is a generic list only and is intended for use as a guideline.

Appointment	**Legal Reference**
Construction Manager	Construction Regulation 8(1)
Assistant Construction Manager	Construction Regulation 8(2)
OH&S Officer	Construction Regulation 8(5)
Construction Supervisor	Construction Regulation 8(7)
Risk Assessor	Construction Regulation 9
Fall Protection Plan Developer	Construction Regulation 10
Structures Supervisor/Inspector	Construction Regulation 11
Excavation Supervisor	Construction Regulation 13
Bulk Mixing Plant Supervisor	Construction Regulation 20
Crane Inspector	Construction Regulation 22
Construction Vehicle / Mobile Plant / Machinery Supervisor	Construction Regulation 23
Drivers / Operators of Construction Vehicles / Plant	Construction Regulation 23
Electrical Installation and Appliances Inspector	Construction Regulation 24
Hazardous Chemical Agent Supervisor	HCA Regulations & CR 25
Stacking & Storage Supervisor	Construction Regulation 28
Emergency/Security/Fire Coordinator	Construction Regulation 29
First Aider	General Safety Regulation 3
Fire Equipment Inspector	Construction Regulation 29
Incident Investigator	General Admin Regulation 9
Ladder Inspector	General Safety Regulation 13A
OH&S Committee	OHS Act Section 19
OH&S Representatives	OHS Act Section 17
Person Responsible for Machinery	General Machinery Regulation 2
Pressure Equipment Supervisor	Pressure Equipment Regulations
Welding Supervisor	General Safety Regulation 9
Water Environment Supervisor	Construction Regulation 26

The above appointments shall be in writing and the responsibilities clearly stated together with the period for which the appointment is made. This information shall be communicated and agreed with the appointees.

Competencies of all Appointed Personnel to be attached to Appointment and Placed on Health and Safety File

The principal contractor shall, furthermore, provide the clients agent with an organogram of all contractors that he/she has appointed or intends to appoint and keep this list updated and prominently displayed on site.

4.3 Communication & Liaison

4.3.1 OH&S Liaison between the Client, the principal Contractor, the other Contractors, the Designer and other concerned parties will be through the OH&S committee or Committee established by Client for this purpose.

4.3.2 In addition to the above, communication may be directly to the Client or his appointed Agent, verbally or in writing, as and when the need arises.

4.3.3 Consultation with the workforce on OH&S matters will be through their Supervisors, OH&S Representatives, the OH&S committee and their elected Trade Union Representatives, if any.

4.3.4 The Principal Contractor will be responsible for the dissemination of all relevant OH&S information to the other Contractors e.g. design changes agreed with the Client and the Designer, instructions by the Client and/or his/her agent, exchange of information between Contractors, the reporting of hazardous/dangerous conditions/situations etc.

4.4 OH&S File

The Principal Contractor must, in terms of Construction Regulation 7(1)(b), keep a health & safety file on site at all times that must include all documentation required in terms of the Act and Regulations and must also include a list of all Contractors on site that are accountable to the Principal Contractor and the agreements between the parties and details of work being done.

The following documents must inter alia be kept in the OH&S file:

1. Notification of Construction Work (Construction Regulation 4)
2. Copy of OH&S Act (updated) (General Administrative Regulation 4.)
3. Proof of Registration and good standing with a COID Insurer - Construction Regulation 5(1)(j)
4. OH&S Plan agreed with client including the underpinning Risk Assessment/s & Method Statements (Construction regulation 5(1)(l))
5. Policies
6. Risk assessment conducted and reviewed during works.
7. Safe Work Procedures
8. Health and safety specifications provided by the client.
9. Designs/drawings (Construction Regulation 6&7)
10. Traffic Management / Accommodation Drawings
11. A list of Contractors (Sub-Contractors) including copies of the agreements between the parties and the type of work being done by each Contractor (Construction Regulation 7)
12. Appointment/Designation forms as per 4.1.2 above.
13. Competency Certificates
14. Occupational Medical Certificates of all personnel working on site to proof Fitness to work
15. AIA Certificate of Service Provider responsible for Occupational Hygiene Monitoring
16. Minutes of Safety Committee Monthly meetings
17. Statistical Data
18. Registers as follow:
    - Risk Register
    - PPE - Personal Protective Clothing and Equipment issued
    - Daily Mobile Machinery Checklists
    - Generator and Other Fuel Driven Machinery Registers
    - Registers / Checklists for all Equipment being used on site
    - Stacking & Storage Inspection Register
    - Excavations Inspection Register – Daily
    - Monthly Environmental Checklist
    - Weekly Hygiene Facility Inspection Register – Ablutions and Eating areas
    - Incident Register
    - Safe Area Declarations
    - Fire Extinguishing Equipment Register
    - Training Attendance Registers
    - First Aid Box and Equipment Checklist

- Dressing Record Register – To be placed in First Aid kit
- Risk Assessment Communication Registers
- Lock-out Request Forms (Water and Electricity)
- Lock-out Permits (Water and Electricity)
- SHE Officer Inspection Register (Non-Conformance Register) – Monthly checklist and deviations
- Traffic Drawing Inspection Register

4.5. OH&S Goals and Objectives and Arrangements for Monitoring and Review of OH&S Performance

The Principal Contractor is required to maintain a DIFR of less than 1 and report on this to the Client on a monthly basis.

4.6 Identification of Hazards and Development of Risk Assessments, Standard Working Procedures (SWP) and Method Statements

The Principal Contractor is required to develop Risk Assessments, Standard Working Procedures (SWP) and Method Statements for each activity executed in the contract or project (See Section 5 below "Project/Site Specific Requirements")

4.7. Arrangements for Monitoring and Review

4.7.1. Monthly Audit by Client

The Client will be conducting monthly Audits to comply with Construction Regulation 5(1)(o) to ensure that the principal Contractor has implemented and is maintaining the agreed and approved OH&S Plan.

If contractor is non-compliant according to Client's Health and Safety Audit, the Client's Agent / Representative may stop the work or a specific work activity and request a re-audit that must be approved by the client and the contractor will be held liable for the cost.

4.7.2. Other Audits and Inspections by Client

The Client reserves the right to conduct other ad hoc audits and inspections as deemed necessary.

The Principal Contractor must conduct a Monthly Internal Health and Safety Audit and an Audit on all Sub-Contractors. The Audit must be conducted by an independent person of the contractor or contractor's representative, which is not working on the site, on condition that the person is qualified to conduct an Occupational Health and Safety Audit.

4.7.3. A representative of the Principal Contractor must accompany the Client on all Audits and Inspections and may conduct his/her own audit/inspection at the same time. Each party will, however, take responsibility for the results of his/her own audit/inspection results.

The client's representative / Agent must approve the Principal Contractor's Health and Safety Audit Template, to be used, before work commences

4.7.4. Reports

4.7.4.1 The Principal Contractor is required to provide the Client with a monthly report.

4.7.4.2 The Principal Contractor must report all incidents where an employee is injured on duty to the
extent that he/she:

* dies
* becomes unconscious
* loses a limb or part of a limb
* is injured or becomes ill to such a degree that he/she is likely either to die or to suffer a permanent physical defect or likely to be unable for a period of at least 14 days either to work or continue with the activity for which he/she was usually employed

OR where:

* a major incident occurred
* the health or safety of any person was endangered
* where a dangerous substance was spilled
* the uncontrolled release of any substance under pressure took place machinery or any part of machinery fractured or failed resulting in flying, falling or uncontrolled moving objects
* machinery ran out of control to the Provincial Director of the Department of Employment & Labour within seven days. (Section 24 of the Act & General Administrative Regulation 8.)

4.7.4.3. The Principal Contractor is required to provide the Client with copies of all statutory reports required in terms of the Act. The Principal Contractor is required to provide the Client with copies of all internal and external accident/incident investigation reports.

4.7.5. *Review*

4.7.5.1 The Principal Contractor is to review the Hazard Identification, Risk Assessments and SWP's at each Production Planning and Progress Report meeting as the construction work develops and progresses and each time changes are made to the designs, plans and construction methods and processes.

4.7.5.2 The Principal Contractor must provide the Client, other Contractors and all other concerned parties with copies of any changes, alterations or amendments.

4.8 Site Rules and other Restrictions

4.8.1 Site OH&S Rules

The Principal Contractor must develop a set of site-specific OH&S rules that will be applied to regulate the OH&S aspects of the construction.

4.8.2. *Security Arrangements*

4.8.2.1 The Principal Contractor must establish site access rules and implement and maintain these throughout the construction period. Access control must include the rule that non-employees will not be allowed on site unaccompanied.

4.8.2.2 The Principal Contractor must develop a set of Security rules and procedures and maintain these throughout the construction period.

4.8.2.3 The Principal Contractor must appoint a competent Emergency Controller who must develop emergency contingency plans for any emergency that may arise on site as indicated by the risk assessments. These must include a monthly practice/testing program for the plans e.g. January: Fall Accident, February: Electrical Shock, etc. and practiced/tested with all persons on site at the time, participating.

4.9 Training

The contents and syllabi of all training required by the Act and Regulations to be included in the Principal Contractor's OH&S Plan.

4.9.1 General Induction Training

All employees of the Principal and other Contractors to be in possession of proof of General Induction training.

4.9.2 Site Specific Induction Training

All employees of the Principal and other Contractors to be in possession of Site Specific OH&S Induction training.

4.9.3 Other Training

4.9.3.1 All operators, drivers and users of construction vehicles, mobile plant and other equipment to be in possession of Competency Certificates & Medical Certificates of Fitness (Construction Regulation 23).

4.9.3.2 All employees in jobs requiring training in terms of the Act and Regulations to be in possession of valid proof of training.

4.9.3.3 OH&S Training Requirements: (as required by the Construction Regulations and as indicated by the OH&S Specification & the Risk Assessment/s):

- General Induction (Section 8 of the Act)
- Site/Job Specific Induction (also visitors) (Sections 8 & 9 of the Act)
- Construction Manager
- Construction Supervisor
- OH&S Representatives (Section 18 (3) of the Act)
- Operation of Cranes (Driven Machinery Regulations 18 (11)
- Operators & Drivers of Construction Vehicles & Mobile Plant (CR 23)
- Basic Fire Prevention & Protection (ERW 9 and CR 29)
- Basic First Aid (General Safety Regulations 3)
- Storekeeping Methods & Safe Stacking (Construction Regulation 28)
- Emergency, Security and Fire coordinator
- Work and Appointment Related training
- Work at Heights Training (Where Required)
- Training related to Risks / Hazards identified

4.10. Accident and Incident Investigation

4.10.1 The Principal Contractor is responsible for the investigation of all accidents/incidents where employees and non-employees were injured to the extent that he/she/they had to be referred for medical treatment by a doctor, hospital or clinic. (General Administrative Regulation 9)

4.10.2. The results of the investigation to be entered into the Accident/Incident Register: Annexure 1. (General Administrative Regulation 9)

4.10.3. The Principal Contractor is responsible for the investigation of all non-injury incidents as described in Section 24 (1) (b) & (c) of the Act and keeping a record of the results of such investigations including the steps taken to prevent similar accidents in future.

4.10.4. The Principal Contractor is responsible for the investigation of all road traffic accidents and keeping a record of the results of such investigations including the steps taken to prevent similar accidents in future.

4.11 H&S Representatives and Committees

4.11.1 Designation of OH&S Representatives

Before commencing work, the Principal Contractor shall designate a competent Safety, Health and Environmental representative (SHE Rep) who shall be acceptable to the Agent, to represent and act for the Contractor and Sub Contractors. This person may be the appointed Full-Time Construction Health and Safety Officer

It should be noted that the Principal Contractor is held responsible for the activities of the Sub Contractors. Failure of Health and Safety measures by the Sub Contractor will revert directly back to the Principal Contractor.

The Contractor shall inform the Agent in writing of the name and address of the Contractor's SHE Rep and of any subsequent changes in the name and address of the SHE Rep, together with the scope and limitations of the SHE Rep's authority to act for the Contractor. The Contractor's SHE Rep shall make available to the Employer an all-hours telephone number at which the SHE Rep can be contacted at any time in the event of an emergency involving any of the Contractor's employees, or other persons at the Works.

The Contractor must also ensure that Health and Safety Representatives (H&S) as per Section 17 of the Act is Nominated by the Employees, Trained and Appointed

4.11.1.2 OH&S Representatives have to be designated in writing and the designation must include the area of responsibility of the person and term of the designation.

4.11.2 Duties and Functions of the OH&S Representatives

4.11.2.1 The Principal Contractor must ensure that the designated OH&S Representatives conduct a minimum monthly inspection of their respective areas of responsibility using a checklist and report thereon to the Principal Contractor.

4.11.2.2 OH&S representatives must be included in accident/incident investigations.

4.11.2.3 OH&S representatives must attend all OH&S committee meetings.

4.11.3. *Appointment of OH&S Committee*

4.11.3.1 The Principal Contractor must establish an OH&S Committee consisting of all the designated OH&S Representatives together with a number of management representatives that are not allowed to exceed the number of OH&S representatives on the committee. The members of the OH&S committee must be appointed in writing.

4.11.3.2. The OH&S Committee must meet minimum monthly and consider, at least, the following Agenda:

1) Opening
2) Previous Minutes
3) Observations
4) Program and Safety considerations
5) Occupational Health
6) Housekeeping improvement
7) Incidents & Accidents / Injuries
8) Equipment Registers
9) Safety performance Evaluations
10) Occupational Hygiene monitoring and measuring
11) Education & Safety promotion program
12) Legal Non-Compliances

13) Construction Activities e.g. Electrical Work, Asbestos Work, etc.
14) Sub-Contractors
15) Fines & Penalties
16) General
17) Date of Next Meeting
18) Closing

4.12 Occupational Medicals

4.12.1 Principal Contractor must ensure that all employees actively involved with the project, have a valid medical certificate of fitness specific to the construction work to be performed and issued by an occupational health practitioner as per Annexure 3 of Construction Regulation, 2014 - Construction Regulation 7(1)(g)

4.13 Traffic Management

4.13.1 Principal Contractor must ensure that Traffic Management must be done according to Client's Specifications and Approved Drawings

4.14 Fines & Penalties

4.14.1 Repeated non-conformances raised during Audits may be subjected to a Minimum Fine of R 250.00 per Finding and a Maximum Fine of R 5,000.00 per finding.

4.14.2 The value of the fine will be recommended by the Pr. CHSA and Finally Approved by the Client's Project Manager

5 PROJECT/SITE SPECIFIC REQUIREMENTS

5.1 The following is a list of specific activities and considerations that have been identified for the project and site and for which Risk Assessments, Standard Working Procedures (SWP), management and control measures and Method Statements (where necessary) have to be developed by the Principal Contractor:

- Site Establishment
- Offices
- Secure / safe storage for materials, plant and equipment
- Ablutions
- Sheltered eating area

- Vehicle access to the site
- Dealing with existing structures
- Location of existing structures
- Installation and Maintenance of temporary construction electrical supply
- Adjacent land uses / surrounding property exposures
- Boundary and access control
- Public liability exposures
- Health risks arising from neighboring as well as own activities and from the environment e.g. threats by dogs, bees, snakes, lightning etc.
- Exposure to noise
- Exposure to vibration
- Protection against dehydration and heat exhaustion
- Protection from wet and cold conditions
- Dealing with HIV/Aids and other diseases
- Use of portable electrical equipment
- Excavations & Trenching
- Welding & Flame cutting
- Loading and offloading of trucks
- Manual and mechanical handling
- Lifting and lowering operations
- Working in elevated positions
- Surveying an Setting Out
- Traffic Management
- Clear & Grub
- Loading & Hauling
- Driving & Operation of Construction Vehicles and Mobile Plant
- Use and Storage of Flammable Liquids and other Hazardous Substances
- Reinforced steel fixing
- Concrete works
- General building work (brick laying & plastering)
- Electrical work
- Pipe installations
- Installation of Support Services
- Signage
- Working near Water
- As discovered by the principal contractors hazard identification exercise
- As discovered from any inspections and audits conducted by the client or by the principal contractor or any other contractor on site.
- As discovered from any accident / Incident Investigation

The following are in particular requirements of works and will form a basis for compliance audits.

1. Administrative & Legal Requirements
2. Education, Training & Promotion
3. Public Safety & Emergency Preparedness
4. Personal Protective Equipment
5. Housekeeping
6. Working at Heights
7. Temporary Structures
8. Traffic Control & Accommodation
9. Electrical Safeguarding
10. Emergency/Fire Prevention & Protection
11. Excavations (Foundations, Trenches, etc.)
12. Ladders & Tools
13. Lifting Equipment
14. Permits
15. Transport & Materials Handling
16. Site Plant & Machinery
17. Plant & Storage Yard
18. Occupational Health & Hygiene
19. Construction Activities
20. Sub-Contractors

5.2 Construction Vehicles and Mobile Plant – Regulation 23

The Contractor shall ensure that drivers of motor vehicles are in possession of a driver's license, valid for the class of vehicle which they are required to drive and shall produce the license on request.

The Contractor shall not permit any driver to be in control of a vehicle at the Works while under the influence of alcohol, drugs or other substance.

A register shall be kept of workers operating construction vehicles and mobile plant.

The register shall contain proof of training of operators to operate construction vehicles and mobile plant, certification of competency and authorization of operators to operate machinery, vehicles or plant.

Names of operators and their relevant training with date and time stamps together with name of course instructor shall be kept in the Health and Safety File on site.

Physical and Psychological fitness shall be proved by way of a medical certificate of fitness of the said operators before allowing operators to operate machinery, vehicles or plant.

The Health and Safety File shall include the written training material offered to operators for the different construction vehicles and mobile plant.

Each and every driver shall be trained on risks involved and safety procedures.

All Construction vehicles and mobile plant must be of acceptable design and construction and used according to their design.

All construction vehicles and mobile plant must be maintained in good working order.

A register of all vehicles and plant shall be kept on site together with names of operators responsible for each.

The register shall report all maintenance activities performed on these vehicles and plant as well as signatures certifying the condition of the vehicles as in a good working order.

All requirements on the vehicles and mobile plant with regard to safety and health shall be inspected and certified

During use of Construction vehicles or mobile plant the following rules shall be adhered to:

- Construction vehicles or mobile plant must be prevented from falling into excavations, water or any other area lower than the working surface. These protection must consist of adequate edge protection e.g. Guard rails and/or crash barriers
- No person shall be allowed to or require to ride on any Construction Vehicle or Mobile Plant in a position otherwise than a safe place provided for on the construction vehicle or mobile plant as designed for that purpose.
- The construction site must be organized in such a way that as far as is reasonable practical, pedestrians and vehicles can move safely and without risks to health and safety.
- Traffic routes shall be of sufficient size, sufficient in number and in suitable positions to be used safely by construction vehicles, mobile plant and pedestrians.
- Each and every traffic route shall be indicated by suitable signs for reasons of safety and health.
- No tools and/or material shall be transported in the same compartment as the operators/drivers/employees unless the said are secured against movement during transportation.

- All Construction Vehicles and Mobile Plant left unattended at night adjacent to a freeway in normal use or adjacent to construction areas where work is in progress, shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, in order to identify the location of vehicles or plant
- Bulldozers, scrapers, loaders and other similar mobile plant are, when being repaired or when not in use, fully lowered or blocked with controls in a neutral position, motors stopped and brakes set.
- Reflective indicators must be provided to workers in the form of reflective yellow jackets or vests as specified and worn by workers working on/or adjacent to public roads

5.3 Excavation Work Construction - Regulation 13

An excavation could be a hole or trench of any size and shape. A Risk Assessment must be done prior to making an excavation.

The following must be taken in consideration when doing the Risk Assessment:

- Depth of the excavation
- Length of the excavation
- Existing services
- Barricading and demarcation
- Depth of the excavation

Should an excavation be more than chest deep (1.2m), it must be adequately shored or braced.

Slopes or trenches shall be as flat as possible, 1 x vertical to 2 x horizontal must be considered maximum for dry conditions. In wet conditions either a much lower slope shall be used, or if space is a constraint, shoring and de-watering shall be applied.

A competent person shall be appointed to supervise excavation work. Stability evaluation of ground must be done and a certificate shall be issued.

A plan for prevention of persons being trap due to collapse shall be provided by the Contractor. The design of shoring shall be documented by Contractor in the Health and Safety file as provided by the competent designer of shoring.

The maximum loading of sides of an excavation must be documented in a usable format If adjacent structures and buildings are present and can be affected a design and construction of supporting details shall be represented.

Provision shall be made for access routes to the excavation. Routes must not be more than 6 meters away from worker.

Contractor must establish all existing services in area of excavations. Plan of existing services shall be documented in the Health and Safety file. Existing services include Telkom, Gas, Water, Electricity Supplies and other similar services.

Excavation Inspection shall be done on a

- daily basis
- prior to each shift
- after every blasting operation
- after an unexpected fall of ground
- after substantial damage to supports
- after rain

5.4 Barricading and Demarcation

The construction site shall be barricaded completely to prevent pedestrians and vehicles to enter the construction area.

Protection around the site must be in the form of a physical barrier and appropriate signage, to prevent public from entering the area.

It is advised to use 1.2m high DAY-GLO Mesh (barrier netting) to prevent pedestrians to enter the specific construction area.

5.5 Housekeeping and Construction Sites – Regulation 27

The Contractor shall at all time carry out the Works in a manner to avoid the risk of bodily harm to persons or risk of damage to any property. The Contractor shall take all precautions, which are necessary and adequate to eliminate any conditions, which contribute to the risk of injury to persons or damage to property. The Contractor shall continuously inspect all work, materials and equipment to discover and determine any such conditions and shall be solely responsible for the discovery, determination and elimination of such conditions.

During the period of this Contract, the Contractor shall be responsible for the safe storage of all materials and equipment required for execution of the Contract, and for disposal of all non-usable waste material in an orderly manner.

All materials, whether stored on the construction site or within the Contractor's designated area, shall be stored neatly and safely to prevent possible injury to any personnel. The material shall be stored to facilitate safe access to, and removal of the material from the storage area.

Any flammable material, such as paint, diesel fuel and oil, shall be stored in lockable non-combustible structures, which shall be clearly marked to indicate the hazardous nature of the materials stored within. The flammable materials stores shall be located in safe areas away from hazardous surroundings and adequate and suitable fire-fighting equipment shall be provided within easy reach of the materials stores.

Loose material need for use shall not accumulate so as to obstruct means of access to and egress from the workplace.

Scrap and waste shall not be allowed on site and must be removed daily.

The construction sites adjacent to build up area or public way shall be effectively fenced and controlled with access points.

5.6 Stacking and Storage on Construction Sites – Regulation 28

A Competent person shall be appointed in writing with the duty of supervising all stacking and storage of material on site.

Adequate storage areas shall be provided which includes demarcated areas. All storage areas shall be kept neat and under control. Registers and checklist on housekeeping shall be kept on site

5.7 First Aid

5.7.1 Safety Notice Board

The Contractor shall provide a Safety Notice Board where safety notices, site regulations concerning safe working practices and information on the location of the nearest first aid station, can be conspicuously displayed to all staff. The size of the notice board shall be at least 600 mm x 800 mm.

5.7.2 First Aid Equipment

The Contractor shall provide for its employees a stretcher for emergencies and an approved first aid box. The first aid box shall be checked weekly by a responsible person, who shall be appointed by the Contractor, and a record shall be kept of the contents. Any deficient medical supplies shall be promptly replenished by the Contractor.

5.7.3 Hazard Notices

The Contractor shall display hazard notices in all areas where hazardous conditions prevail or may occur.

5.7.4 Reporting of Incidents and/or Injuries

All incidents in respect of damage to Works, property or machinery, or injury to persons, shall be reported by the Contractor's SHE Rep by the quickest means possible.

A mandatory incident report form, containing full details of the incident, shall be completed and submitted to the Site Agent and the Department of Employment & Labour within twenty four (24) hours of the occurrence of the incident.

5.8 Fire Precautions on Construction Sites – Regulation 29

A register shall be kept on all Acetylene and Oxygen cylinders used on the site. Condition of components, sub-components and safety components (e.g. Flame back arrestors) shall be listed in the register and signed by the construction supervisor at regular intervals as required with time and date stamp.

Acetylene, Oxygen and LP Gas cylinders shall be stored in suitable places to minimize the risk of fire.

Suitable storage to be provided for flammable liquids, e.g. petrol, diesel, paint, thinners.

Smoking shall be prohibited in the workplace and notices posted accordingly.

Suitable and sufficient firefighting equipment shall be placed in strategic positions in the work place. (On vehicles and other positions as deemed necessary).

A register shall be kept on type and number of equipment for each site in the Health and Safety File.

A competent person shall inspect all firefighting equipment. A sufficient number of employees shall be trained in the use of firefighting equipment.

A register shall be kept in the Health and Safety File on site with names of employees and type of firefighting training completed with date.

Suitable signs shall be erected in work places indicating escape routes.

Escape routes shall be kept clear. Evacuation plans shall be in Health and Safety File as part of Induction Training. Combustible materials shall not accumulated on site.

5.9 Construction Welfare Facilities – Regulation 30

On each site where existing facilities are not present, at least one sanitary facility shall be erected for every 10 workers, one shower for every 15 workers, a changing facility for each sex and sheltered eating areas.

Mobile toilets with bucket system shall be installed at the site. Cleaning of buckets shall be arranged with the City Council. Where applicable chemical toilets shall be provided.

Eating facilities shall be made available in the form of a shaded net, table and chairs.

For sites in remote areas, transport shall be made available for workers to and from sites.

5.10 Hazardous Chemical Agents (Substances)

The Contractor shall exercise all necessary care in the handling of toxic compounds and shall be able to identify the major chemical components in the event of medical treatment being required.

5.10.1 Hazardous Chemicals and Materials

a) The Contractor shall provide suitable and adequate protective equipment when working in an area where hazardous chemicals and materials are being used.

b) The Contractor shall ensure that its employees have familiarized themselves with the hazardous material data sheets applicable to the specific site as well as the location of firefighting equipment, safety showers / baths and other washing facilities, prior to commencement of work.

5.11 Commissioning Safety Precautions

The Contractor shall ensure that wherever repairs, adjustments or any other work are undertaken on any plant or machinery, the power supply is switched off, disconnected or the plant / machinery disengaged until the work or repairs have been completed.

5.12 Electrical Installations and Machinery on Construction Sites – Regulation 24

Before construction commences or any other related works and during the progress thereof adequate steps must be taken to establish the presence of and guard against any danger to the workers in respect to electrical cables or apparatus.

In areas where it cannot be established where electrical devices are, the employees must use tools of which the handles are insulated or rubber insulated gloves.

Any temporary electrical installation set up by the principal contractor or contractor must be inspected at least once a week by a competent person. The inspections shall be recorded in a register and kept in the Health and Safety File.

When working on or next to live electrical Machinery/Equipment the Principal Contractor or Contractor must provide insulated stands, trestles and mats.

When Distribution Boards are removed the incoming power supplies shall be cut by the client's authorized Electrician. The incomer electricity supply feeder shall be earthed by a suitable earth wire or spike to prevent cable of becoming live during the installation of new Distribution Boards.

No person shall continue with wiring of premises unless the supply to the premises has been rendered dead and the above effective measures has been taken to ensure that such cables remains dead. When rewiring of premises is done the feeder breakers at the other end of the supply cables shall be locked out and the cable earthed to prevent any injury to workers by Electrical Shock.

A register shall be kept on site in the Health and Safety File indicating all signatures of competent persons switching electricity supply on or off with time and date stamp.

No person shall use or permit to use a portable electric load operating at a voltage exceeding 50V to earth unless it is connected to a source of electrical energy incorporating an earth leakage protection device.

A register shall be kept on site in which all daily checks of portable electric tools are performed and signed by the responsible person. Checks shall include condition of plug top, power cord, on-off switch and insulation condition of electric tool. All tools shall be numbered and entered accordingly into the register. Condition of tools as listed in the register shall be inspected and signed by the construction supervisor at regular intervals as required by the nature of the equipment.

5.13 Traffic Accommodation

Traffic Accommodation shall be done in accordance with the South African Road Traffic Signs Manual (SARTSM) Chapter 13.

Signs for Deviations, Stop/Go`s, Lane Drops and Lane Narrowings shall conform to the requirements as stipulated by the SARTSM and be visible/reflective during night time. A daily register of all signs used shall be kept by the contractor.

A competent Traffic Officer shall be appointed to supervise all Traffic Accommodation activities and maintain signage throughout the site. Employees used/working as part of the traffic accommodation team shall be trained in traffic management by and accredited training provider in the relevant Unit Standard (Unit Standard 14561).

If night time Stop/Go`s are set up, a second night time Traffic Officer shall be appointed to supervise all Traffic Accommodation activities and maintain signage throughout the site during night time.

Members of the traffic accommodation team/flagmen shall at all times where high visibility PPE. No flagmen shall stand in the road or in the way of vehicles to avoid them being run over or being hit.

Flags used shall be in accordance with the SARTSM (red with a silver reflective cross and 400mm x 400mm).

5.14 Structures – Construction Regulation 11

A contractor shall ensure that-

(i) all reasonable practicable steps are taken to prevent the uncontrolled collapse of any new or existing structure or any part thereof, which may become unstable or is in a temporary state of weakness or instability due to the carrying out of construction work:
And-
(ii) no structure or part of a structure is loaded in a manner which would render it unsafe.

The designer of a structure shall-

a) before the contractor is put out to tender, make available to the client all relevant information about the design of the relevant structure that may affect the pricing of the construction work;

b) inform the contractor in writing of any known or anticipated dangers or hazards relating to the construction work, and make available all relevant information required for the safe execution of the work upon being designed or when the design is subsequently altered;

c) subject to the provisions of paragraph (a) and (b) ensure that the following information is included in a report and made available to the contractor-

- a geo-science technical report where appropriate;
- the loading of the structure is designed to withstand; and
- the methods and sequence of construction process;

d) not including anything in the design of the structure necessitating the use of dangerous procedures or materials hazardous to the health and safety of persons, which could be avoided by modifying the design or by substituting materials;

e) Take into account the hazards relating to any subsequent maintenance of the relevant structure and should make provision in the design for that work to be performed to minimize the risk;

f) carry out sufficient inspections at appropriate times of the construction work involving the design of the relevant structure in order to ensure compliance with the design and a record of those inspections is to be kept on site;

g) stop any contractor from executing any construction work which is not in accordance with the relevant design;

h) conduct a final inspection of the completed structure prior to its commissioning to render it safe for commissioning and issue a completion certificate to the contractor;

e) Ensure that during commissioning, cognizance is taken of ergonomic design principles in order to minimize ergonomic related hazards in all phases of the life cycle of a structure.

f) A contractor shall ensure that all drawings pertaining to the design of the relevant structure are kept on site and are available on request by an inspector, contractors, client, client's agent or employee.

g) Any owner of a structure shall ensure that inspections of that structure upon completion are carried out periodically by competent persons in order to render the structure safe for continued use: Provided that the inspections are carried out at least once every six months for the first two years and thereafter yearly and records of such inspections are kept and made available to an inspector upon request.

h) Any owner of a structure shall ensure that the structure upon completion is maintained in such a manner that the structure remains safe for continued use and such maintenance records shall be kept and made available to an inspector upon request.

5.15 Water Environments – Construction Regulation 26

A contractor shall ensure that where construction work is done over or in close proximity to water, provision is made for:

(a) preventing persons from falling into water
(b) the rescue of persons in danger of drowning

5.16 Dealing with Diseases e.g. COVID19, HIV / Aids, etc.

The Principal Contractor need to comply with Section 8 of the Occupational Health & Safety Act, taking into consideration transmittable diseases (e.g. COVID19 virus).

5.16.1 Health & Safety Planning

The Health & Safety Management Plan must include the planning in relation to dealing with transmittable diseases and must include the following as a minimum

- Method of Transmitting
- Risk of Transmitting
- Control or Mitigation measures to minimise the risk of transmission, but as a minimum include the following
    - Ensure all appointed employees reporting to site be screened daily
    - The communication of risk assessments and Control Measures to all employees
    - Essential site visitor and all employees must to be inducted
    - Screening of all persons entering the construction site using an non touch infrared thermometer
    - Prevention of nonessential visitors onto the construction site.
    - Controls to ensure social distancing when entering and exiting construction site during screening process.
    - Allow additional entry points to prevent very large queues if required.
    - Issuing of Face masks to all employees.
    - Controls to ensure wearing of Face Masks at all times.
    - Disinfecting of site camps (offices, toilets, public spaces, kitchen, plant, vehicles, etc) and contactable surfaces.
    - Disposable Utensils for use in Kitchen
    - Provision of adequate PPE
    - Controls to ensure that all persons are using PPE when entering construction site to protect them against diseases e.g. COVID19.

- Provision of sanitisers with at least 70% alcohol content.
- Provision of prescribed sanitizers at all work zones within construction site as well as in all offices, vehicles, plant, toilets, kitchens, public spaces.
- Adhere to the social distancing requirements. (if this cannot be achieved provided adequate PPE)
- Social Distancing protocols when transporting employees
- Controls to ensure that all construction vehicles are disinfected in an ongoing basis.
- Control when meetings takes place e.g. Area, Ventilation, Sanitising, etc.

5.16.2 Awareness

An awareness programme must be implemented by the Principal Contractor pertaining to transmittable diseases such as COVID9.

The awareness programme may include aspects such as, displaying posters, washing and personal hygiene, toolbox Talks, etc.

An COVID19 Prevention & Emergency Response Plan must be compiled by the Principal Contractor including the latest applicable Regulations and minimum control measures as per Legislation and all personnel must be informed of content
COVID-19 management and control procedure must be discussed with all personnel on project

5.16.3 Risk Assessment and Safe Operating Procedure:

A risk assessment will be compiled for transmittable diseases including the following:

- Identification of hazards pertaining to the disease
- Identifying the risks involved
- Evaluating these risks (evaluating in accordance with risk matrix)
- Control or Mitigation measures

When compiling documentation, the Principal Contractor must take the following into consideration:

- Section 8 of the Occupation Health & Safety Act:
    - Section 8 (1) - Duties of Employers to Employees
        - *Every employer shall provide and maintain, as far as reasonably practicable, a working environment that is safe and without risk to the health of his employees.*
- *Other specified regulations pertaining to a specific disease (e.g. COVID-19)*
- Use and supply of proper personal protective equipment and other items (e.g. condoms) in the workplace

5.17 Ergonomics – Ergonomic Regulations 2019

The Contractor shall:

Ensure a training programme is established for employees who may be potentially affected or exposed to ergonomic risks. Such training shall prior to placement of the relevant employee in the workplace. Refresher training shall also be conduct when recommended by the health and safety committee.

Ensure that all employees obey any lawful instruction given to him/her regarding the

- The use of measures adopted to control ergonomic risks
- Cooperating with employer in determining his/her exposure to ergonomic risks
- The reporting of potential ergonomic risks to the health and safety representative
- Reporting for medical surveillance as required in ER 8
- Information, instructions and training received as contemplated in ER 3

Ensure a risk assessment is conducted by a competent person before any work commence that may exposed employees to ergonomic risks. Risk assessment shall include:

- A complete hazard identification
- The identification of all persons who may be affected by the ergonomic risks
- How employees may be affected by the ergonomic risks
- The analysis and evaluation of the ergonomic risks
- The prioritisation of the ergonomic risks

Revision of Ergonomic Risk Assessment:

- When Assessment in no longer valid
- When control measures are no longer effective

- When Technological or scientific advances allow for more effective control measures
- When there is a change in: work method, the type of work carried out, the type of equipment used to control the exposure and an accident occurs or medical surveillance reveals an adverse health effect, where ergonomic risks are identified as a contributing factor.

Ensure all ergonomic risks are prevented or when not reasonably practicable adequately controlled to the benefit of the employee

Ensure all employees are placed under medical surveillance, which is overseen by a registered occupational medicine practitioner as required in ER 8

Ensure all records are kept as contemplated in Environmental Regulation 3, 6, 7, 8, 9.

Compiled By: EF Pieterse (Can CHSA/044/2016 – SACPCMP)

Reviewed By: F du Toit (Pr. CHSA/040/2016 – SACPCMP)

End of Document

C5.3 ENVIRONMENTAL MANGEMENT PLAN (EMP)

C5.4 CONTRACT SIGNBOARD

HARRY GWALA DISTRICT MUNICIPALITY

GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

GIBB ENGINEERING & ARCHITECTURE

DOCUMENT NUMBER & STATUS	DOCUMENT TITLE
LAYOUTS AND PLANS	
J40044-001-A	Abstraction Works - Abstraction River GA
ROADS	
J40044-100-A	Abstraction Works - Road Plan, Longitudinal Section and Cross Sections
J40044-101-A	Abstraction Works - Roads Typical and Standard Details
PIPELINES	
J40044-200-A	Abstraction Works -Rising Main Plan and Longitudinal Section
ABSTRACTION WORKS STRUCTURES	
J40044-300-A	Abstraction Works Plan Layouts
J40044-301-A	Abstraction Works Sections Layout Sheet 1 of 2
J40044-302-A	Abstraction Works Sections Layout Sheet 2 of 2
J40044-303-A	Abstraction Works General Notes
J40044-305-A	Abstraction Works 3D VIEWS
MECHANICAL AND ELECTRICAL	
J40044-400-A	Abstraction Works - Main Pumps and Pipework
J40044-401-A	Abstraction Works - Ancillary Civil and Mechanical Equipment
J40044-402-A	Abstraction Works - Main Pumps and Pipework Details
J40044-403-A	Abstraction Works - Main Pumps and Pipework Details
J40044-404-A	Abstraction Works - Main Pumps and Pipework Schedule
J40044-405-A	Abstraction Works - Finishing Schedule
J40044-410-A	Abstraction Works - Electrical Panel and Electrical Panel SLD
J40044-411-A	Abstraction Works - Power and Lighting Layout
TYPICAL DETAILS / STANDARDS	
J40044-900-A	Standard Details - Galvanised Ball Type Handrail, Stanchions Base Mounting Details
J40044-901-A	Standard Details -Ball Type Handrail Bends, Stairs Return & Kink Bends
J40044-902-A	Standard Details -Galvanised Ladder Internal up to 8m High
J40044-903-A	Standard Details -Galvanised Ladder Details External up to 8m
J40044-904-A	Standard Details -Reticulation Air Valve Detail
J40044-905-A	Standard Details -Precast Marker Post and Reinforcement Details
J40044-906-A	Standard Details -Pipe Support Detail Sheet 1 of 2
J40044-907-A	Standard Details -Pipe Support Detail Sheet 2 of 2
J40044-908-A	Standard Details -Isolation Valve Details
J40044-909-A	Standard Details -HDPe Welded Bend Details
J40044-910-A	Standard Details -Wedge Wire Screen Detail

ISSUED FOR TENDER

SETTING OUT COORDINATES			
POINT	Y	X	Z
A1	-97118.598	3371087.435	471.00
A2	-97121.415	3371090.482	471.00
A3	- 97120.066	3371086.078	470.00
A4	-97122.884	3371089.125	470.20
A5	-97126.408	3371085.866	470.20
A6	- 97123.591	3371082.819	470.20
B1	-97133.095	3371074.133	480.50
B2	-97132.361	3371074.812	480.50
B3	-97135.861	3371077.125	480.50
B4	-97135.127	3371077.804	480.50
B5	-97129.928	3371077.742	478.40
B6	-97132.016	3371080.000	478.40
B7	-97129.047	3371078.557	478.40
B8	-97131.135	3371080.815	478.40

ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

CO-ORDINATE SYSTEM	
ELLIPSOID	WGS 84
DATUM	HARTEBEESTHOEK 94
PROJECTION	WG 31

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By: S. BECHAN | Designed By: M.FUNNELL | Reviewed By: M.HOLMES

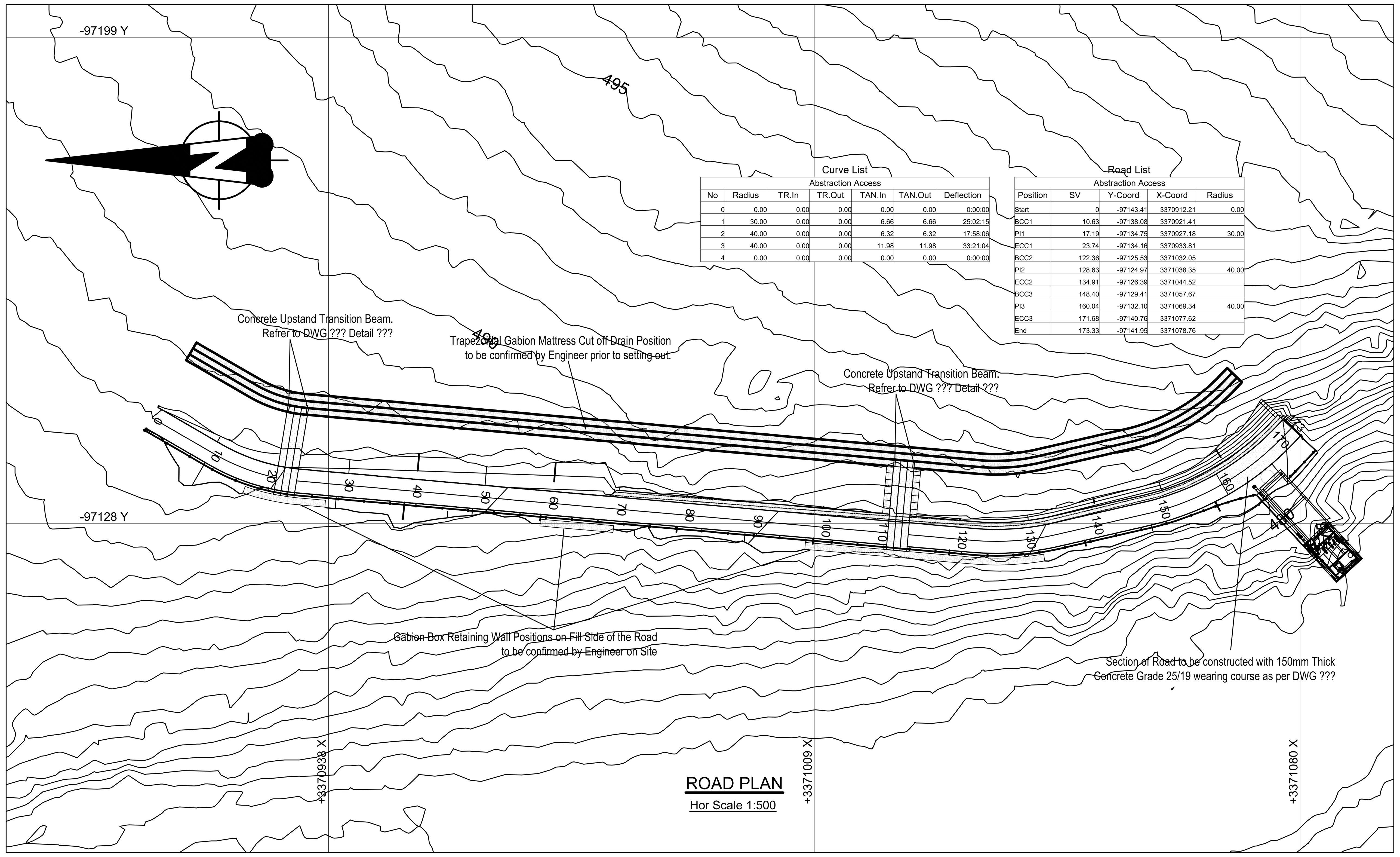
Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

Description: ABSTRACTION WORKS

ABSTRACTION RIVER GA

Scale: 1 : 100 | Date: 26/06/21

Project No: J40044 / Drg. No: 001 / Rev: A



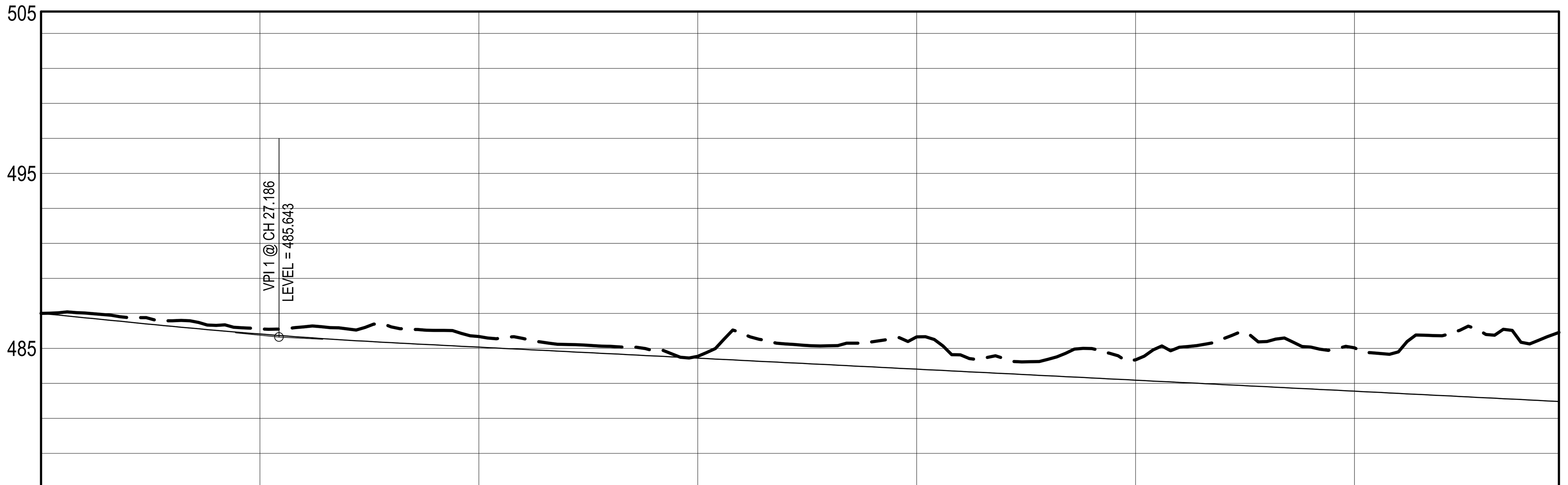
Curve List

Abstraction Access						
No	Radius	TR.In	TR.Out	TAN.In	TAN.Out	Deflection
0	0.00	0.00	0.00	0.00	0.00	0:00:00
1	30.00	0.00	0.00	6.66	6.66	25:02:15
2	40.00	0.00	0.00	6.32	6.32	17:58:06
3	40.00	0.00	0.00	11.98	11.98	33:21:04
4	0.00	0.00	0.00	0.00	0.00	0:00:00

Road List

Abstraction Access				
Position	SV	Y-Coord	X-Coord	Radius
Start	0	-97143.41	3370912.21	0.00
BCC1	10.63	-97138.08	3370921.41	
PI1	17.19	-97134.75	3370927.18	30.00
ECC1	23.74	-97134.16	3370933.81	
BCC2	122.36	-97125.53	3371032.05	
PI2	128.63	-97124.97	3371038.35	40.00
ECC2	134.91	-97126.39	3371044.52	
BCC3	148.40	-97129.41	3371057.67	
PI3	160.04	-97132.10	3371069.34	40.00
ECC3	171.68	-97140.76	3371077.62	
End	173.33	-97141.95	3371078.76	

ROAD PLAN
Hor Scale 1:500



Chainage			0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170 / 173.33
Centreline Peg Levels			487.00	486.75	486.31	486.23	486.23	485.68	485.22	484.85	485.89	485.15	485.65	484.41	484.99	485.06	485.39	485.03	485.72	485.25 / 485.91
Vertical Alignment	Des Road Levels	Left Edge	487.033	486.535	486.061	485.668	485.357	485.104	484.852	484.600	484.349	484.097	483.845	483.593	483.342	483.090	482.838	482.586	482.335	482.083 / 481.999
		Centre Line	486.998	486.500	486.026	485.633	485.322	485.069	484.817	484.565	484.314	484.062	483.810	483.558	483.307	483.055	482.803	482.551	482.300	482.048 / 481.964
		Right Edge	486.963	486.465	485.991	485.598	485.287	485.034	484.782	484.530	484.279	484.027	483.775	483.523	483.272	483.020	482.768	482.516	482.265	482.013 / 481.929

Grades: -4.984 % | 27.186 485.643 | -2.517 %

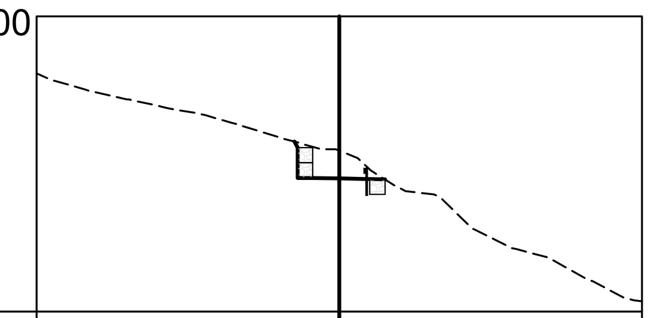
Vertical Curves: BVC 12.186 | 30.000m VC K = 12.161 | 42.186 EVC

Superelevation: 2.00000 / -2.00000

Horizontal Curves: Direction 30.03.40 | 10.634 BCC | Curve 1 Left Radius=30.000 I= 25.02.15 | ECC 23.744 | Direction 5.01.25 | 122.363 BCC | Curve 2 Left Radius=40.000 I= 17.58.06 | ECC 134.907 | Direction 347.03.18 | 148.398 BCC | Curve 3 Left Radius=40.000 I= 33.21.04 | ECC 171.681 | Direction 313.42.14

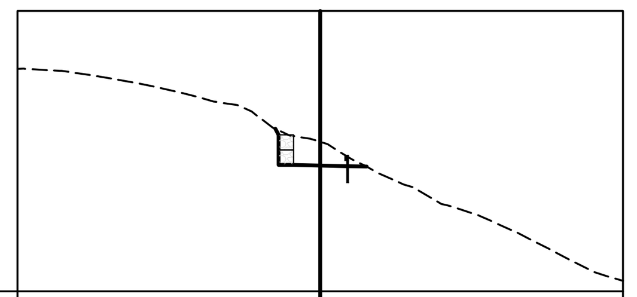
ROAD LONGITUDINAL SECTION
Hor Scale 1:500
Ver Scale 1:250

CHAINAGE 100
H.SCALE 1:500
V.SCALE 1:500
DATUM = 475



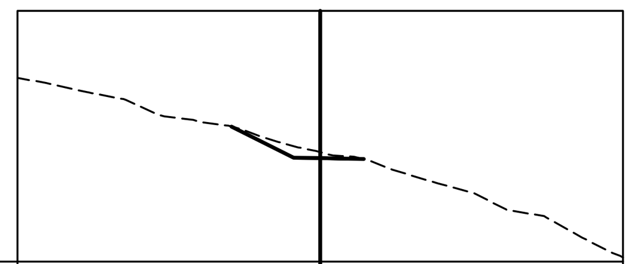
FINISHED	486.242 483.845 483.775 483.750
GROUND	489.256 485.645 477.914
OFFSET	-15.000 -2.949 -1.750 0.000 1.750 3.025 15.000

CHAINAGE 80
H.SCALE 1:500
V.SCALE 1:500
DATUM = 476



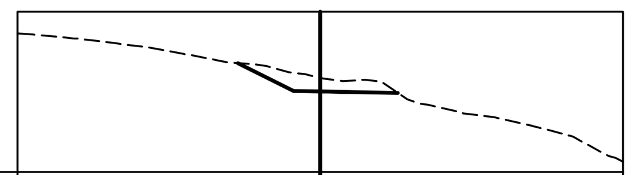
FINISHED	486.738 484.349 484.279 484.252
GROUND	490.264 485.886 478.870
OFFSET	-15.000 -2.945 -1.750 0.000 1.750 3.069 15.000

CHAINAGE 60
H.SCALE 1:500
V.SCALE 1:500
DATUM = 478



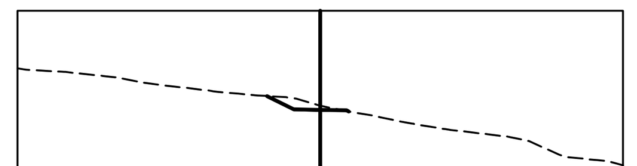
FINISHED	486.904 484.852 484.782 484.759
GROUND	489.100 485.218 480.870
OFFSET	-15.000 -5.855 -1.750 0.000 1.750 2.889 15.000

CHAINAGE 40
H.SCALE 1:500
V.SCALE 1:500
DATUM = 480



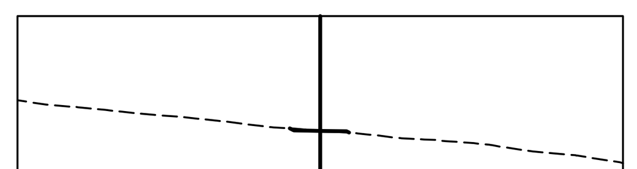
FINISHED	487.198 485.357 485.287 485.220
GROUND	488.692 486.233 482.791
OFFSET	-15.000 -5.432 -1.750 0.000 1.750 5.137 15.000

CHAINAGE 20
H.SCALE 1:500
V.SCALE 1:500
DATUM = 482



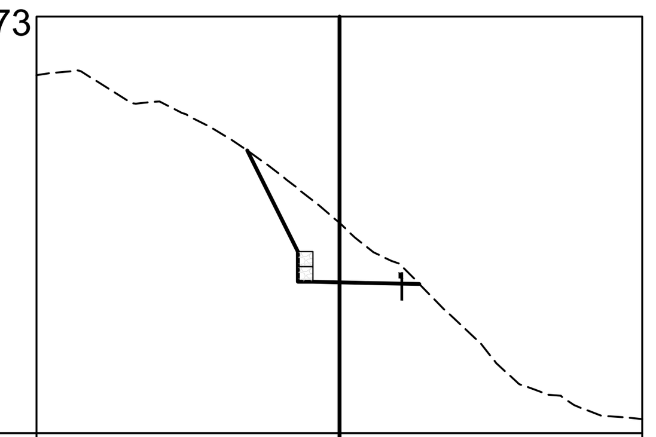
FINISHED	486.943 486.061 485.991 485.923
GROUND	488.340 486.312 483.424
OFFSET	-15.000 -3.513 -1.750 0.000 1.750 1.887 15.000

CHAINAGE 0
H.SCALE 1:500
V.SCALE 1:500
DATUM = 484



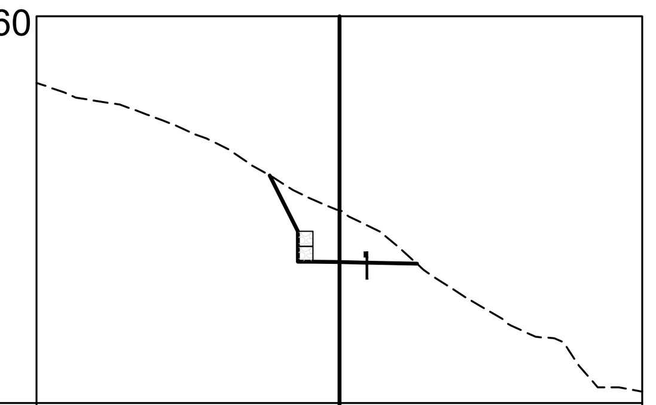
FINISHED	487.158 487.033 486.963 486.882
GROUND	488.458 486.999 485.546
OFFSET	-15.000 -1.999 -1.750 0.000 1.750 1.912 15.000

CHAINAGE 173
H.SCALE 1:500
V.SCALE 1:500
DATUM = 472



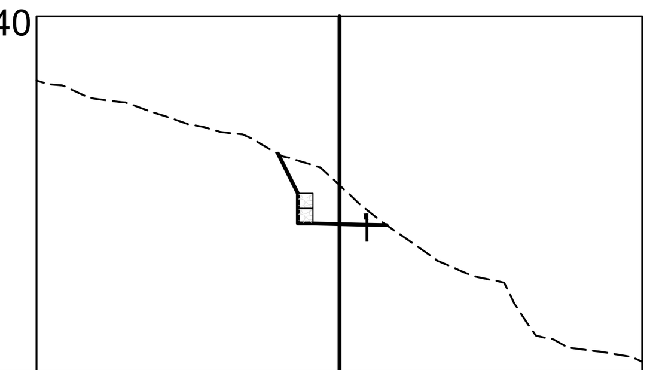
FINISHED	490.689 481.999 481.929 481.859
GROUND	494.604 485.906 474.204
OFFSET	-15.000 -6.095 -1.750 0.000 1.750 5.274 15.000

CHAINAGE 160
H.SCALE 1:500
V.SCALE 1:500
DATUM = 473



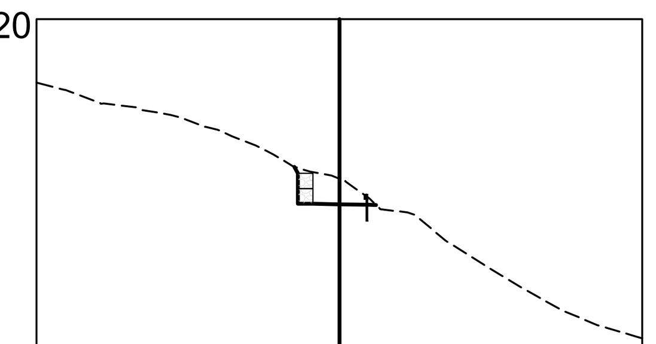
FINISHED	488.021 482.335 482.265 482.197
GROUND	492.789 485.718 476.707
OFFSET	-15.000 -4.594 -1.750 0.000 1.750 5.121 15.000

CHAINAGE 140
H.SCALE 1:500
V.SCALE 1:500
DATUM = 473



FINISHED	487.457 482.838 482.768 482.741
GROUND	490.936 485.387 474.689
OFFSET	-15.000 -4.060 -1.750 0.000 1.750 3.121 15.000

CHAINAGE 120
H.SCALE 1:500
V.SCALE 1:500
DATUM = 474



FINISHED	485.772 483.342 483.272 483.258
GROUND	489.889 484.988 476.185
OFFSET	-15.000 -2.965 -1.750 0.000 1.750 2.429 15.000

ROAD CROSS SECTIONS

ALL DIMENSIONS AND LEVELS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR BEFORE COMMENCING ANY WORK.

ON ORIGINAL
0 5 10 15 20 25 30 40 50MM

Legend:

- Proposed Guardrail
- Proposed Gabion Box Retaining Wall
- Proposed 3.5m wide roadway
- Proposed Trapezoidal Concrete Cross Over Drain
- Proposed Trapezoidal Concrete Chute
- Proposed Trapezoidal Gabion Mattress Cut Off Drain

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-05	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By	Designed By	Reviewed By
C.ROSS	P.CHETTY	M.HOLMES

Project: **GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5**

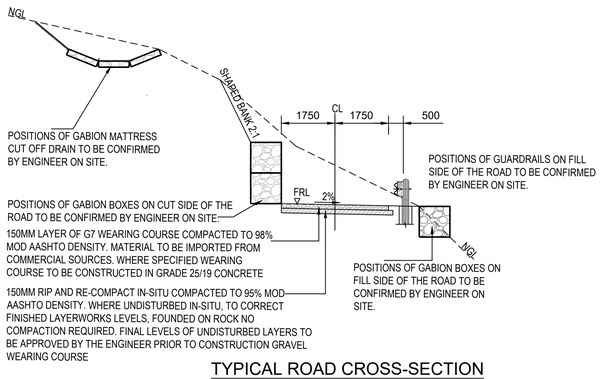
Description: **ABSTRACTION WORKS**
ROAD PLAN, LONGITUDINAL SECTION AND CROSS SECTIONS

Scale	Date
AS SHOWN	02/07/21

Project No	Drg. No	Rev
J40044	100	A

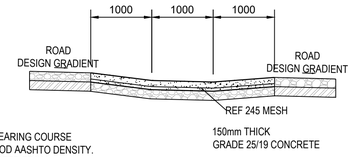
ISSUED FOR TENDER

C:\OneDrive\gibb.co.za\J40044 - Documents\J40044\04_Project Execution\I- Design\Drawings\100 Earthworks and Access Road\J40044-100 Road Plan_Longitudinal Section_Cross Section.dwg | CHERYL ROSS | 09/07/2021 10:48:19



TYPICAL ROAD CROSS-SECTION

SCALE 1:100

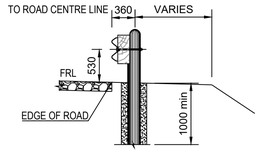


ROAD LAYERWORKS

150mm LAYER OF G7 WEARING COURSE COMPACTED TO 98% MOD AASHTO DENSITY. MATERIAL TO BE IMPORTED FROM COMMERCIAL SOURCES.

TYPICAL CONCRETE CROSS OVER DRAIN

SCALE 1:50

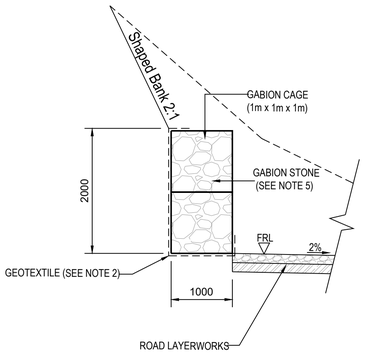


GUARDRAIL DETAIL

SCALE 1:50

NOTES ON GUARDRAIL ERECTION DETAILS

1. THE HOLES FOR TIMBER POSTS SHALL BE OF SUFFICIENT SIZE TO PERMIT PROPER SETTING OF THE POSTS AND TO ALLOW SUFFICIENT ROOM FOR BACKFILLING.
2. AT LEAST 1,0m OF POST SHALL BE EMBEDDED IN THE GROUND
3. HOLES FOR TIMBER POSTS SHALL BE SPACED TO SUITE THE STANDARD LENGTH OF GUARDRAIL SUPPLIED.
4. HOLES SHALL BE BACKFILLED WITH 12:1 SOIL : CEMENT MIXTURE AT OPTIMUM MOISTURE CONTENT IN COMPACTED LAYERS NOT EXCEEDING 100mm.
5. GUARDRAIL POSTS TO BE SPACED AT 3810MM CTC ON STRAIGHTS AND 1905MM CTC ON CURVES

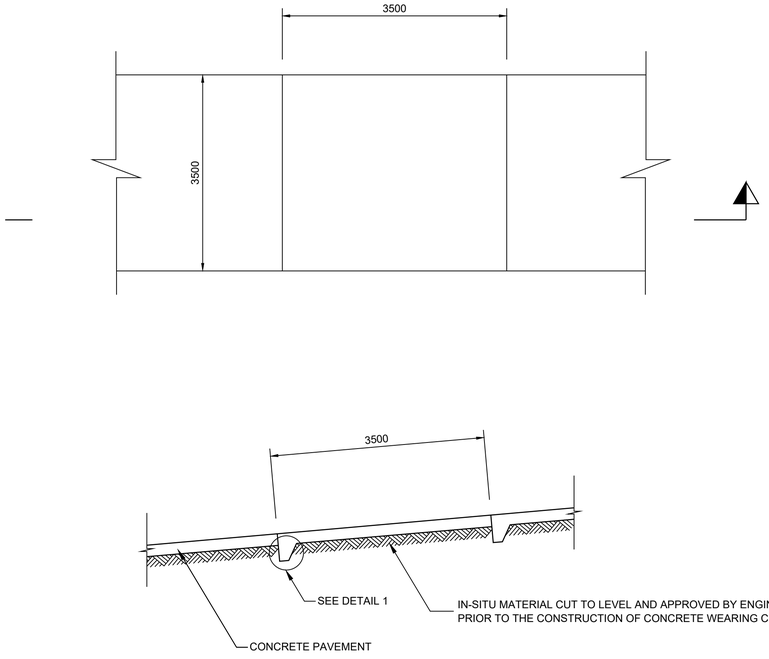


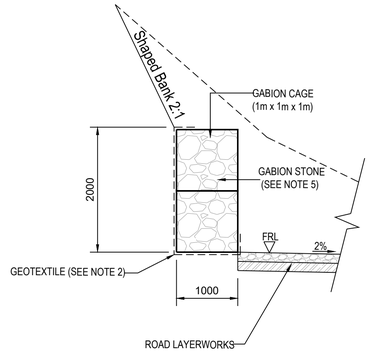
GABION NOTES:

1. FOUNDATIONS TO BE PREPARED AS INSTRUCTED BY THE ENGINEER. FOUNDATIONS TO BE LEVEL UNLESS OTHERWISE INSTRUCTED BY THE ENGINEER.
2. GEOTEXTILE FABRIC TO BE GRADE C OR SIMILAR AS INSTRUCTED BY THE ENGINEER.
3. ALL WIRE USED IN THE MAKING OF GABIONS SHALL BE GALVANISED IN ACCORDANCE WITH THE PROVISIONS S.A.B.S. 1580:1993 FOR CLASS A HEAVY GALVANISED MILD-STEEL WIRE.
4. LACING AND BRACING TO BE DONE IN ACCORDANCE WITH MANUFACTURES RECOMMENDATIONS.
5. GABION STONE TO BE HANDPACKED. STONE SIZE RANGING FROM A MINIMUM OF 150MM TO A MAXIMUM OF 300MM. SELECTED STONE TO BE PLACE ON ALL VISIBLE FACES OF GABIONS AS DIRECTED BY THE ENGINEER.
6. REFER TO SANS 1200 DK FOR A DETAILED BREAKDOWN OF SPECIFICATION OF MATERIALS.

TYPICAL GABION RETAINING WALL ON CUT FACE OF BANK

SCALE 1:50





GABION NOTES:

1. FOUNDATIONS TO BE PREPARED AS INSTRUCTED BY THE ENGINEER. FOUNDATIONS TO BE LEVEL UNLESS OTHERWISE INSTRUCTED BY THE ENGINEER.
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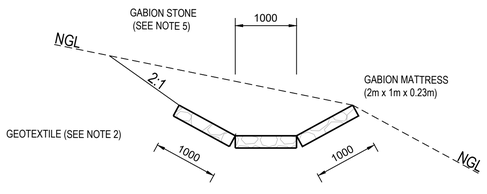
6. REFER TO SANS 1200 DK FOR A DETAILED BREAKDOWN OF SPECIFICATION OF MATERIALS.

TYPICAL GABION RETAINING WALL ON CUT FACE OF BANK

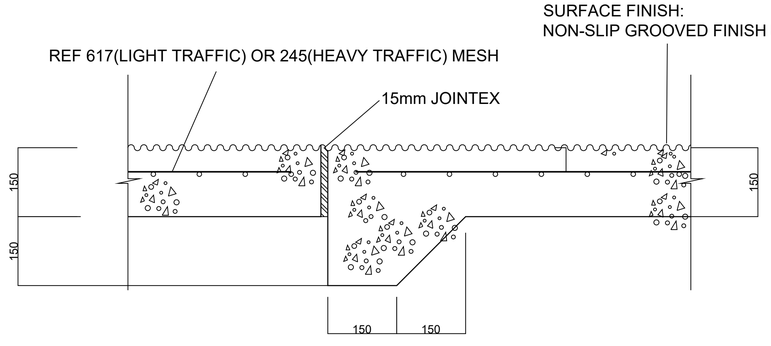
SCALE 1:50



TYPICAL TRAPEZOIDAL GABION MATTRESS CUT OFF DRAIN

SCALE 1:50

SURFACE FINISH:
NON-SLIP GROOVED FINISH USING TAMPER BEAM



DETAIL 1
ANCHOR DETAIL

NTS

ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

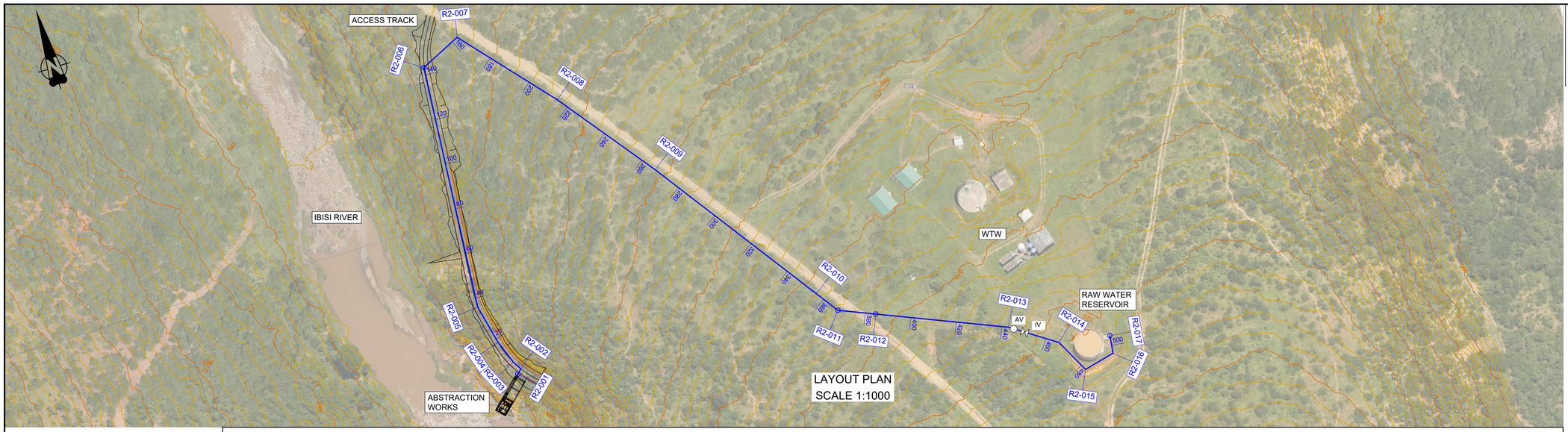
Drawn By	Designed By	Reviewed By
C.ROSS	M.HOLMES	M.HOLMES

Project: **GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5**

Description: **ABSTRACTION WORKS**
ROADS TYPICAL AND STANDARD DETAILS

Scale: AS SHOWN | Date: 26/06/21

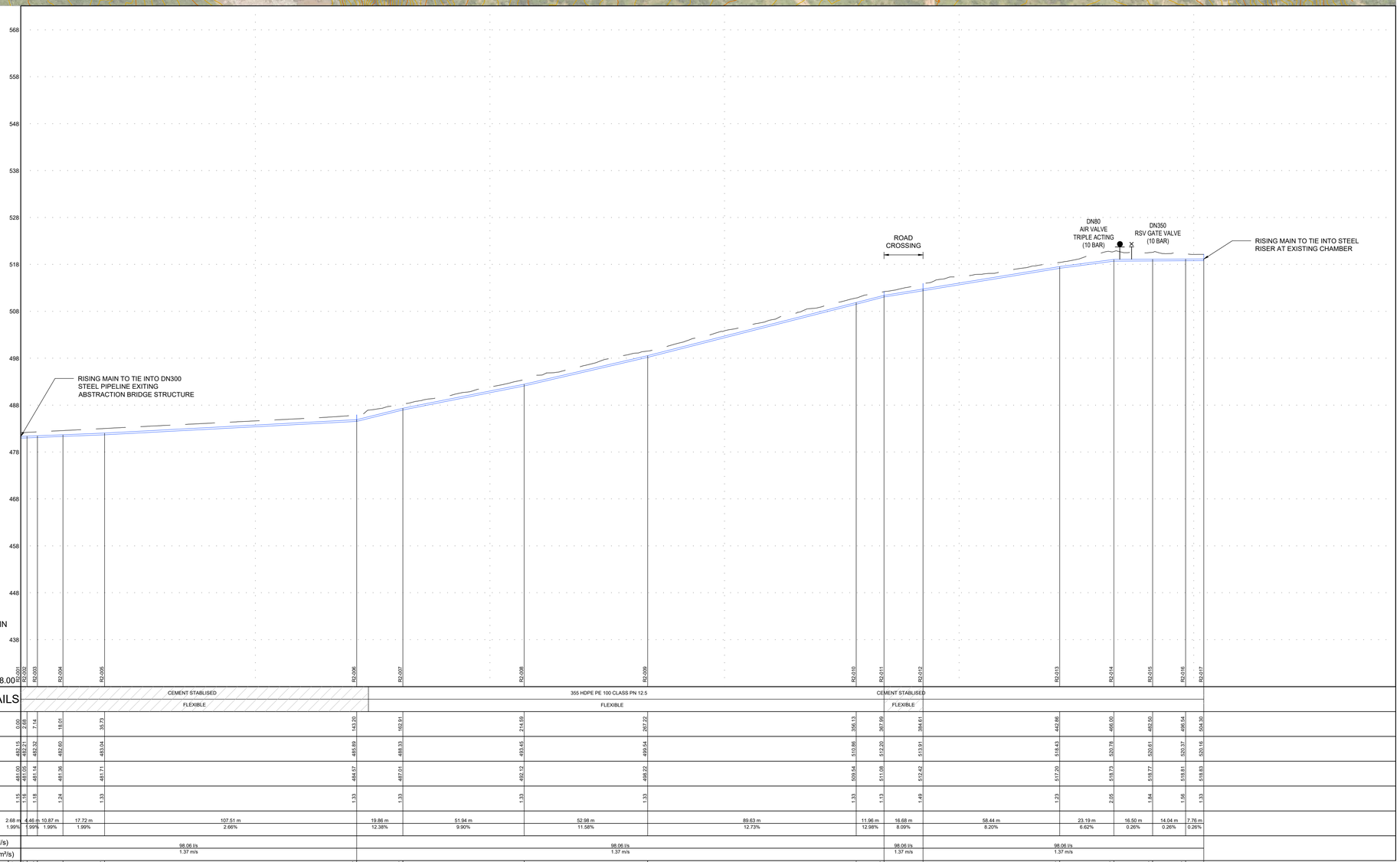
Project No: J40044 / Drg. No: 101 / Rev: A



TABLE

NODE ID	Y	X	Z
R2-001	-97133.47	3371073.19	481.00
R2-002	-97135.44	3371071.37	481.05
R2-003	-97133.12	3371067.56	481.14
R2-004	-97129.35	3371057.37	481.36
R2-005	-97125.38	3371040.11	481.71
R2-006	-97133.88	3370932.97	484.57
R2-007	-97151.72	3370924.58	487.01
R2-008	-97185.52	3370963.68	492.12
R2-009	-97217.32	3371005.62	498.22
R2-010	-97268.57	3371078.27	509.54
R2-011	-97275.40	3371087.96	511.08
R2-012	-97290.71	3371094.43	512.42
R2-013	-97344.37	3371117.10	517.20
R2-014	-97363.54	3371130.06	518.73
R2-015	-97371.13	3371144.71	518.77
R2-016	-97384.79	3371141.49	518.81
R2-017	-97385.69	3371133.79	518.83

CO-ORDINATE SYSTEM	
ELLIPSOID	WGS 84
DATUM	HARTEBEESTHOEK 94
PROJECTION	WG 29



LONSECTION MNQUMENI RAW RISING MAIN
CHAINAGE 0 TO 586

SCALES
Horizontal 1:1000
Vertical 1:500 DATUM 428.00

PIPE INFORMATION AND DETAILS		CEMENT STABLISED / FLEXIBLE				355 HDPE PE 100 CLASS PN 12.5 / FLEXIBLE						CEMENT STABLISED / FLEXIBLE					
CHAINAGE (m)	0.00	2.68	7.14	18.01	35.73	143.20	162.61	214.59	267.22	356.13	367.99	384.61	442.88	466.00	482.50	496.54	504.30
GROUND LEVEL (m)	482.45	482.45	482.22	482.20	483.04	485.89	488.33	493.45	499.54	510.86	512.20	513.91	518.43	520.78	520.61	520.37	520.16
PIPE INVERT LEVEL (m)	481.00	481.00	481.14	481.36	481.71	484.57	487.01	492.12	498.22	509.54	511.08	512.42	517.20	518.73	518.77	518.81	518.83
DEPTH TO IVERT LEVEL (m)	1.45	1.45	1.08	1.84	1.33	1.33	1.33	1.33	1.33	1.33	1.13	1.49	1.23	2.05	1.84	1.56	1.33
LENGTH (m)	2.68 m	4.46 m	10.87 m	17.72 m	107.51 m		19.86 m	51.94 m	52.98 m	89.63 m	11.96 m	16.68 m	58.44 m	23.19 m	16.50 m	14.04 m	7.76 m
SLOPE (%)	1.99%	1.99%	1.99%	1.99%	2.66%		12.38%	9.90%	11.58%	12.73%	12.98%	8.09%	8.20%	6.62%	0.26%	0.26%	0.26%
HYDRAULICS DESIGN Q(l/s)					98.06 l/s			98.06 l/s				98.06 l/s			98.06 l/s		
HYDRAULICS DESIGN V(m³/s)					1.37 m/s			1.37 m/s				1.37 m/s			1.37 m/s		
DIRECTION CHANGES VERT			78.6°		7.4°		5.5° 60.3°		1.9° 3.7°		0.6° 2.0°		0.5° 1.1°	3.5° 28.8°	78.9°	70.1°	
DIRECTION CHANGES HOR			78.6°	11.0°		0.41° 17.5°		1.4° 74.3°				0.1°	2.8° 31.9°	0.1°			
DIRECTION CHANGES COMBINED																	

ISSUED FOR TENDER

ALL DIMENSIONS AND LEVELS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR BEFORE COMMENCING ANY WORK.

ON ORIGINAL
0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

LEGEND:
- AV - AIR VALVE
- IV - ISOLATION VALVE
- 355mmØ HDPE PE100 PN 12.5
- 1m MINOR CONTOUR
- 5m MAJOR CONTOUR

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI
Drawn By: S.BECHAN | Designed By: S.BECHAN | Reviewed By: M.HOLMES

Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5
ABSTRACTION WORKS

Description: ABSTRACTION WORKS
RAW WATER RISING MAIN PLAN AND LONGITUDINAL SECTION

Scale: AS SHOWN | Date: 26/06/21

Project No: J40044 | Drg. No: 200 | Rev: A

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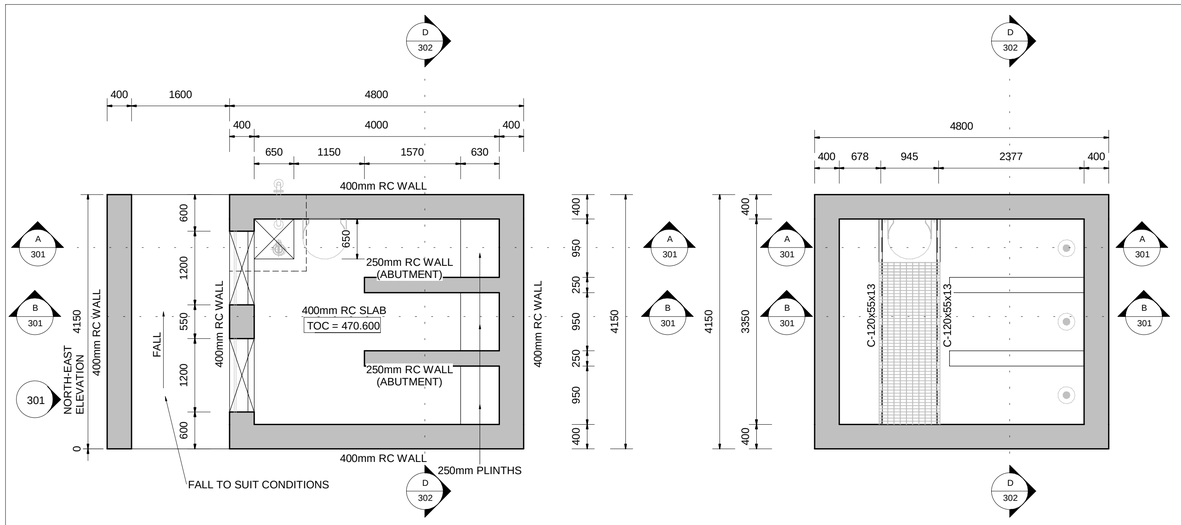
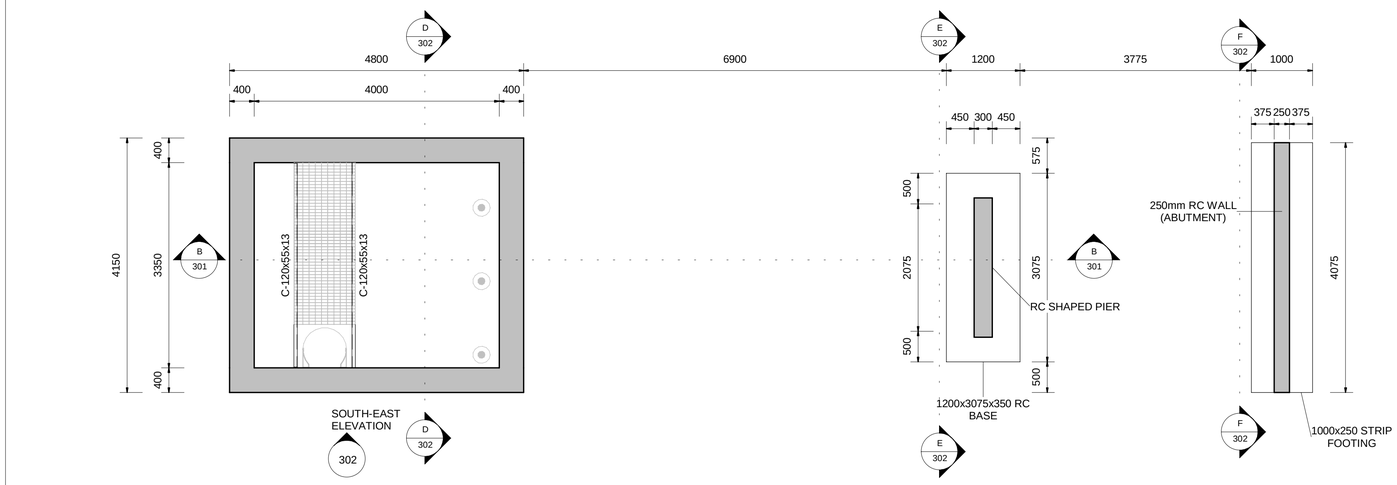


FLOOR LEVEL 470.6

SCALE: 1 : 50

PLATFORM 1

SCALE: 1 : 50



PLATFORM 2 AND FOUNDATIONS

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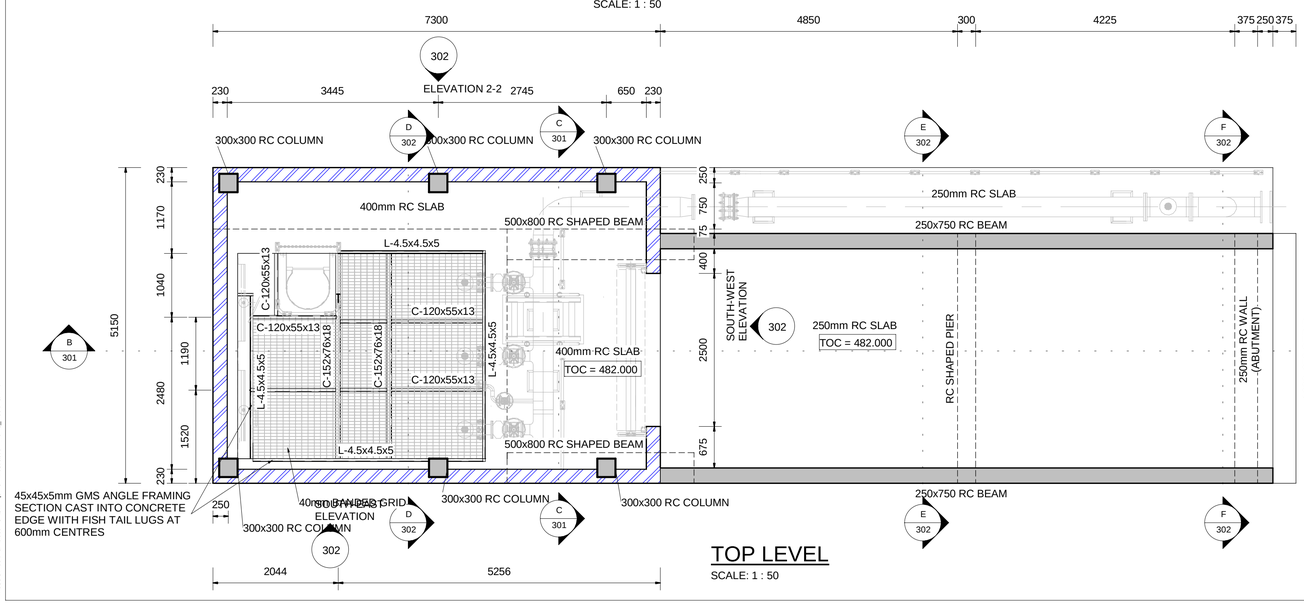
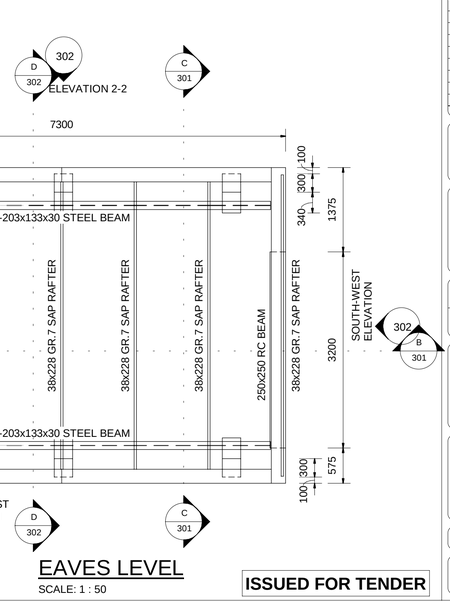


TOP LEVEL

SCALE: 1 : 50



EAVES LEVEL

SCALE: 1 : 50

ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES
- PLEASE REFER TO DRAWING 303

No	Date	Details	Chkd	Appd
A	30/06/21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By: W.BOLTMAN | Designed By: D.VAN WIERINGEN | Reviewed By: M.HOLMES

Project: **GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5**

Description: **ABSTRACTION WORKS**

PLAN LAYOUTS

Scale: AS SHOWN | Date: 30/06/21

Project No: J40044 | Drg. No: 300 | Rev: A

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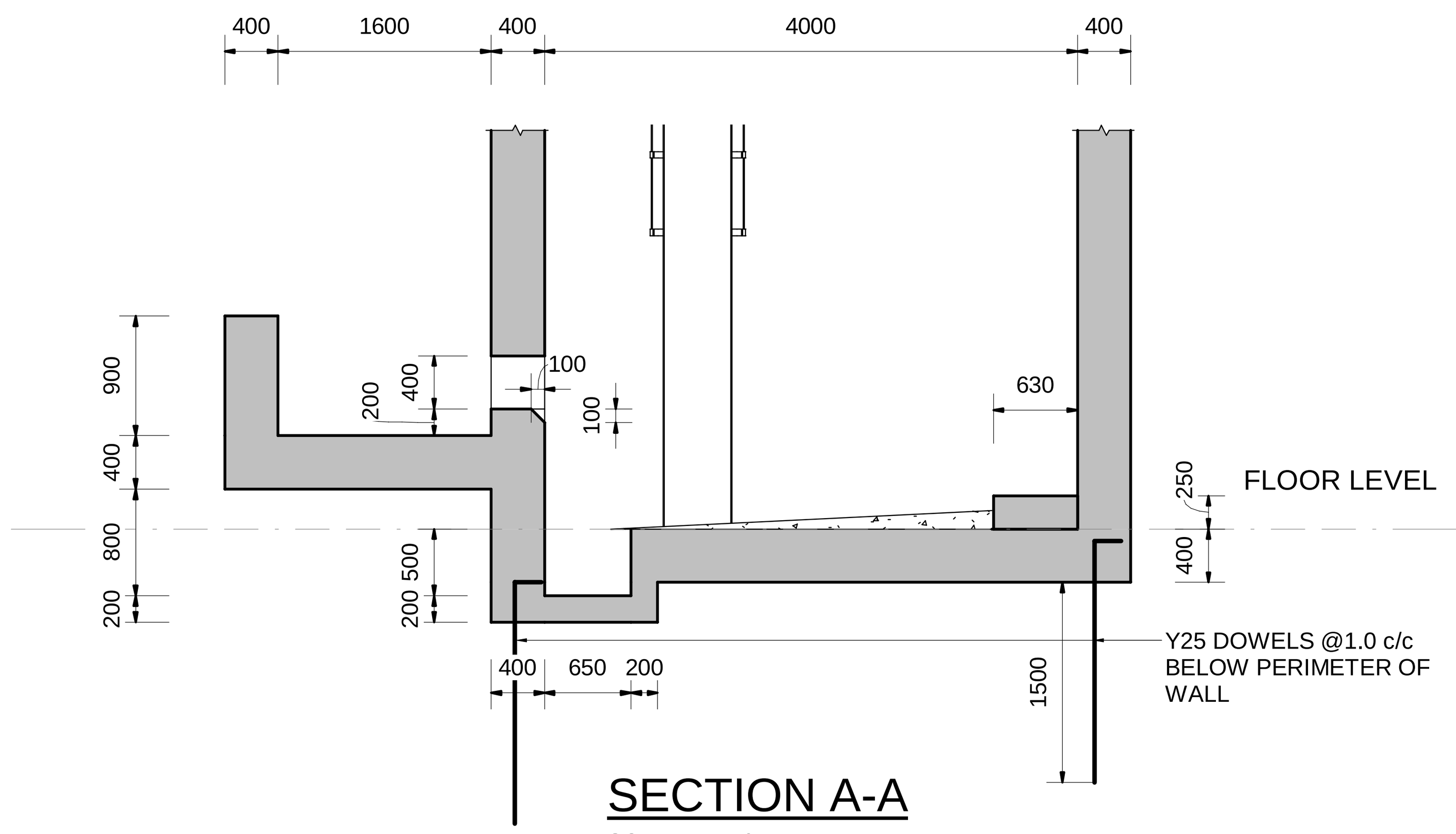
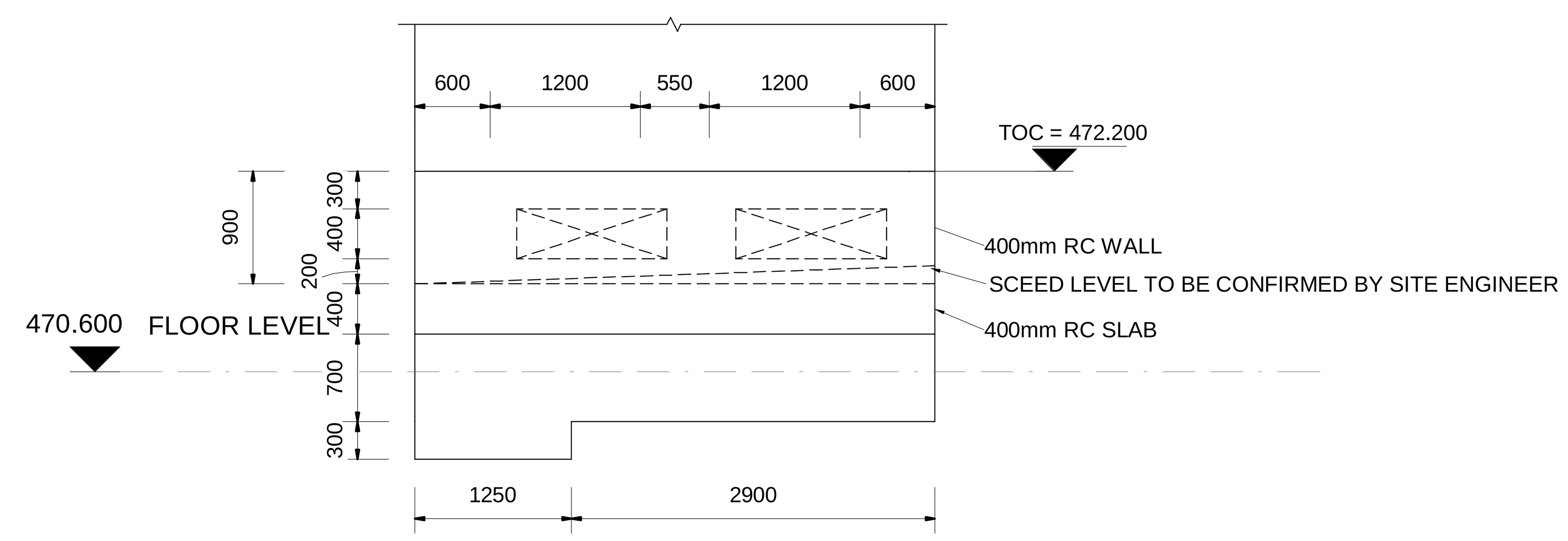


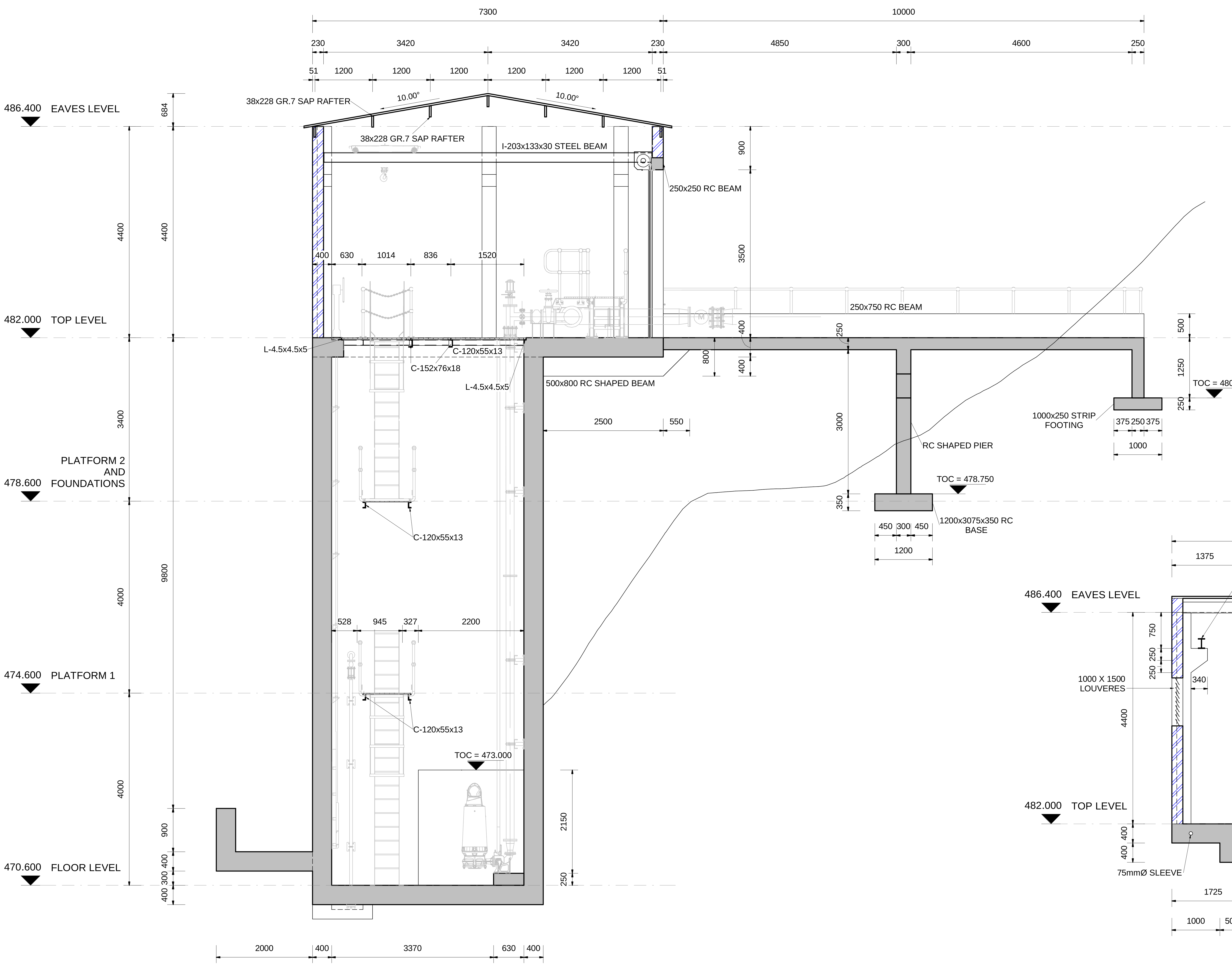
SECTION A-A

SCALE : 1 : 50



NORTH-EAST ELEVATION

SCALE : 1 : 50



SECTION B-B

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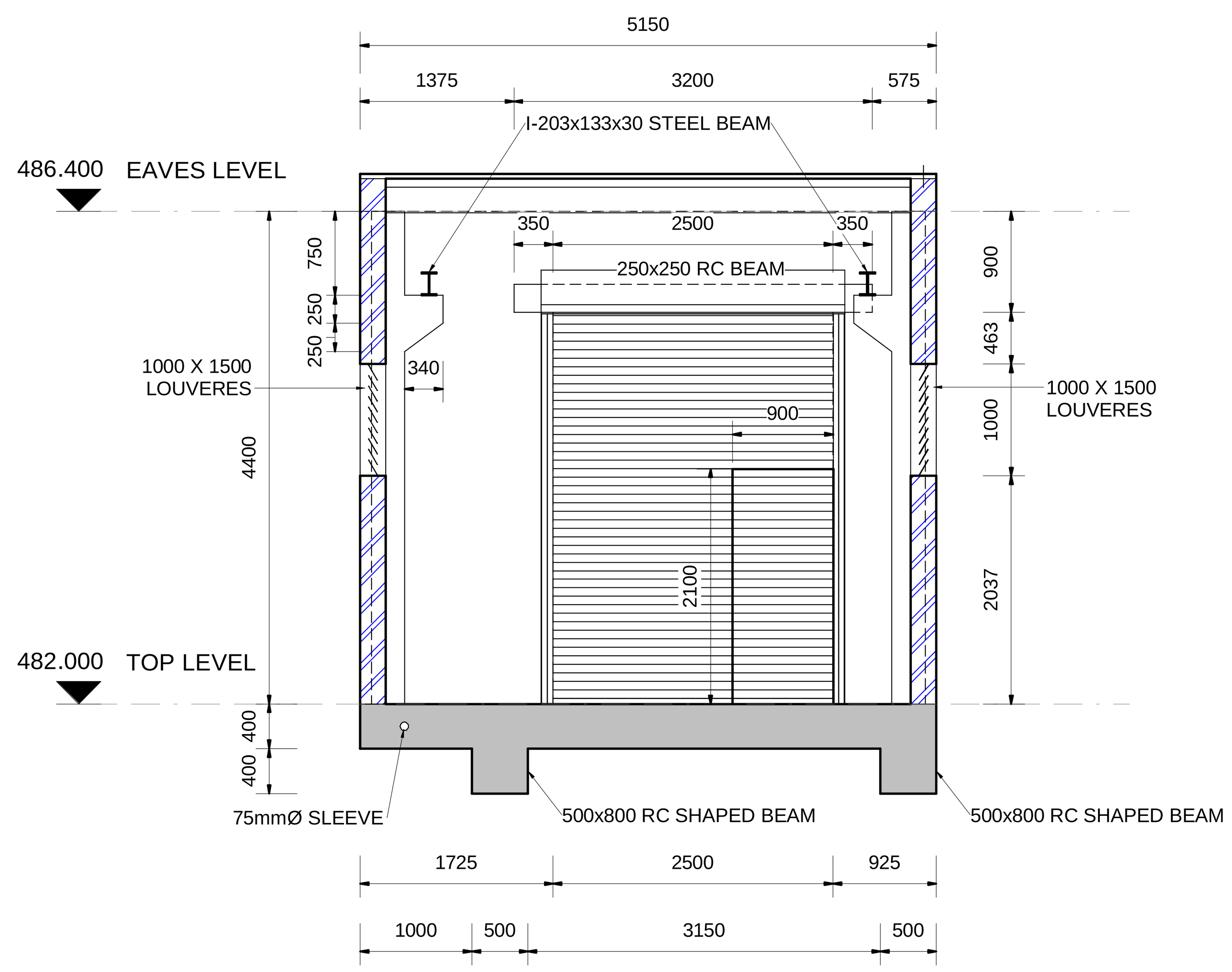

SECTION C-C

SCALE : 1 : 50

ISSUED FOR TENDER

ALL DIMENSIONS AND LEVELS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR BEFORE COMMENCING ANY WORK.

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES

- PLEASE REFER TO DRAWING 303

No	Date	Details	Chkd	Appd
A	30/06/21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By: W.BOLTMAN | Designed By: D VAN WIERINGEN | Reviewed By: M.HOLMES

Project: **GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5**

Description: **ABSTRACTION WORKS**

SECTIONS LAYOUT
SHEET 1 OF 2

Scale: AS SHOWN | Date: 30/06/21

Project No: J40044 | Drg. No: 301 | Rev: A

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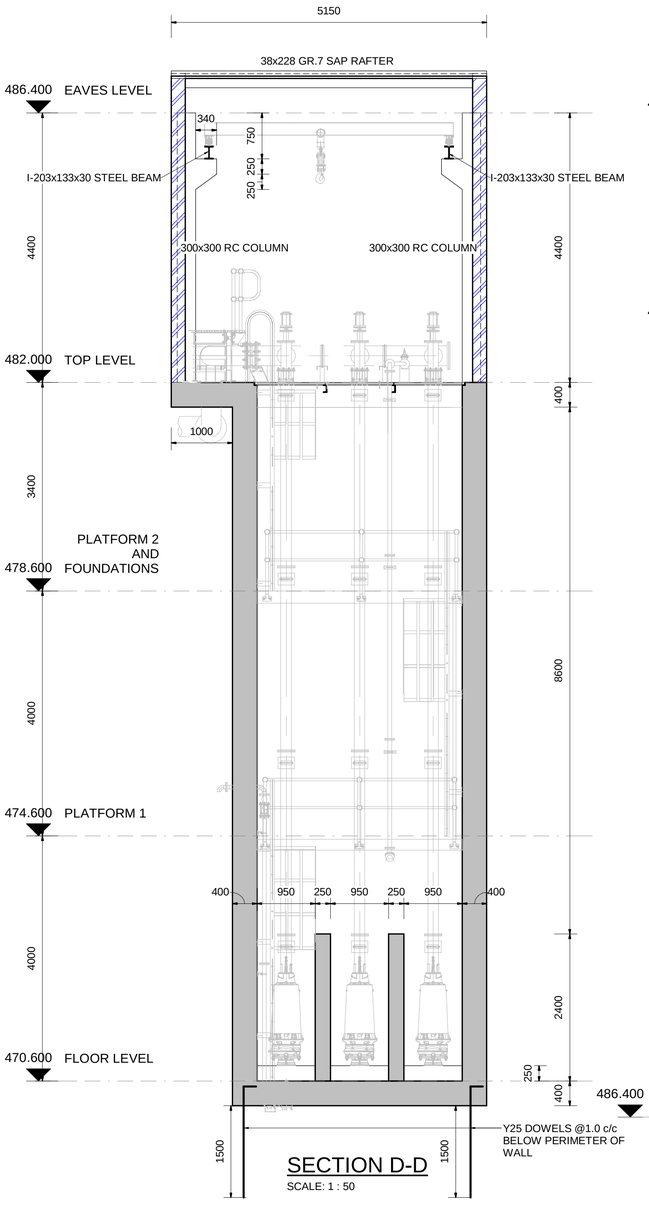
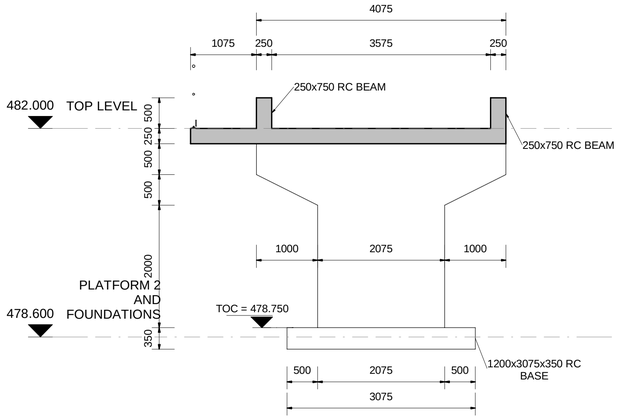


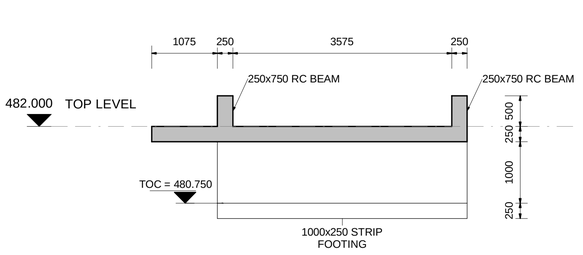
SECTION D-D

SCALE: 1 : 50



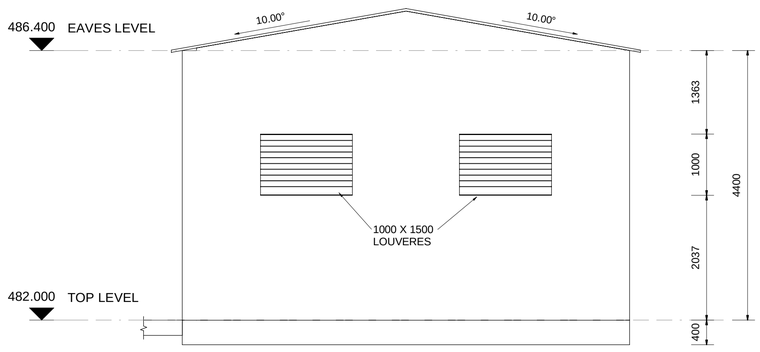
SECTION E-E

SCALE: 1 : 50



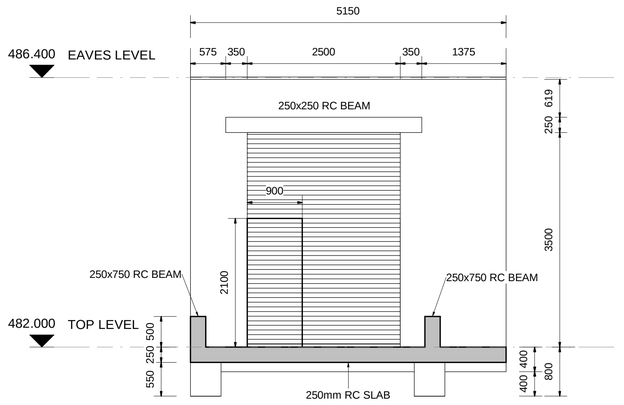
SECTION F-F

SCALE: 1 : 50



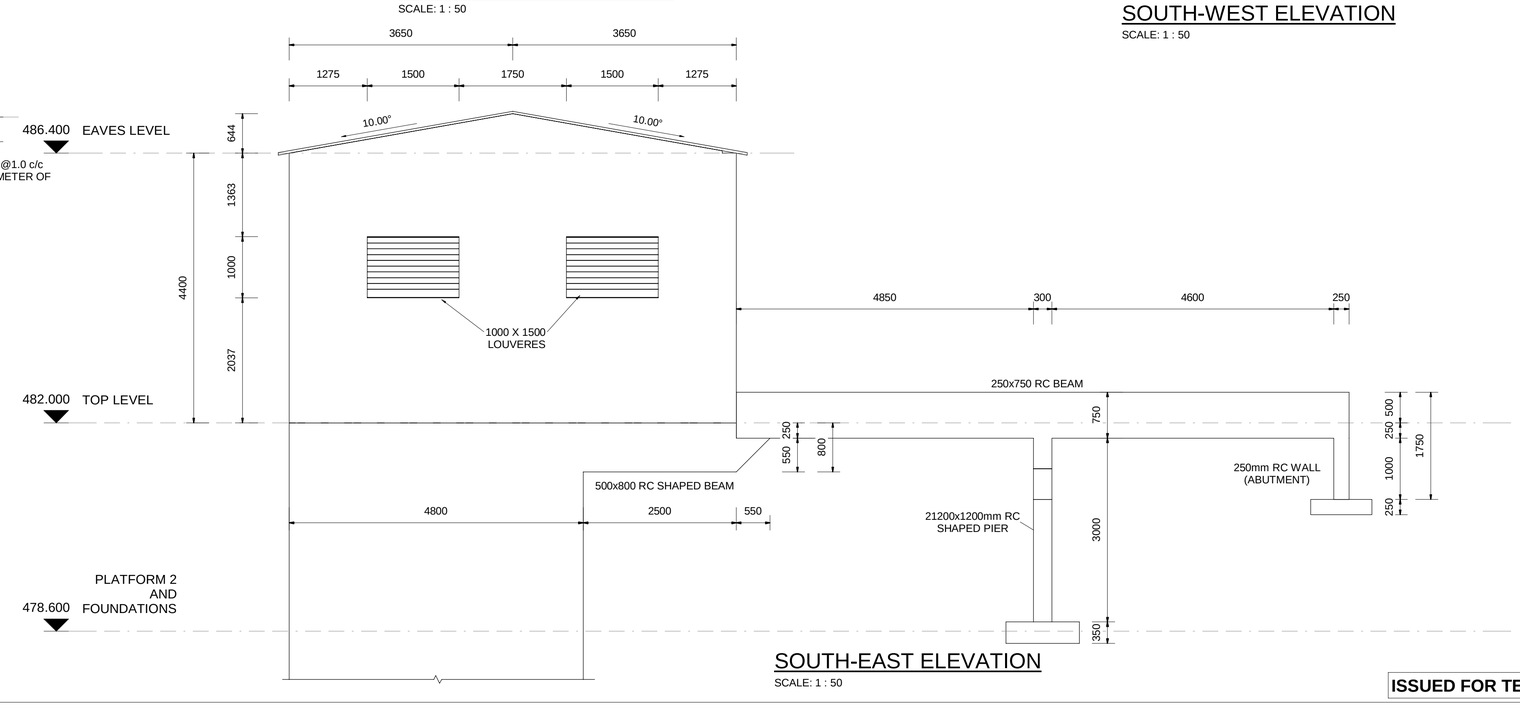
NORTH-WEST ELEVATION

SCALE: 1 : 50



SOUTH-WEST ELEVATION

SCALE: 1 : 50



SOUTH-EAST ELEVATION

SCALE: 1 : 50

ISSUED FOR TENDER

ALL DIMENSIONS AND LEVELS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR BEFORE COMMENCING ANY WORK.

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES
- PLEASE REFER TO DRAWING 303

No	Date	Details	Chkd	Appd
A	30/06/21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By			
	N.MKHWANAZI		
Drawn By	Designed By		Reviewed By
W.BOLTMAN	D VAN WIERINGEN		M.HOLMES

Project: **GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5**

Description: **ABSTRACTION WORKS**

SECTIONS LAYOUT
SHEET 2 OF 2

Scale	Date
AS SHOWN	30/06/21

Project No	Drg. No	Rev
J40044	302	A

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GENERAL

1.ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH THE RELEVANT SECTIONS OF THE SANS 1200 ***OR SANS 2001***.

2.READ THIS DRAWING IN CONJUNCTION WITH AND OTHER ENGINEERING DRAWINGS AND PROJECT SPECIFICATIONS.

3.ALL CONTRACTOR'S QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION TO BE FORWARDED TO ENGINEER BEFORE COMMENCING WITH ANY STRUCTURAL WORK.

4.CONTRACTOR TO CONDUCT HIS OWN QUALITY ASSURANCE/ CONTROL BEFORE CALLING THE ENGINEER FOR INSPECTION.

5.48 HOURS WRITTEN NOTICETO BE GIVEN TO ENGINEER BEFORE TIME OF INSPECTION.

6.ALL LEVELS ARE IN METRES RELATIVE TO THE APPROPRIATE LOCAL DATUM.

7.ALL LEVELS ON DRAWINGS INDICATE TOP OF CONCRETE UNLESS INDICATED OTHERWISE.

8.ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED OTHERWISE.

9.NO DIMENSIONS ON DRAWINGS ARE TO BE SCALED.

10.FOR SETTING OUT DATA, SETTING OUT POINTS AND DATUM LEVELS REFER TO SURVEY INFORMATION.

11.CONTRACTOR TO CHECK ALL DIMENSIONS AND LEVELS ON SITE AND REPORT ANY DISCREPANCIES TO THE ENGINEER, BEFORE SUBMITTING FABRICATION DRAWINGS.

12.JOINTS INDICATED ON SLABS ARE ALSO TO BE CONSTRUCTED IN BRICK WALLS, SCREED AND FINISHES.

DESIGN CRITERIA

1.DESIGN IN ACCORDANCE WITH THE FOLLOWING CODES:

LOADINGS:	SANS 10160
FOUNDATIONS:	SANS 01610
CONCRETE:	SANS 10100
STRUCTURAL STEEL:	SANS 10162
STRUCTURAL TIMBER:	SANS 10163

SURFACE BED

1.REFER TO ARCHITECT DETAILS FOR SURFACE FINISH AND COVERING.

2.PROVIDE 250 MICRON DPC UNDER ALL SURFACE BEDS WITH A MINIMUM LAP OF 300mm.

3.MINIMUM LAP OF MESH REINFORCEMENT IS 450mm UNLESS OTHERWISE NOTED.

4.PROVIDE A VERTICAL ISOLATION JOINT BETWEEN THE SURFACE BED AND ALL VERTICAL WALLS AND COLUMNS PROTRUDING THROUGH THE SURFACE BED.

5.CONCRETE CAST UNDER ROOF COVER: SAW CUT SURFACE BEDS WITHIN 24 HOURS OF CASTING.

6.CONCRETE CAST IN OPEN AIR. SAW CUT FLOOR SLABS WITHIN 6 HOURS OF CASTING

IN SITU CONCRETE WORK

1.ALL CONCRETE WORK TO BE CARRIED OUT IN ACCORDANCE WITH SANS 1200 G ***OR SANS 2001-CC1*** (LATEST ADDITION).

2.MINIMUM CONCRETE CUBE STRENGTH AT 28 DAYS AND MINIMUM COVER TO REINFORCEMENT:

ELEMENT	28 DAY STRENGTH (MPa)	EXPOSURE CONDITION	COVER (mm)
BLINDING, MASS CONCRETE, SCREED	15	SEVERE	N/A
INTERNAL SURFACE BEDS	30	MODERATE	40
SECONDARY CONCRETE/ BENCHING	25	SEVERE	N/A
WEIR NORTHERN BUTTRESS WALL	25	SEVERE	50
WEIR APRON SLAB	35	SEVERE	50
RC FOUNDATIONS	35	SEVERE	50
(INTERNAL)RC COLUMNS	35	MODERATE	40
(INTERNAL)RC SLABS	35	MODERATE	40
(INTERNAL)RC BEAMS	35	MODERATE	40
WALLS	35	SEVERE	50
(EXPOSED)RC COLUMNS	35	SEVERE	50
(EXPOSED)RC SLABS	35	SEVERE	50
(EXPOSED)RC BEAMS	35	SEVERE	50

3.MAXIMUM NOMINAL CONCRETE AGGREGATE SIZE = 19MM, UNLESS OTHERWISE APPROVED BY THE ENGINEER.

4.NO-FINES CONCRETE SHALL CONSIST OF COURSE AGGREGATE OF A SINGLE SIZE (19mm), CEMENT AND WATER ONLY. NO FINE AGGREGATE SHALL BE ALLOWED.
METHOD STATEMENT FOR THE REPAIR.

IN SITU CONCRETE WORK (CONT.)

5.MIX DESIGNS, TRIAL MIX CUBE TEST RESULTS AND SLUMP LIMITS TO BE SUBMITTED TO ENGINEER FOR APPROVAL AT LEAST 7 DAYS BEFORE CONCRETE IS DUE TO BE CAST.

6.A SLUMP TEST SHALL BE CARRIED OUT ON EVERY BATCH/TRUCK OF CONCRETE DELIVERED TO SITE AND ANY BATCH OR TRUCK LOAD OF CONCRETE THAT FALLS OUTSIDE THE LIMITS WILL BE REJECTED AND REMOVED FROM SITE.

7.CUBES SHALL BE TESTED 28 DAYS AFTER CASTING AND REULLTS TO BE SUBMITTED TO THE ENGINNER WITHIN 7 DAYS FROM DATE OF TEST.

8.DIMENSIONS OF BEAMS ARE INDICATED AS WIDTH x DEPTH.

9.THE CONTRACTOR MUST ENSURE THAT ALL EMBEDDED ITEMS AND PENETRATIONS FOR SERVICES HAVE BEEN PROVIDED FOR AND POSITIONED ACCORDING TO THE LATEST DRAWINGS OF ALL DISCIPLINES BEFORE CASTING CONCRETE. NO HOLES ARE TO BE CORED WITHOUT THE ENGINEER'S WRITTEN APPROVAL.

10.ACRONYMS ARE DEFINED AS FOLLOWS:
SC: SAW CUT JOINT
CJ: CONSTRUCTION JOINT
IJ : ISOLATION JOINT
EJ: EXPANSION JOINT

11.CONSTRUCTION JOINT POSITIONS ARE INDICATIVE ONLY AND SHALL BE AGREED WITH THE ENGINEER. MOVEMENT JOINTS ARE TO BE INSTALLED AS INDICATED ON THE DRAWINGS.

12.CONSTRUCTION JOINTS:
NO HORIZONTAL JOINTS WILL BE ALLOWED IN BASES, BEAMS AND SLABS. NO VERTICAL JOINTS IN COLUMNS AND SHEAR WALLS.

13.WHERE IT IS NECESSARY TO UTILIZE CONSTRUCTION JOINTS, SUCH JOINTS SHALL BE INSPECTED BY THE ENGINEER PRIOR TO COMMENCEMENT OF CONSTRUCTION.

14.THE PROPOSED CASTING SEQUENCE OF ALL CONCRETE TO BE APPROVED BY THE ENGINEERS REPRESENTATIVE 14 DAYS BEFORE CASTING.\

15.IF FOR ANY REASON A COLD JOINT SHOULD FORM DURING CASTING, THE PLANE OF THE JOINT SHOULD BE AT 45 DEGREES TO THE SOFFIT OF THE MEMBER AND THE ENGINEER SHOULD BE NOTIFIED IMMEDIATELY.

16.ARCHITECTS DRAWINGS TO BE FOLLOWED FOR CONCRETE FINISHES, GROOVES, CHAMFERS, ETC ***OR ALL EXPOSED CONCRETE CORNERS WITH AN ANGLE OF 90° OR LESS SHALL HAVE A 20mm x 20mm CHAMFER UNLESS OTHERWISE NOTED ON THE DRAWINGS.***

17.NO CONCRETE SHALL BE CAST IN LIFTS IN EXCESS OF 3m UNLESS MEASURES ARE TAKEN TO ENSURE SEGREGATION DOES NOT OCCUR, AS APPROVED BY ENGINEER.

18.ALL CONCRETE TO BE COMPACTED USING A MECHANICAL VIBRATOR OF A SUITABLE SIZE. POURS DEEPER THAN 300mm TO BE DOUBLE VIBRATED, THE SECOND VIBRATING BEING DONE JUST BEFORE INITIAL SET.

19.THE TOP OF CONCRETE ELEMENTS AND THE SURFACE OF ALL CONSTRUCTION JOINTS SHALL BE SCABBLE OR WATER JETTED TO REMOVE LAITENCE AND LOOSE MATERIAL AND TO ROUGHENED EDGES PRIOR TO CASTING THE NEXT LIFT OF CONCRETE. A WET TO DRY EPOXY TO BE PROVIDED TO THE ENGINEER'S APPROVAL ON TOP OF SLABS WHERE UPSTAND BEAMS ARE CAST.

20.ALL CONCRETE TO BE CONTINUOUSLY CURED USING AN APPROVED METHOD FOR A MINIMUM OF 7 DAYS.

21.SHOULD NO ALTERNATIVE CURING METHOD BE APPROVED BY THE ENGINEER IN WRITING, THE FOLLOWING SHOULD BE DONE:

- FOR CONCRETE CAST UNDER ROOF COVER: CURE BY WETTING SIX TIMES PER DAY FOR A MINIMUM OF 7 DAYS.
- CONCRETE CAST IN OPEN AIR: CURE BY COVERING WITH PLASTIC SHEETING IMMEDIATELY AFTER STRIKING OF FORMWORK.
- FOR POWER FLOATED SLABS, COVER SLAB WITH WHITE PLASTIC SHEETING IMMEDIATELY AFTER STRIKING OFF FORMWORK AND REPLACE PLASTIC SHEETING AFTER POWER FLOATING.
- COLUMNS TO BE WRAPPED IN PLASTIC.
- CURING COMPOUND TO BE APPROVED BY THE ENGINEER PRIOR TO COMMENCING WORKS.

22.CONCRETE DEFECTS MAY ONLY BE REPAIRED AFTER THE ENGINEER HAS APPROVED A METHOD STATEMENT FOR THE REPAIR.

FORMWORK

1.STAGING AND FORMWORK SHALL BE DESIGNED AND CERTIFIED BY SUITABLY EXPERIENCED PROFFESIONALLY REGISTERED ENGINEER. WHERE APPROPRIATE THE CONTRACTOR SHALL SUBMIT FORMWORK AND TEMPORARY WORKS DESIGN AND DETAILS TO THE ENGINEER FOR REVIEW.

2.THE STAGING AND BACK PROPPING DETAILS ARE TO BE SUBMITTED TO THE ENG. REP. FOR REVIEW. ALLOWANCE SHALL BE MADE FOR BACK PROPPING LOWER FLOORS WHILST CONCRETE IS BEING CAST ABOVE.

3.THE CONTRACTOR TO ENSURE THAT THE NECESSARY PROVISION IS MADE IN THE FALSEWORK FOR 3 SLABS TO SUPPORT THE WET WEIGHT OF ONE SLAB. e.g FOR THE CASTING OF LEVEL 5 SLAB 100% SUPPORT WORK MUST BE PROVIDED ON LEVEL 4, 70% ON LEVEL 3 AND 30% ON LEVEL 2.

FORMWORK (CONT.)

4.ALL SLAB PANELS WITH UPSTAND BEAMS TO REMAIN PROPPED UNTIL THE UPSTANDS HAVE BEEN CAST AND ARE 14 DAYS OLD.

5.CLASS OF FORMWORK AS FOLLOWS:

FORMED VERICAL CONCRETE SURFACE AS DEFINED IN SANS 1200 G ***OR TABLE 1 OF SANS 2001- CC1***

SURFACE	
UNEXPOSED SURFACE MORE THAN 300mm BELOW GROUND LEVEL AND SIDES OF GROUND BEAMS	ROUGH
UNEXPOSED SURFACE 0-300mm BELOW GROUND LEVEL	SMOOTH
EXPOSED WALLS, COLUMNS, BEAMS AND SLABS IN PARKING AREAS	SMOOTH
EXPOSED WALLS, COLUMNS, BEAMS AND SLABS IN OFFICES AND OTHER HABITABLE AREAS	SMOOTH

HORIZONTAL UNFORMED SURFACES:

SURFACE	FINISH
SURFACE BED	POWER FLOATED
SUSPENDED SLAB	WOOD FLOATED
WALL TOPS	STEEL FLOATED
TOP OF EXPOSED FOUNDATIONS	STEEL FLOATED
TOP OF COVERED FOUNDATIONS	WOOD FLOATED

6.DEGREE OF ACCURACY FOR FORMED CONCRETE SURFACES AS DEFINED IN SANS 1200 G ***OR TABLE 11 OF SANS 2001- CC1***

SURFACE	DEGREE OF ACCURACY
UNEXPOSED SURFACE MORE THAN 300mm BELOW GROUND LEVEL AND SIDES OF GROUND BEAMS	II
UNEXPOSED SURFACE 0-300mm BELOW GROUND LEVEL	II
EXPOSED WALLS, COLUMNS, BEAMS AND SLABS IN PARKING AREAS	II
EXPOSED WALLS, COLUMNS, BEAMS AND SLABS IN OFFICES AND OTHER HABITABLE AREAS	I

PRE-CAST PRESTRESSED CONRETE LINTELS

1.LINTELS TO COMPLY WITH SANS 1504.

2.LINTELS MINIMUM BEARING LENGTH:

LOADING	MIN. LENGTH (mm)
MASONRY ONLY	150

3.LINTELS MAY NOT SPAN FURTHER THAN 3m UNLESS APPROVED METHOD OF CONSTRUCTION IS USED.

4.LINTELS TO HAVE AT LEAST 5 LAYERS OF BRICKWORK ABOVE IT WITH BRICKFORCE AS PER MASONRY NOTES.

5.LINTELS TO BE ADEQUATELY SUPPORTED FOR AT LEAST 7 DAYS AFTER COMPLETION.

PRESTRESSED CONCRETE:

1.PRECAST CONCRETE WORKS SHOULD BE CARRIED OUT IN ACCORDANCE WITH SANS 1200 GE ***OR SANS 2001 - CC1***(LATEST REVISION)

2.PRECAST FORMED AND FLOATED SURFACES SHALL BE TO DEGREE OF ACCURACY I.

3.THE CONTRACTOR SHALL SUBMIT A DETAILED METHOD STATEMENT FOR APPROVAL BY THE ENGINEER FOR THE INSTALLATION OF ANY PRECAST ELEMENTS THAT MAY FORM PART OF THE WORKS.

REINFORCEMENT

1.ALL REINFORCEMENT SHALL COMPLY WITH SANS 920, TYPE C, CLASS 2 GRADE 1.

2.BAR DESIGNATION IS AS FOLLOWS :
'R' = 250MPa YIELD STRENGTH PLAIN ROUND MILD STEEL BARS
Y = GRADE 450MPa YIELD STRENGTH DEFORMED TYPE 2 HIGH YIELD BARS

3.WIRE MESH SHALL BE WELDED WIRE FABRIC REINFORCEMENT SMOOTH ROUND BARS MINIMUM PROOF STRESS 485MPa COMPLYING WITH THE REQUIREMENTS OF SANS 1024.

4.REINFORCING BARS ARE CALLED UP ON DRAWINGS IN THE FOLLOWING MANNER :
NO. OFF : BAR TYPE : BAR DIAMETER - BAR MARK - PITCH : POSITION AND/OR COMMENTS
E.G. 7 Y20 03 - 200 B1

5.POSITION/COMMENT IS DESIGNATED AS FOLLOWS :
T = TOP FACE B = BOTTOM FACE
NF = NEAR FACE FF = FAR FACE
EW = EACH WAY EF = EACH FACE
AB = ALTERNATE BARS ABR = ALTERNATE BARS REVERSED
AP = ALTERNATIVELY PLACED
AS = ALTERNATIVELY STAGGERED
STG = BARS STAGGERED BY AMOUNT SHOWN.
ALT = ALTERNATING
SUFFIX 1,2 INDICATES THE LAYER WITH 1 BEING CLOSEST TO THE CONCRETE SURFACE WHERE TWO BAR MARKS ARE CALLED UP TOGETHER AND IDENTIFIED AS 'ALT' THE SPACING STATED IS THE SPACING OF ALL BARS, NOT OF EACH BAR MARK
E.G. 5 Y25 03 - 125T ALT 6 Y20 02 INDICATES 11 BARS AT 125 CENTRES IN THE TOP FACE.

REINFORCEMENT (CONT.)

6.SYMBOLS DENOTING LAYERS OF REINFORCEMENT IN SLABS AND BASES ARE SHOWN IN FIGURE 1 BELOW:

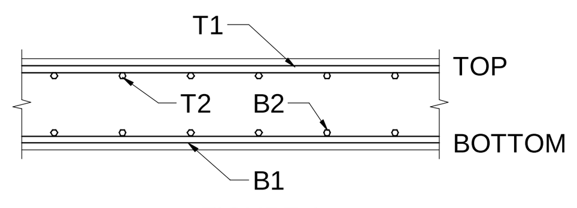

FIGURE 1

7.MINIMUM LAP LENGTH TO REINFORCING TO BE 50 X SMALLER DIAMETER BAR, AND MINIMUM ANCHORAGE LENGTH TO BE 40 X THE BAR DIAMETER UNLESS NOTED OTHERWISE.

8.SPLICES SHALL BE AVOIDED AT POINTS OF MAXIMUM STRESS AND ALL SPLICES SHALL BE STAGGERED.

9.COUPLERS MAY BE PROPOSED WHERE SITE CONSTRAINTS PREVENT THE ACHIEVEMENT OF FULL LAP LENGTHS. WHERE COUPLERS ARE USED THEY ARE TO BE POSITIONED SO AS TO ACHIEVE THE SAME NOMINAL COVER AS THAT SPECIFIED FOR THE REINFORCING BARS WHICH THEY JOIN. THE USE OF COUPLERS IS SUBJECT TO THE APPROVAL OF THE ENGINEER.

10.WELDING OF REINFORCEMENT IS NOT ALLOWED UNLESS APPROVED BY ENGINEER IN WRITING.

11.FABRIC REINFORCEMENT IS CALLED UP ON THE DRAWINGS BY REFERENCE TO ITS SANS REFERENCE, AND BY INDICATION OF THE AREA TO BE REINFORCED.

12.FOR FABRIC REINFORCEMENT OTHER THAN SQUARE MESH FABRIC, THE DIRECTION OF THE MAIN LONGITUDINAL BARS SHALL BE AS SHOWN ON THE DRAWINGS.

13.ALL LAPS TO FABRIC REINFORCEMENT SHOULD BE A MINIMUM OF 450MM.

14.SPACERS, TIES AND STOOLS SHALL BE SUPPLIED AND FIXED BY THE CONTRACTOR AS NECESSARY TO SECURE THE REINFORCEMENT AGAINST DISPLACEMENT. CONCRETE COVER BLOCKS MUST BE MANUFACTURED FROM CONCRETE WITH THE SAME STRENGTHS AS THE UNITS IN WHICH IT IS INCORPORATED.

15.CARE SHOULD BE TAKEN TO ENSURE THAT THE MINIMUM CONCRETE COVER OVER REINFORCEMENT IS ACHIEVED THROUGHOUT.

16.PULL OUT BAR REINFORCEMENT MAY NOT BE USED UNLESS WRITTEN CONFORMATION IS GIVEN BY THE ENGINEER.

17.ALL REINFORCEMENT IS TO BE APPROVED BY THE ENGINEER BEFORE CONCRETE IS CAST.

18.THE FOLLOWING ESTIMATED REBAR QUANTITIES SHALL BE ALLOWED FOR:

ELEMENT	REINFORCEMENT MASS (kg/m³)
BASES	90
COLUMNS	150
BEAMS	120
SLABS	90
RETAINING WALLS	120

FOUNDATIONS

1.EXCAVATIONS, FOUNDING CONDITIONS AND LEVELS TO BE APPROVED BE APPROVED BY ENGINEER PRIOR TO CASTING BLINDING.

2.THE MINIMUM DEPTH TO BOTTOM OF FOUNDATION SHALL NOT BE LESS THAN ***400mm*** DEEP BELOW UNFINISHED GROUND LEVEL.

3.ANY OVER EXCAVATIONS BELOW FOUNDATIONS ARE TO BE MADE GOOD WITH 10MPa CONCRETE AT THE CONTRACTORS EXPENSE.

4.UNLESS OTHERWISE SPECIFIED ALL FILL UNDER FOUNDATIONS SHALL BE AN APPROVED MATERIAL COMPACTED TO 98% MOD AASHTO.

5.PROVIDE 50mm BLINDING UNDER ALL COLUMN AND WALL BASES.

6.DESIGN ALLOWABLE BEARING CAPACITIES:- FOUNDATIONS ON INSITU ROCK OR
RCC: 400kPa
OTHER FOUNDATIONS: 150 kPa

7.NO BACKFILL MATERIAL TO BE BROUGHT ONTO SITE WITHOUT WRITTEN APPROVAL FROM THE ENGINEER.

8.BACKFILLING OVER COLUMN BASES SHALL BE DONE WITH AN APPROVED MATERIAL COMPACTED IN LAYERS.

9.BACKFILL AROUND COLUMNS AND WALLS TO COMMENCE EVENLY.

10.COMPACTION TEST RESULTS OF IN SITU MATERIAL UNDER STRUCTURES TO CONFIRM ALLOWABLE BEARING CAPACITY, TO BE SUBMITTED AND APPROVED BY THE ENGINEER BEFORE CONCRETE WORKS COMMENCES.

PROPRIETARY EXPANSION JOINTS AND ANCHORS

1.ALL EXPANSION JOINTS AND CHEMICAL TYPE ANCHORS FOR FIXING INTO CONCRETE AND MASONRY TO BE INSTALLED STRICTLY TO MANUFACTURERS SPECIFICATION.

2.ALL EXPANSION AND CHEMICAL ANCHORS TO BE HOT DIP GALVANISED.

LIQUID RETAINING STRUCTURES

1.ALL CONCRETE SHALL BE MADE WITH ORDINARY PORTLAND CEMENT WITH 30% FLY ASH OR SIMILAR APRROVED CEMENT EXTENDER .

2.WATER:CEMENT RATIO NOT TO EXCEED 0.50.

3.CEMENT CONTENT 325 kg/m³ - 450 kg/m³

4.NO OPEN FERRELS ARE PERMITTED. ALL SHUTTERS TO BE SUPPORTED USING AN APPROVED EMBEDDED BOLT SYSTEM.

WATERPROOFING

1.ALL WATERPROOFING AND TANKING TO BE CARRIED OUT TO MANUFACTURER'S SPECIFICATIONS AND ENGINEER'S DETAILS.

MASONRY

1.ALL MASONRY WORK SHALL BE IN ACCORDANCE WITH SANS 10164, SANS 10400K ***OR SANS 2001-CM1***.

2.REFER TO ARCHITECT'S DRAWINGS FOR MASONRY WALL LAYOUTS.

3.THE FOLLOWING BRICK AND MORTAR STRENGTHS SHALL APPLY:

	MASONRY COMPRESSIVE STRENGTH (MPa)	MORTAR CLASS (SANS 0164)
RETAINING WALLS & MASONRY BELOW GL	14	CLASS I
LOAD BEARING WALLS	14	CLASS I
PANEL WALLS IN RC FRAME	7	CLASS II

4.GALVANISED BUTTERFLY WALL TIES TO SANS 28 WITH A WIRE THICKNESS OF 3.15mm ARE TO BE PROVIDED IN CAVITY WALLS AS FOLLOWS (NO SINGLE STRAND TYPE WALL TIES WILL BE PERMITTED):

WALL TYPE	NUMBER OF TIES
GROUTED CAVITY WALLS	4/m²
CAVITY WALLS	3/m²
WITHIN 230mm EITHER SIDE OF VERTICAL CONTROL JOINT IN THE OUTER SKIN OF A CAVITY WALL	VERTICAL ROW OF TIES AT 250mm c/c (EVERY THIRD COURSE)
CAVITY WALLS ON SUSPENDED SLABS AND BEAMS	EVERY 500mm FOR FIRST TWO COURSE AND CONTINUE AS ABOVE THEREAFTER

EACH TIE SHALL BE EMBEDDED AT LEAST 50mm INTO THE MORTAR JOINT OF EACH LEAF.

5.GALVANISED BRICKFORCE IS TO BE PROVIDED AS FOLLOWS: ALL BRICKFORCE TO BE SABS APPROVED. READ IN CONJUNCTION WITH NOTE 6.

WALL TYPE	BRICKFORCE QUANTITY
MASONRY FOUNDATION WALLS BELOW DPC	EVERY COURSE
MASONRY WALLS IN GENERAL	EVERY 4th COURSE
CEMENT BLOCKS (THROUGHOUT)	EVERY 2nd COURSE
WALLS WITH OPENINGS	FIRST 5 COURSES ABOVE AND WHERE APPLICABLE BELOW OPENINGS, CONTINUING 600mm PAST OPENINGS
CONTROL JOINTS	CONTINUOUS THROUGH CONTOL JOINT
WALLS ON SUSPENDED SLABS AND BEAMS	IN EACH COURSE FOR THE FIRST THREE COURSES AND CONTINUE AS ABOVE THEREAFTER

MINIMUM DIAMETER OF BRICKFORCE: 3.55mm
YIELD STRENGTH: 485MPa
LAP LENGTH: 400mm

6.PROVIDE DPC LAYER AS BOND BREAKER BETWEEN CONCRETE AND FIRST COURSE OF BRICKWORK.

7.WALLS BUILT ON SUSPENDED RC SLABS/BEAMS: ALL TEMPORARY PROPS TO HAVE BEEN REMOVED PRIOR TO COMMENCEMENT OF BRICKWORK. PROVIDE GALVANISED BRICKFORCE TO THE BOTTOM THREE COURSES AND AS PER NOTE 5 THEREAFTER. PRE LOAD THE FLOOR SLAB WITH BRICKS PRIOR TO BUILDING THE WALL.

8.BRICK PANEL WALLS TO BE ANCHORED TO RC COLUMNS WITH GALVANISED HOOP IRON ANCHORS (1.2x30mm CROSS SECTION), FIXED TWICE TO THE COLUMN EVERY 4TH COURSE AND BUILT 700 mm INTO BRICKWORK. PROVIDE 10 mm JOINTEX BETWEEN BRICKWORK AND COLUMN.

9.PROVIDE A SKIMMED MORTAR FINISH AND TWO LAYERS OF 250 MICRON DPC AS A SLIP JOINT TO THE TOPS OF ALL LOADBEARING BRICK WALLS PRIOR TO CASTING OF SLAB.

10.PROVIDE A 10 mm SOFT JOINT (JOINTEX) BETWEEN THE TOP OF ALL NON LOADBEARING BRICK PANEL WALLS AND THE SOFFIT OF CONCRETE STRUCTURE ABOVE.

11.HEIGHT OF BRICKWORK ERECTED IN 24 HOURS NOT TO EXCEED 10 BRICK COURSES.

12.NO HORIZONTAL CHASING OF SERVICES IN WALLS WILL BE PERMITTED.

13.NO BRICK WALLS ARE TO BE FOUNDED ON THE SURFACE BED WITHOUT WRITTEN CONSENT FROM THE ENGINEER.

STEELWORK

1.ALL STRUCTURAL STEELWORK SHALL BE IN ACCORDANCE WITH SANS 1200H ***OR SANS 2001 - CS1*** WHERE APPLICABLE.

2.THE CONTRACTOR SHOULD CHECK THAT THE ENGINEERS DRAWING CONTAINS ALL THE INFORMATION REQUIRED FOR THE PREPERATION OF THE WORKSHOP DRAWING AS SOON AS POSSIBLE.

3.WORKSHOP DRAWINGS TOGETHER WITH SUPPORTING CALCULATIONS TO BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR TO FABRICATION. APPROVAL PROCESS WILL TAKE A MINIMUM OF 10 WORKING DAYS

4.MATERIALS SPECIFIED ON SHOP DRAWINGS MUST CORRESPOND WITH MATERIALS STATED ON ENGINEER'S DRAWINGS AND APPLICABLE SPECIFICATIONS.

5.STEEL GRADES:

PRODUCTION METHOD	STEEL GRADE
HOT FORMED HOLLOW SECTIONS	S355JR
HOT ROLLED SECTIONS (SANS 1431)	S355JR
COLD FORMED STEEL SECTIONS	MIN. 200 MPa YIELD STRENGTH
HOLLOW SECTIONS	S355JR
PLATES AND FLATS	S355JR

6.ALL WELDING SHALL BE IN ACCORDANCE WITH SANS 10044.

7.ALL WELDS ARE TO BE DESIGNED TO GIVE FULL MEMBER STRENGTH AND TO BE MINIMUM 6mm FILLET WELD TO GRADE E70XX, UNLESS SPECIFIED OTHERWISE.

8.ALL INTERSECTIONS TO BE WELDED CONTINUOUS ALL ROUND.

9.NO SITE WELDING IS PERMITTED.

10.ALL WELDING TO BE CARRIED OUT UNDER SUPERVISION OF A CODED WELDER AND BY A SUITABLY EXPERIENCED AND TRAINED WELDER. ALL WELDS TO BE CERTIFIED BY THE CODED WELDER .

11.DETAILS OF WELDING CONSUMABLES AND CERTIFICATES TO BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

12.ALL WELDS MUST BE VISUALLY INSPECTED AND 10% OF ALL WELDS MUST BE CRACK TESTED USING DYE INDICATORS OR ANY OTHER TEST APPROVED BY THE ENGINEER.

13.ALL BOLTED CONNECTIONS ARE TO BE DESIGNED TO SANS 10162.

14.ALL BOLTS TO BE GRADE 8,8 UNLESS NOTED OTHERWISE. ALL BOLTS TO BE HOT DIP GALVANISED.

15.ALL BOLTS TO RECEIVE WASHERS WITH MATERIAL OF WASHER TO MATCH MATERIAL OF BOLTS. EG. HOT DIP GALVANISED BOLT TO HAVE HOT DIP GALVANISED WASHER.

16.ALL BOLTED CONNECTIONS TO CONSIST OF MINIMUM 2M16 GRADE 8.8 BOLTS UNLESS SPECIFIED OTHERWISE.

17.ALL HOLDING DOWN BOLTS TO BE MINIMUM M16 AND HOT DIP GALVANISED.

18.ALL GUSSET PLATES ARE TO BE MIN. 6mm THICK UNLESS NOTED OTHERWISE.

19.PROVIDE 60MPa NON-SHRINK STRUCTURAL GROUT BELOW ALL BASE PLATES.

20.ALL MECHANICAL AND ELECTRICAL SUPPORTS ON TRUSSES TO BE AT NODE POINTS OR AS AGREED WITH THE ENGINEER.

21.CONNECTIONS TO PURLINS FOR MECHANICAL AND ELECTRICAL SUPPORTS WILL ONLY BE MADE BY BOLTING TO THE WEB OF THE PURLIN MAXIMUM LOAD 25kg.

22.ALL FIXINGS TO ROOF STEELWORK TO BE APPROVED BY THE ENGINEER.

23.ALL RUNNERS AND BRACING TO BE FULLY FIXED IN POSITION BEFORE SHEETING COMMENCES.

24.ALL CORROSION PROTECTION SHALL BE BE DONE IN ACCORDANCE WITH SANS 1200 HC.

25.ALL STRUCTURAL STEEL BELOW GROUND LEVEL, CAST INTO CONCRETE OR BUILT INTO BRICKWORK, SHALL BE PAINTED WITH TWO COATS OF BITUMEN.

26.SURFACE PREPARATION OF STRUCTURAL STEELWORK:
- SANDBLAST ALL NEW STEELWORK TO A MINIMUM SA 2.5 IN ACCORDANCE WITH SWEDISH SIS 055900-1967.

27.ALL STEELWORK THAT IS SPECIFIED TO BE HOT DIPPED GALVANISED SHALL BE HOT DIPPED GALVANISED FOR EXPOSURE CLASS C3 IN ACCORDANCE TO SANS 121.

28.WHERE PAINTED FINISH IS SPECIFIED ON GALVANISED STEEL, DEGREASE WITH GALVANISED IRON CLEANER AND 3M SCOTCH BRITE PADS AND RINSE WITH FRESH WATER PRIOR TO APPLICATION OF PRIMER COAT.

STEELWORK (CONT.)

29.NO ALKYD PRIMERS ON GALVANIZING.
ALL STEELWORK SPECIFIED TO BE PAINTED SHALL BE PAINTED AS FOLLOWS:
- PRIMER: STEELWORK TO BE PAINTED ONE COAT OF EPOXY ZINC PHOSPHATE PRIMER, (85 microns DTF).
- INTERMEDIATE COAT: STEELWORK TO BE PAINTED WITH ONE COAT OF POLYAMIDE EPOXY M10, (125 microns DTF).
- TOP COAT: STEELWORK TO BE SPRAY PAINTED WITH ONE COAT ACRYLIC POLYURETHANE (60 microns DTF).

30.FINAL COLOUR FOR APPROVAL.

31.PAINT DFT TO BE TESTED USING A PAINT THICKNESS GAUGE.

32.NO CUTTING, DRILLING OR WELDING OF CORROSION PROTECTED MEMBERS SHALL BE ALLOWED.

33.ALL PAINTWORK DAMAGED DURING ERECTION AND TRANSPORTATION TO BE TOUCHED UP TO ABOVE SPEC.

REINFORCED MASONRY CONSTRUCTION:

1.CAVITIES IN REINFORCED MASONRY WALLS TO BE GROUTED UP WITH 25 MPa/10mm CONCRETE IN MAXIMUM LIFTS OF 450mm AS BRICK LAYING PROCEEDS.

2.CAVITIES TO BE CLEAR OF MORTAR DROPPINGS AND PROVIDED WITH WALLS TIES IN ACCORDANCE WITH MASONRY NOTES.

3.MINIMUM GROUT COVER TO REINFORCEMENT = 20mm.

TIMBER STRUCTURES

1.ALL STRUCTURAL TIMBERWORK TO BE DONE IN ACCORDANCE WITH SANS 2001-CT1 AND SANS 2001-CT2

2.TIMBER STRUCTURES TO BE MANUFACTURED STRICTLY IN ACCORDANCE WITH ENGINEER'S DRAWINGS.

3.WORKSHOP DRAWINGS TO BE SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR TO FABRICATION.

4.TIMBER GRADE AND SIZING AVAILABILITY SHALL BE CHECKED BEFORE COMMENCEMENT OF FABRICATION OF TIMBER STRUCTURES. ANY POSSIBLE PROCUREMENT ISSUES SHALL BE REPORTED TO THE ENGINEER BEFORE ORDERING.

5.EXTERNAL TIMBER MEMBERS SHALL BE PLANED ALL ROUND (PAR).

6.ALL BOLT HOLES TO BE DRILLED A MAXIMUM OF 1mm LARGER THAN THE BOLT DIAMETER.

7.BOLTS AND COACH SCREWS CONNECTING DIRECTLY TO TIMBER WITHOUT STEEL BRACKETS TO BE FITTED WITH HOT DIPPED GALVANISED STEEL WASHERS AS FOLLOWS:

COACH SCREW/BOLT SIZE	WASHER SIZE (ØxTHICKNESS)
M6	Ø20x2mm
M8	Ø35x4mm
M10	Ø35x4mm
M12	Ø35x4mm
M16	Ø60x6mm
M20	Ø60x6mm

8.COACH SCREWS SHALL BE SCREWED IN AND UNDER NO CIRCUMSTANCESSHALL COACH SCREWS BE DRIVEN IN WITH A HAMMER.

9. ALL BOLTS, COACH SCREWS AND NAILS SHALL BE HOT DIP GALVANISED.

10.ALL CONNECTING BRACKETS AND PLATES TO BE HOT DIPPED GALVANISED AFTER FABRICATION.

11.SURFACE PREPARATION:
- ENSURE THAT ALL SURFACES ARE CLEAN, DRY AND FREE OF ANY OIL, GREASE OR OTHER CONTAMINANTS.
- SAND WITH 150 GRIT SANDING PAPER IN DIRECTION OF GRAIN.
- REMOVE DUST WITH A DAMP CLOTH.
- APPLY KNOT SEAL TO ALL KNOTS.

12.PROTECTIVE COATING SHALL BE AN APPROVED PENETRATING OIL BASED COATING FOR WATERPROOFING AND PROTECTION OF THE TIMBER APPLIED AS FOLLOWS:
a. APPLY TWO COATS WITH A BRUSH BEFORE INSTALLATION OF TIMBER MEMBERS.
b. APPLY TWO COATS AFTER INSTALLATION OF TIMBER MEMBERS WITH A ONE DAY INTERVAL BETWEEN APPLICATIONS.

13.PROTECTIVE COATING COLOUR AS PER ARCHITECTS SPECIFICATIONS.

14.TIMBER MEMBERS BUILT INTO BRICKWORK TO BE GIVEN TWO COATS OF DURAM 195 OR SIMILAR AND WRAPPED IN DPC.

15.TIMBER STRUCTURES TO BE SIGNED OFF BEFORE ROOF COVERING OR DECKING MAY BE INSTALLED.

ISSUED FOR TENDER

ALL DIMENSIONS AND LEVELS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR BEFORE COMMENCING ANY WORK.

ON ORIGINAL
0 5 10 15 20 25 30 40 50MM

GENERAL NOTES

No	Date	Details	Chkd	Appd
A	30/06/21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI
Drawn By: W.BOLTMAN
Designed By: D VAN WIERINGEN
Reviewed By: M.HOLMES

Project: **GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5**

Description: **ABSTRACTION WORKS**
GENERAL NOTES

Scale: NTS
Date: 30/06/21

Project No: J40044
Drg. No: 304
Rev: A

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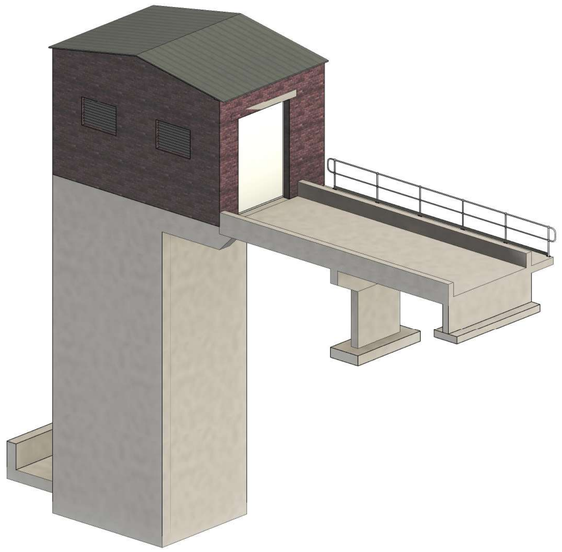
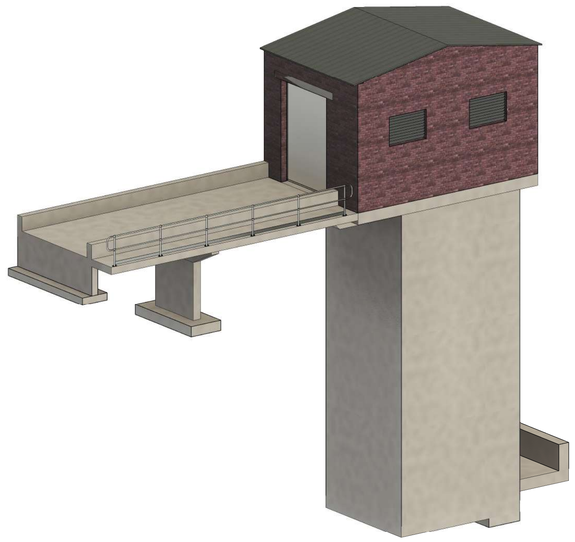


3D VIEW 1

SCALE:



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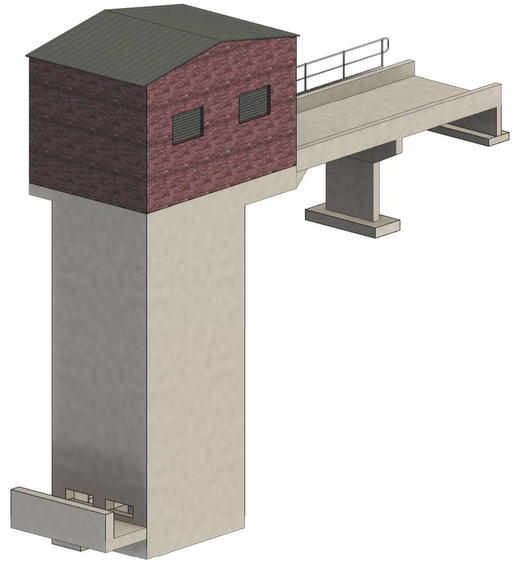

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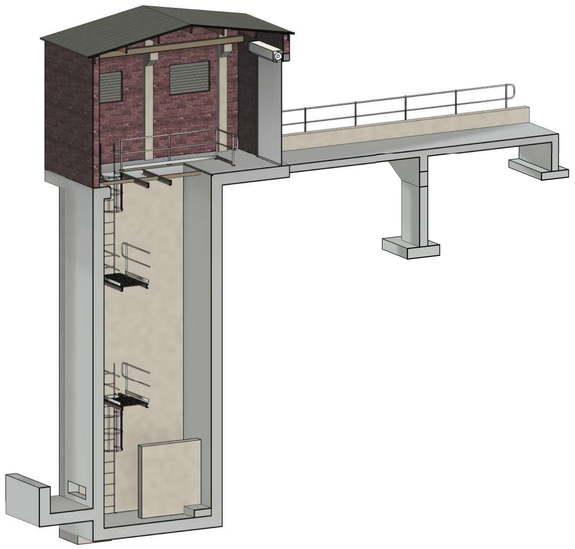

3D VIEW 4

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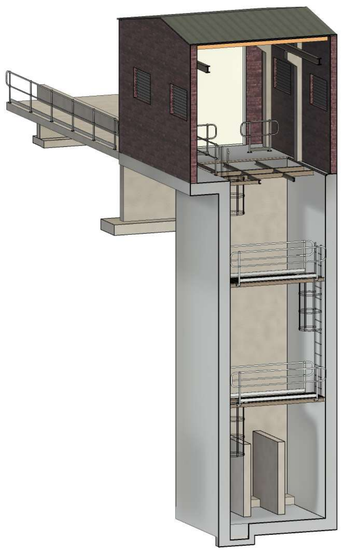

3D VIEW 5

SCALE:

ISSUED FOR TENDER

ON ORIGINAL

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GENERAL NOTES

No	Date	Details	Chkd	Appd
A	30/06/21	ISSUED FOR TENDER	MH	NM

Revisions

Client

HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By	Designed By	Reviewed By
W.BOLTMAN	D.VAN WIERINGEN	M.HOLMES

Project

GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

Description

ABSTRACTION WORKS

3D VIEWS

Scale	Date
NTS	30/06/21

Project No	Drg. No	Rev
J40044	305	A

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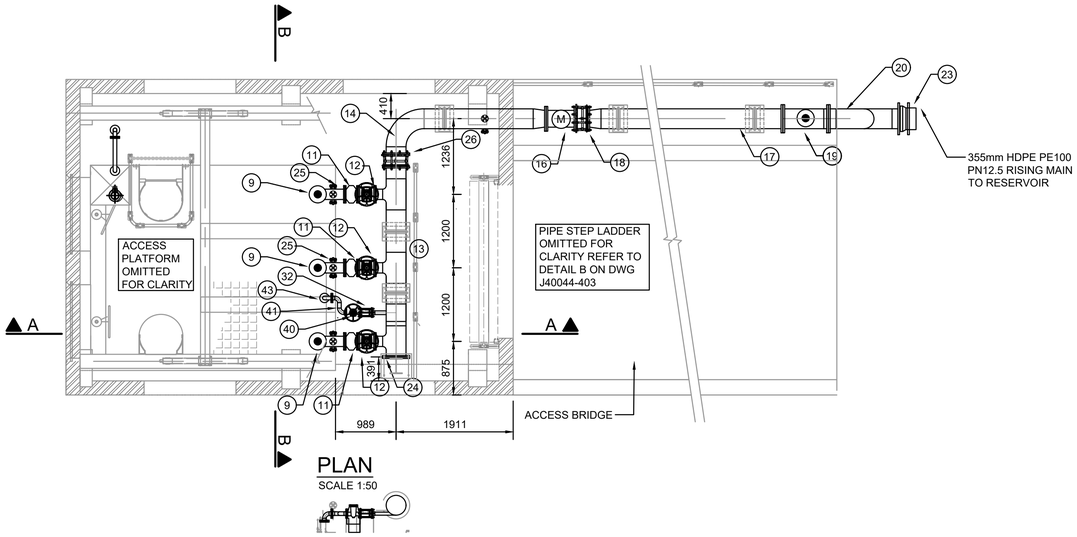
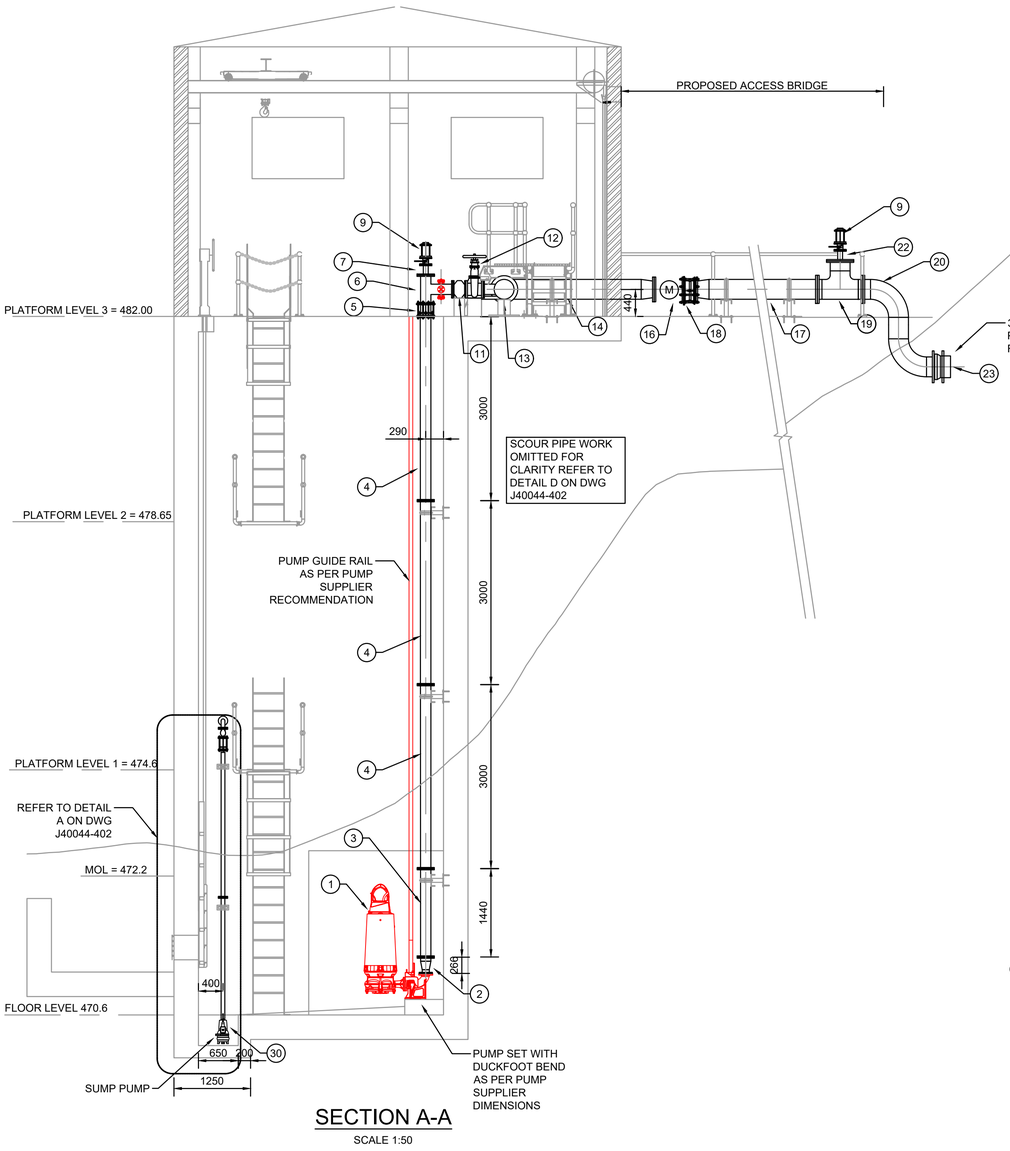
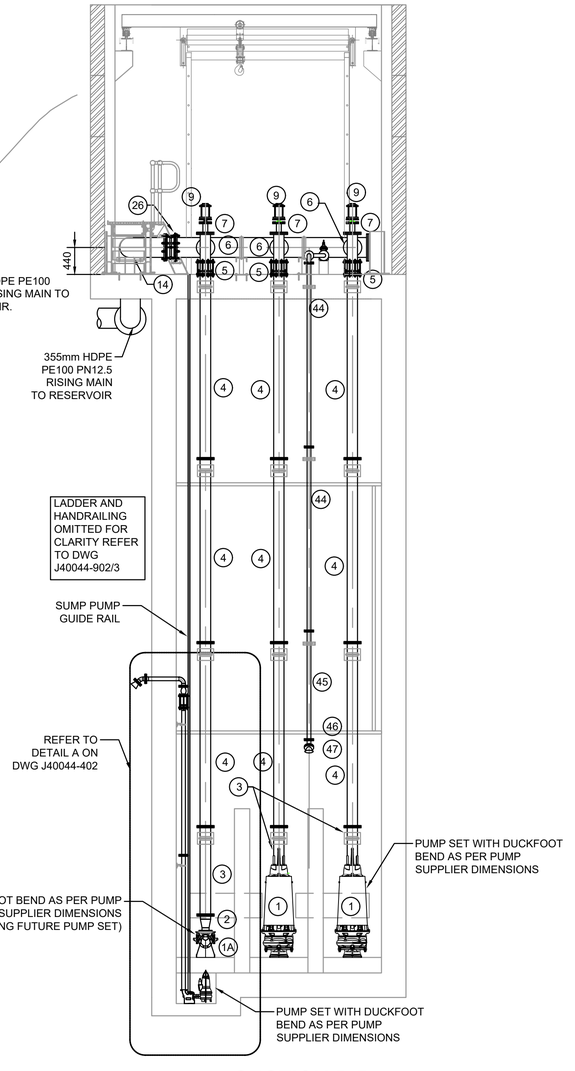


PLAN
SCALE 1:50



SECTION A-A
SCALE 1:50



SECTION B-B
SCALE 1:50

PIPEWORK NOTES:

1. ALL STEEL PIPES & FITTINGS DN150 AND SMALLER TO BE MINIMUM MEDIUM DUTY TO SABS 62 UNLESS OTHERWISE SPECIFIED.
2. ALL STEEL PIPES & FITTINGS LARGER THAN DN150 TO HAVE EITHER A MINIMUM 4.5mm WALL THICKNESS TO SABS 719 GRADE B OR TO HAVE A DIAMETER TO THICKNESS RATIO OF 125, WHICHEVER IS THE GREATER
3. SURFACE PREPARATION FOR APPLICATION OF CORROSION PROTECTION MATERIALS SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS.
4. ALL WELDED FITTINGS & FLANGES TO BE DOCUMENTED AS PER SPECIFICATIONS & WELDERS MUST BE QUALIFIED TO WQR. ALL WELDS MUST BE 100% VISUALLY INSPECTED INSIDE & OUT AND 100% DYE PENETRANT INSPECTED BEFORE GALVANISING.
5. ALL WELDING SHALL CONFORM TO SABS 0167-1984 AND SABS 044 SPECIFICATIONS.
6. ALL FLANGES TO BE MANUFACTURED & DRILLED TO SABS 1123
7. ALL THREADS TO BE BRITISH STANDARD PIPE(BSP) THREADS.
8. ALL STEEL PIPES & FITTINGS SMALLER THAN DN50 SHALL BE HOT DIPPED GALVANISED TO ISO 1461 : 2009 WITH A COATING NO LESS THAN 700 g/m² OR THICKNESS OF 80 MICRONS.
9. ALL STEEL PIPES & FITTINGS SMALLER THAN DN350 BUT LARGER THAN DN 50 TO BE FBE COATED AND LINED TO MINIMUM THICKNESS OF 350 MICRON
10. ALL STEEL PIPES & FITTINGS DN350 AND LARGER TO BE EPOXY COATED AND LINED WITH A MINIMUM DRY FILM THICKNESS OF 450 MICRONS UNLESS OTHERWISE SPECIFIED IN THE SPECIFICATIONS
11. ALL BURIED STEEL PIPES CAST THROUGH CONCRETE WALLS, REGARDLESS OF DIAMETER, TO BE WRAPPED WITH DENSO STEELCOAT 500, OR SIMILAR APPROVED AND WRAPPING TO EXTEND 100mm FROM INNER AND OUTER FACES OF CONCRETE UNLESS OTHERWISE SPECIFIED.
12. ALL STEEL PIPES CAST IN CONCRETE SHALL BE POSITIONED WITH OUTER SURFACE NO CLOSER THAN 25mm TO ANY REINFORCING OR OTHER STEEL IN THE CONCRETE.
13. ALL STEEL COMPONENTS, BOLTS, NUTS & WASHERS TO BE HOT DIP GALVANISED TO ISO 1461 : 2009 UNLESS OTHERWISE SPECIFIED IN THE SPECIFICATIONS.
14. ALL BOLTED CONNECTIONS TO HAVE WASHERS UNDER BOTH THE HEAD OF THE BOLT AND THE NUT.
15. ALL BURIED FITTINGS AND PIPES TO BE PROTECTED BY "DENSO" PETROLATUM SYSTEM INCLUDING MASTIC PROFILING PUDDY, PETROLATUM TAPE AND ULTRA FLEX PSA 180 TAPE INSTALLED TO MANUFACTURERS SPECIFICATIONS.
16. ALL GMS NUTS, BOLTS, WASHERS, THREADED BARS AND ALL OTHER GMS OR UNCOATED METAL SURFACES, IN EXPOSED SITUATIONS, SHALL, AFTER SUCCESSFUL PRESSURE- TESTING AND AFTER THOROUGH BRUSHING / CHIPPING TO REMOVE CONCRETE SPLATTER ETC, DE-GREASING AND DETERGENT CLEANING AND CLEAN WATER RINSING, SHALL BE COMPLETELY AND GENEROUSLY HAND-PAINT COATED BY AN APPROVED HEAVY-DUTY, SELF-HEALING, SURFACE TOLERANT, FLEXIBLE POLYMER-MODIFIED WAX CORROSION-INHIBITOR SUCH AS 'CHESTERTON 740 HEAVY DUTY RUST GUARD'
17. ALL DIMENSIONS IN MILLIMETRES.
18. ALL PIPEWORKS & FITTINGS TO BE MEASURED & CHECKED ON SITE PRIOR TO INSTALLATION AND ADVISE THE ENGINEER OF ANY DISCREPANCIES PRIOR TO FABRICATION.
19. 2 STRIPS OF NEOPRENE 25 OR AN APPROVED RUBBER OF ONE LAYER BETWEEN 2mm AND 5mm TO BE PLACED BETWEEN THE PIPEWORK AND SUPPORTS.
20. WHERE PIPE SUPPORTS ARE CAST INSITU, DENSO STEELCOAT 500, OR SIMILAR APPROVED, IS TO BE USED AT INTERFACE WITH PIPES AND VALVES. WRAPPING TO EXTEND 100mm FROM EDGE SUPPORT.
21. IF THE PIPELINE HAS CATHODIC-PROTECTION, THE FIRST EXPOSED FLANGED JOINT SHALL BE FITTED WITH AN INSULATING GASKET AND BOLT SET, COMPLETE WITH SPARK-GAP DEVICE IN ORDER TO ELECTRICALLY-INSULATE THE CHAMBER PIPEWORK FROM THE PROTECTED PIPELINE OUTSIDE.
22. DAMAGED COATINGS AND LININGS SHALL BE REPAIRED IN ACCORDANCE WITH THE SPECIFICATIONS.
23. COLLARS, WRAPPERS AND CROTCH PLATES ARE TO BE MANUFACTURED FROM A MINIMUM OF SABS 719 GRADE B STEEL, OR OF THE SAME GRADE AS THE MAIN PIPE WHICHEVER HAS THE HIGHER YIELD STRESS STRENGTH AND WELDED IN ACCORDANCE WITH THE SPECIFICATIONS
24. PIPE SUPPORT POSITIONS TO BE DETERMINED ON SITE AND APPROVED BY ENGINEER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

LABELS

ME	- MACHINED ENDS
FL	- FLANGE
PE	- PLAIN ENDED
PF	- PUDDLE FLANGE
C/F	- CENTRE TO FACE
D/FL	- DOUBLE FLANGE
C/C	- CENTRE TO CENTRE
F/F	- FACE TO FACE
RF	- RESTRAINING FLANGE

REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION
J40044-402	MAIN PUMPS AND PIPEWORK DETAILS (SHEET 1 OF 2)
J40044-403	MAIN PUMPS AND PIPEWORK DETAILS (SHEET 2 OF 2)
J40044-902	GALVANISED LADDER INTERNAL UP TO 8m HIGH
J40044-903	GALVANISED LADDER EXTERNAL UP TO 8m HIGH

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By	Designed By	Reviewed By
M.FUNNELL	M.FUNNELL	M.HOLMES

Project: **GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5**

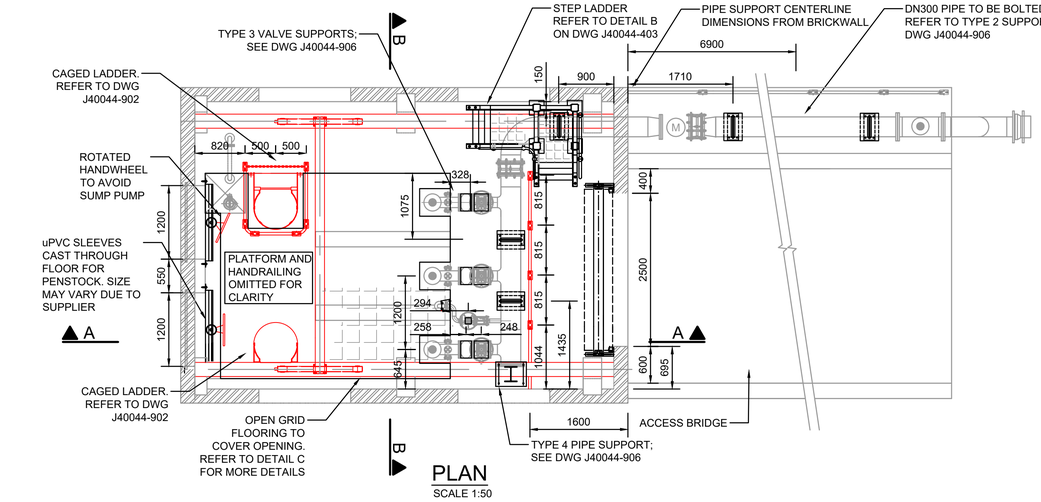
Description: **ABSTRACTION WORKS**

MAIN PUMPS AND PIPEWORK

Scale: AS SHOWN | Date: 26/06/21

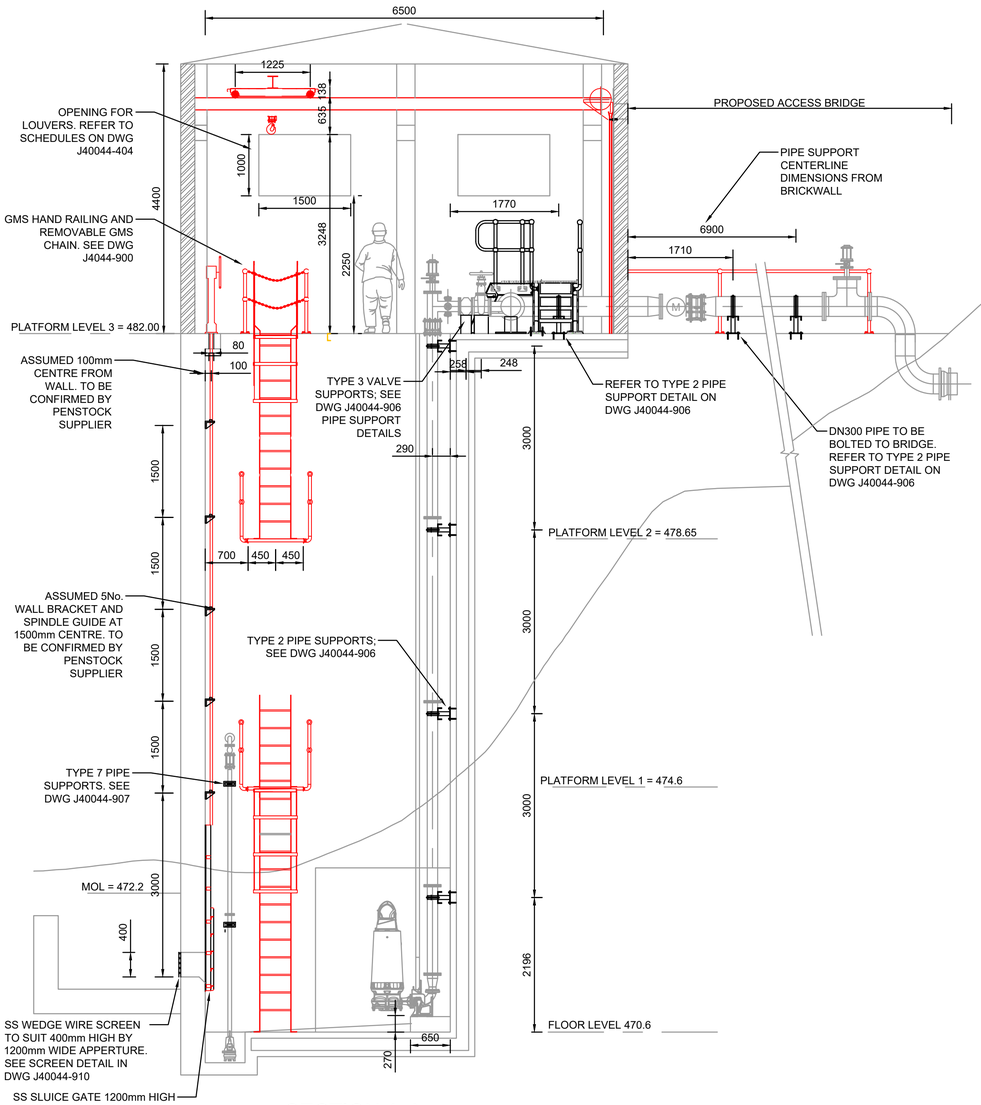
Project No: J40044 / Drg. No: 400 / Rev: A

ISSUED FOR TENDER



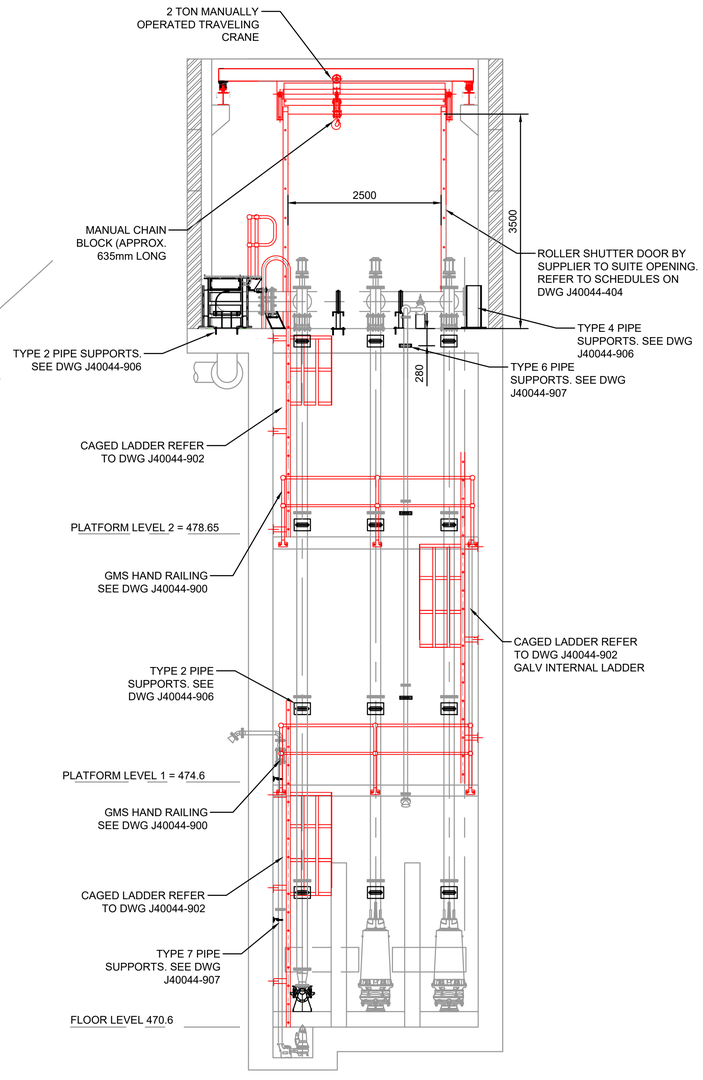
PLAN

SCALE 1:50



SECTION A-A

SCALE 1:50



SECTION B-B

SCALE 1:50

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION
J40044-403	MAIN PUMPS AND PIPEWORK DETAILS (SHEET 2 OF 2)
J40044-404	MAIN PUMPS AND PIPEWORK SCHEDULE
J40044-900	GALVANISED BALL TYPE HANDRAIL, STANCHIONS BASE MOUNTING DETAILS
J40044-902	GALVANISED LADDER INTERNAL UP TO 8m HIGH
J40044-903	GALVANISED LADDER EXTERNAL UP TO 8m HIGH
J40044-906	PIPE SUPPORT DETAIL SHEET 1 OF 2
J40044-907	PIPE SUPPORT DETAIL SHEET 2 OF 2
J40044-910	WEDGE WIRE SCREEN DETAIL

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

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M.FUNNELL	M.FUNNELL	M.HOLMES

Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

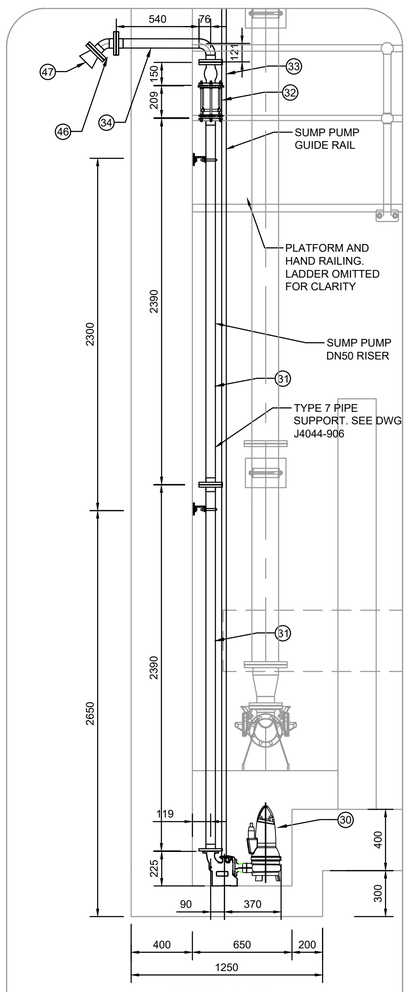
Description: ABSTRACTION WORKS

ANCILLARY CIVIL AND MECHANICAL EQUIPMENT

Scale	Date
AS SHOWN	26/06/21

Project No	Drg. No	Rev
J40044	401	A

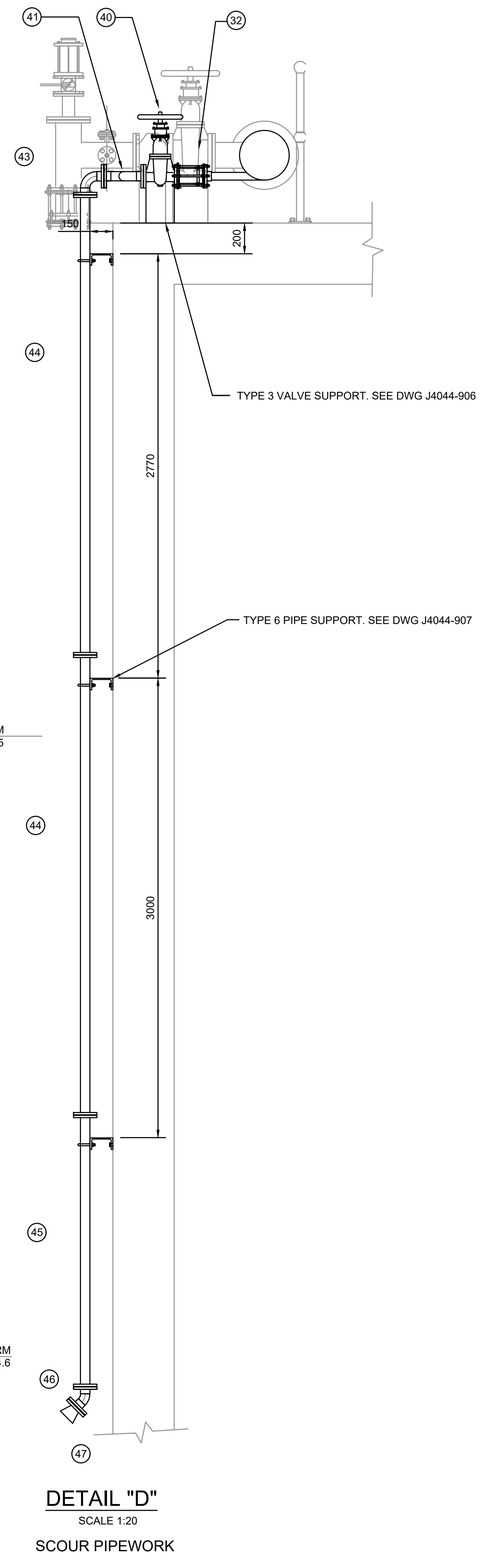
ISSUED FOR TENDER



DETAIL 'A'

SCALE 1:20

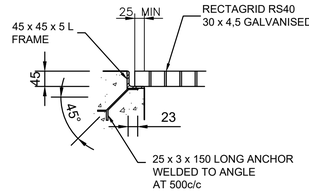
SUMP DELIVERY PIPEWORK



DETAIL "D"

SCALE 1:20

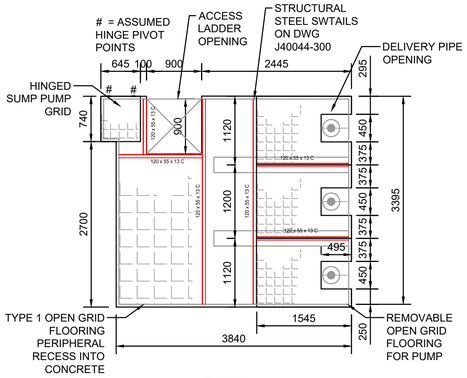
SCOUR PIPEWORK



TYPE 1

DETAILS OF REBATE / RECESS

SCALE 1 : 20



DETAIL'C'

OPEN GRID FLOORING DETAIL

SCALE 1:50

PIPEWORK NOTES:

1. ALL STEEL PIPES & FITTINGS DN150 AND SMALLER TO BE MINIMUM MEDIUM DUTY TO SABS 62 UNLESS OTHERWISE SPECIFIED.
2. ALL STEEL PIPES & FITTINGS LARGER THAN DN150 TO HAVE EITHER A MINIMUM 4.5mm WALL THICKNESS TO SABS 719 GRADE B OR TO HAVE A DIAMETER TO THICKNESS RATIO OF 125, WHICHEVER IS THE GREATER
3. SURFACE PREPARATION FOR APPLICATION OF CORROSION PROTECTION MATERIALS SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS.
4. ALL WELDED FITTINGS & FLANGES TO BE DOCUMENTED AS PER SPECIFICATIONS & WELDERS MUST BE QUALIFIED TO WQR. ALL WELDS MUST BE 100% VISUALLY INSPECTED INSIDE & OUT AND 100% DYE PENETRANT INSPECTED BEFORE GALVANISING.
5. ALL WELDING SHALL CONFORM TO SABS 0167-1984 AND SABS 044 SPECIFICATIONS.
6. ALL FLANGES TO BE MANUFACTURED & DRILLED TO SABS 1123
7. ALL THREADS TO BE BRITISH STANDARD PIPE(BSP) THREADS.
8. ALL STEEL PIPES & FITTINGS SMALLER THAN DN50 SHALL BE HOT DIPPED GALVANISED TO ISO 1461 : 2009 WITH A COATING NO LESS THAN 700 g/m² OR THICKNESS OF 80 MICRONS.
9. ALL STEEL PIPES & FITTINGS SMALLER THAN DN350 BUT LARGER THAN DN 50 TO BE FBE COATED AND LINED TO MINIMUM THICKNESS OF 350 MICRON
10. ALL STEEL PIPES & FITTINGS DN350 AND LARGER TO BE EPOXY COATED AND LINED WITH A MINIMUM DRY FILM THICKNESS OF 450 MICRONS UNLESS OTHERWISE SPECIFIED IN THE SPECIFICATIONS
11. ALL BURIED STEEL PIPES CAST THROUGH CONCRETE WALLS, REGARDLESS OF DIAMETER, TO BE WRAPPED WITH DENSO STEELCOAT 500, OR SIMILAR APPROVED AND WRAPPING TO EXTEND 100mm FROM INNER AND OUTER FACES OF CONCRETE UNLESS OTHERWISE SPECIFIED.
12. ALL STEEL PIPES CAST IN CONCRETE SHALL BE POSITIONED WITH OUTER SURFACE NO CLOSER THAN 25mm TO ANY REINFORCING OR OTHER STEEL IN THE CONCRETE.
13. ALL STEEL COMPONENTS, BOLTS, NUTS & WASHERS TO BE HOT DIP GALVANISED TO ISO 1461 : 2009 UNLESS OTHERWISE SPECIFIED IN THE SPECIFICATIONS.
14. ALL BOLTED CONNECTIONS TO HAVE WASHERS UNDER BOTH THE HEAD OF THE BOLT AND THE NUT.
15. ALL BURIED FITTINGS AND PIPES TO BE PROTECTED BY "DENSO" PETROLATUM SYSTEM INCLUDING MASTIC PROFILING PUDDY, PETROLATUM TAPE AND ULTRA FLEX PSA 180 TAPE INSTALLED TO MANUFACTURERS SPECIFICATIONS.
16. ALL GMS NUTS, BOLTS, WASHERS, THREADED BARS AND ALL OTHER GMS OR UNCOATED METAL SURFACES, IN EXPOSED SITUATIONS, SHALL, AFTER SUCCESSFUL PRESSURE- TESTING AND AFTER THOROUGH BRUSHING / CHIPPING TO REMOVE CONCRETE SPLATTER ETC, DE-GREASING AND DETERGENT CLEANING AND CLEAN WATER RINSING, SHALL BE COMPLETELY AND GENEROUSLY HAND-PAINT COATED BY AN APPROVED HEAVY-DUTY, SELF-HEALING, SURFACE TOLERANT, FLEXIBLE POLYMER-MODIFIED WAX CORROSION-INHIBITOR SUCH AS 'CHESTERTON 740 HEAVY DUTY RUST GUARD'
17. ALL DIMENSIONS IN MILLIMETRES.
18. ALL PIPEWORKS & FITTINGS TO BE MEASURED & CHECKED ON SITE PRIOR TO INSTALLATION AND ADVISE THE ENGINEER OF ANY DISCREPANCIES PRIOR TO FABRICATION.
19. 2 STRIPS OF NEOPRENE 25 OR AN APPROVED RUBBER OF ONE LAYER BETWEEN 2mm AND 5mm TO BE PLACED BETWEEN THE PIPEWORK AND SUPPORTS.
20. WHERE PIPE SUPPORTS ARE CAST INSITU, DENSO STEELCOAT 500, OR SIMILAR APPROVED, IS TO BE USED AT INTERFACE WITH PIPES AND VALVES. WRAPPING TO EXTEND 100mm FROM EDGE SUPPORT.
21. IF THE PIPELINE HAS CATHODIC-PROTECTION, THE FIRST EXPOSED FLANGED JOINT SHALL BE FITTED WITH AN INSULATING GASKET AND BOLT SET, COMPLETE WITH SPARK-GAP DEVICE IN ORDER TO ELECTRICALLY-INSULATE THE CHAMBER PIPEWORK FROM THE PROTECTED PIPELINE OUTSIDE.
22. DAMAGED COATINGS AND LININGS SHALL BE REPAIRED IN ACCORDANCE WITH THE SPECIFICATIONS.
23. COLLARS, WRAPPERS AND CROTCH PLATES ARE TO BE MANUFACTURED FROM A MINIMUM OF SABS 719 GRADE B STEEL, OR OF THE SAME GRADE AS THE MAIN PIPE WHICHEVER HAS THE HIGHER YIELD STRESS STRENGTH AND WELDED IN ACCORDANCE WITH THE SPECIFICATIONS
24. PIPE SUPPORT POSITIONS TO BE DETERMINED ON SITE AND APPROVED BY ENGINEER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

LABELS

ME	- MACHINED ENDS
FL	- FLANGE
PE	- PLAIN ENDED
PF	- PUDDLE FLANGE
C/F	- CENTRE TO FACE
D/FL	- DOUBLE FLANGE
C/C	- CENTRE TO CENTRE
F/F	- FACE TO FACE
RF	- RESTRAINING FLANGE

REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION
J40044-300	ABSTRACTION WORKS PLAN LAYOUTS
J40044-906	PIPE SUPPORT DETAIL SHEET 1 OF 2
J40044-907	PIPE SUPPORT DETAIL SHEET 2 OF 2

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

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GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By	Designed By	Reviewed By
M.FUNNELL	M.FUNNELL	M.HOLMES

Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

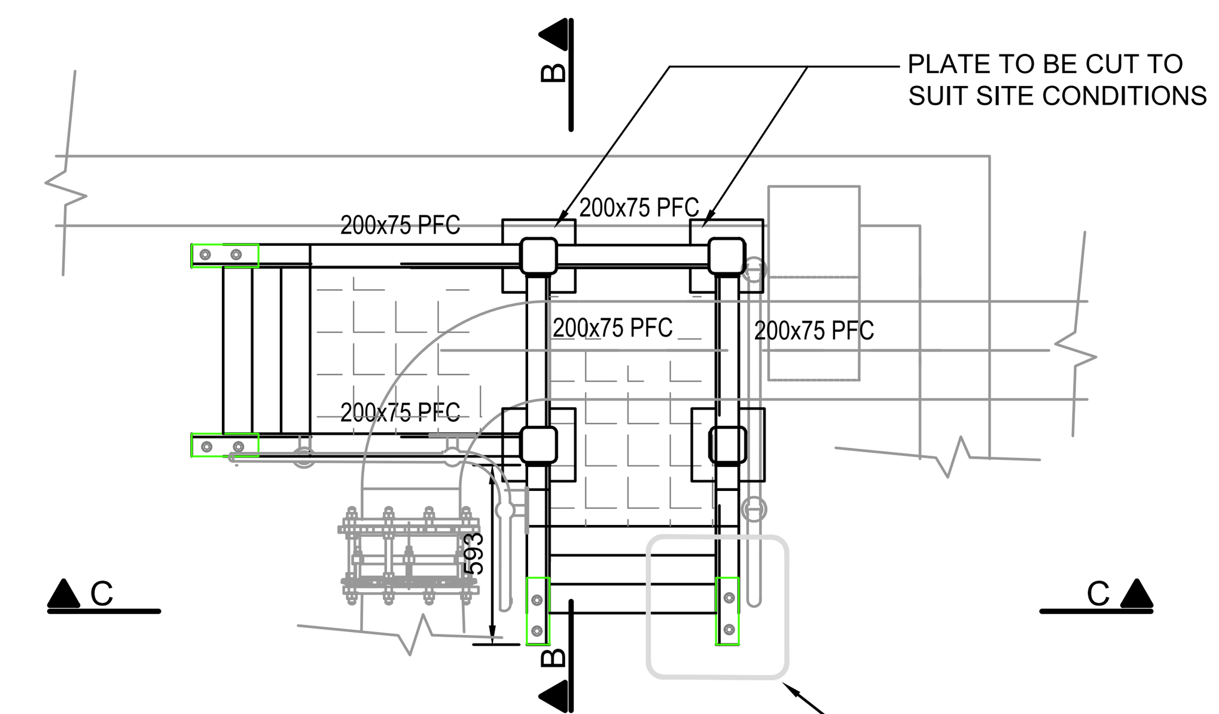
Description: ABSTRACTION WORKS

MAIN PUMPS AND PIPEWORK DETAILS

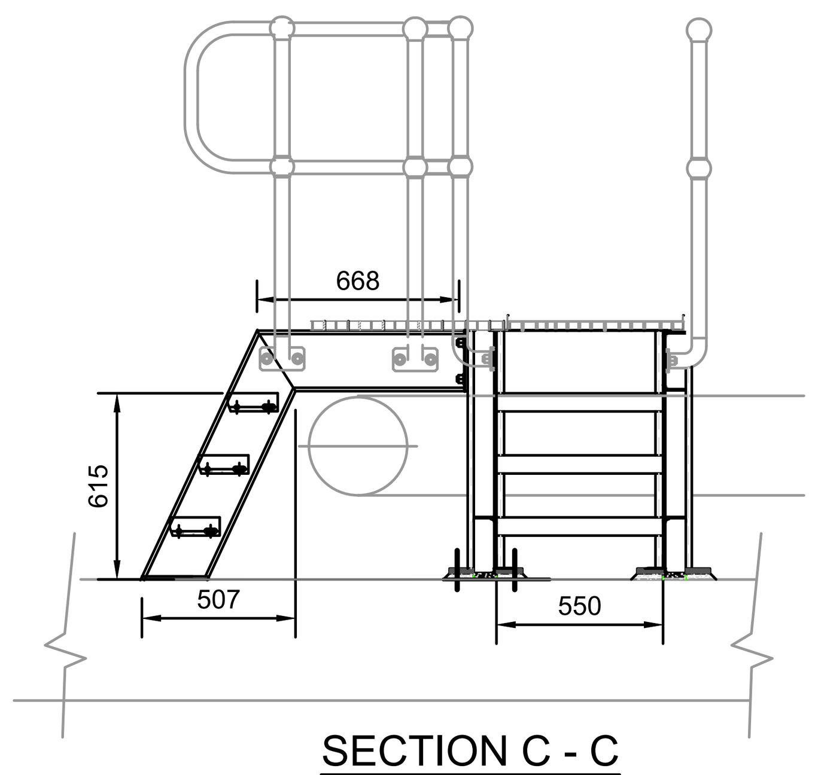
Scale	Date
AS SHOWN	26/06/21

Project No	Drg. No	Rev.
J40044	402	A

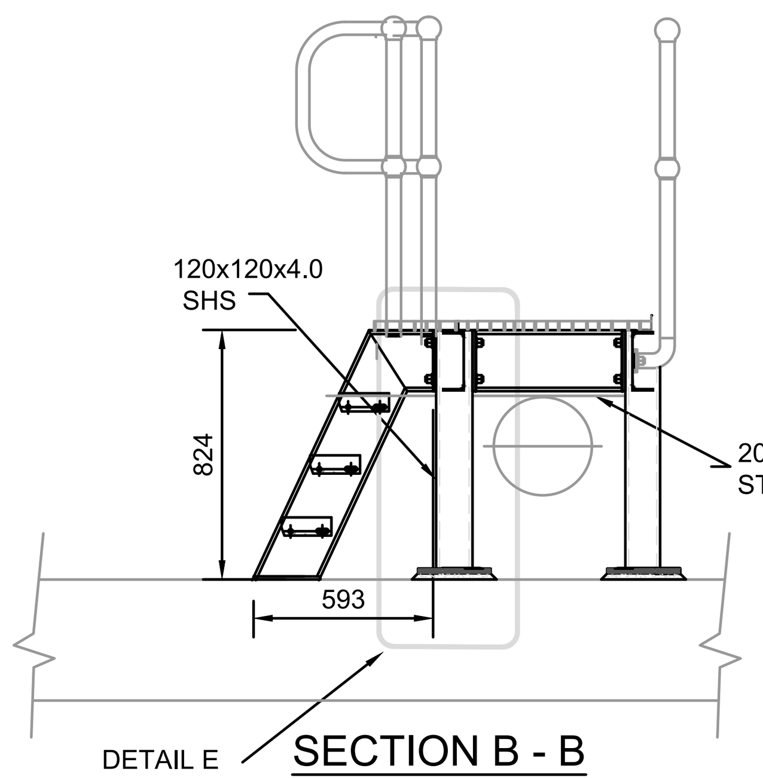
ISSUED FOR TENDER



PLAN
SCALE 1:25

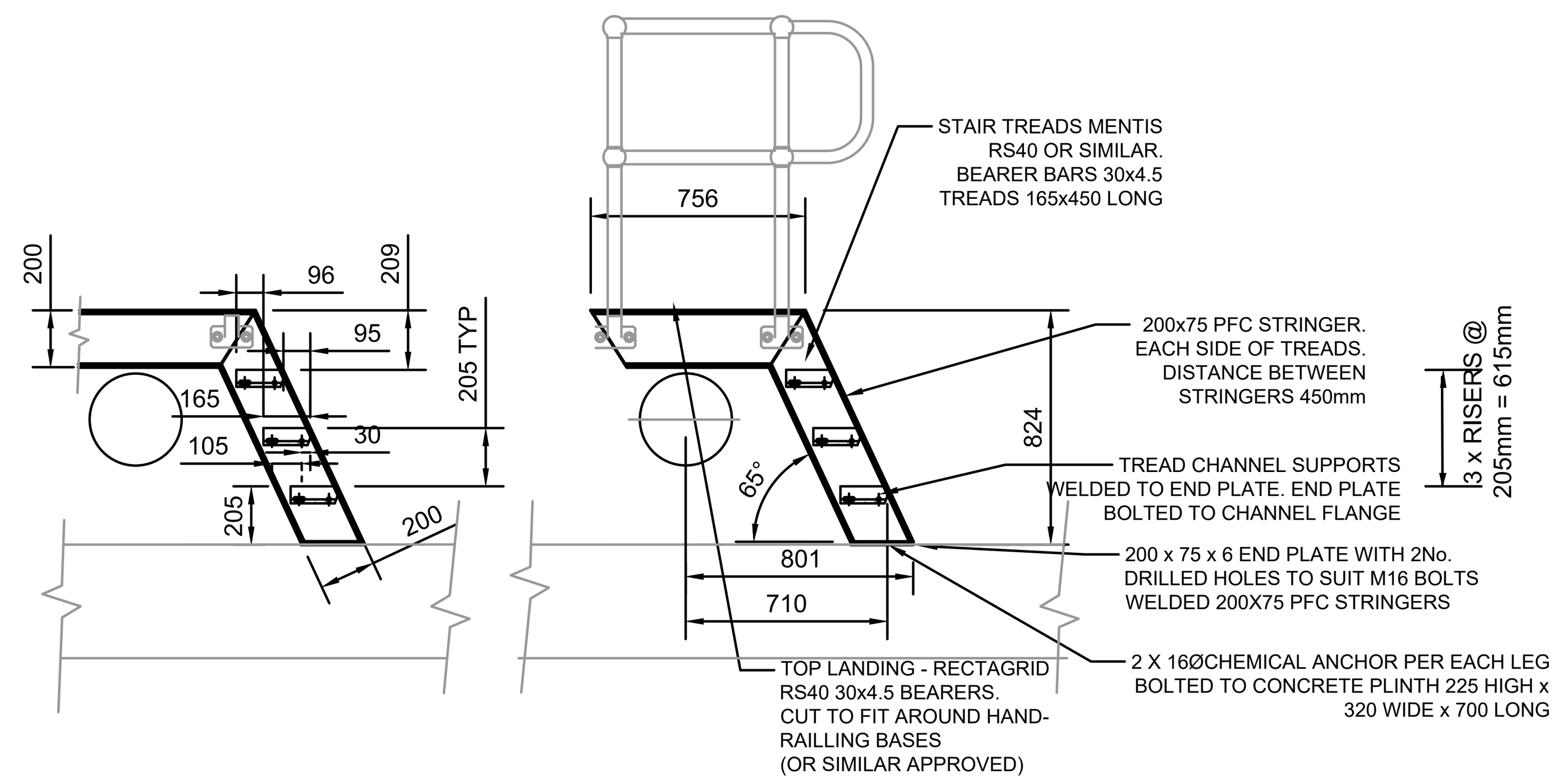


SECTION C - C
SCALE 1:25

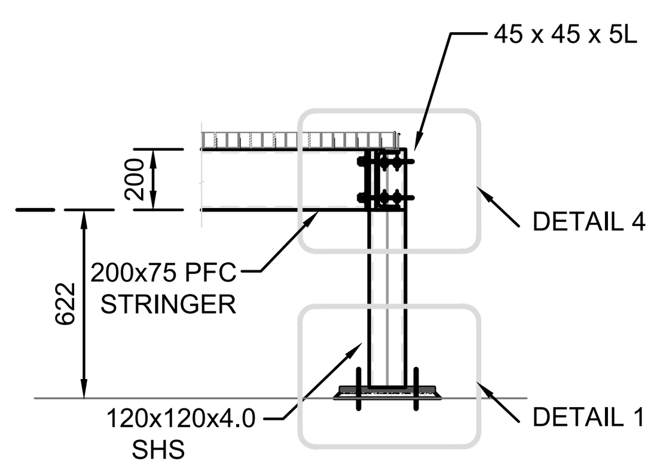


SECTION B - B
SCALE 1:25

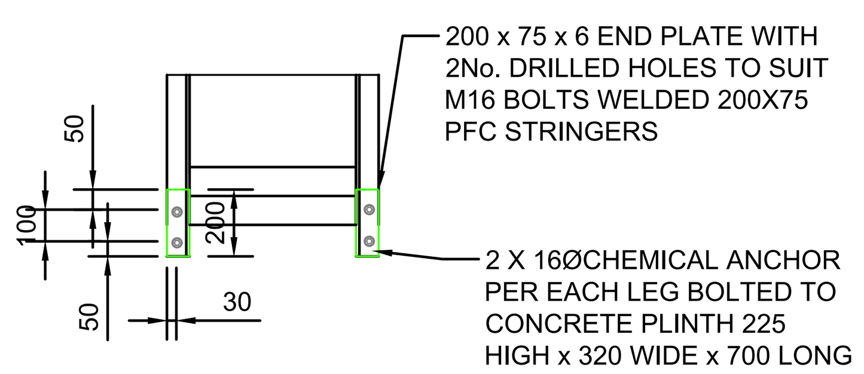
DETAIL'B'
PIPE STEP LADDER



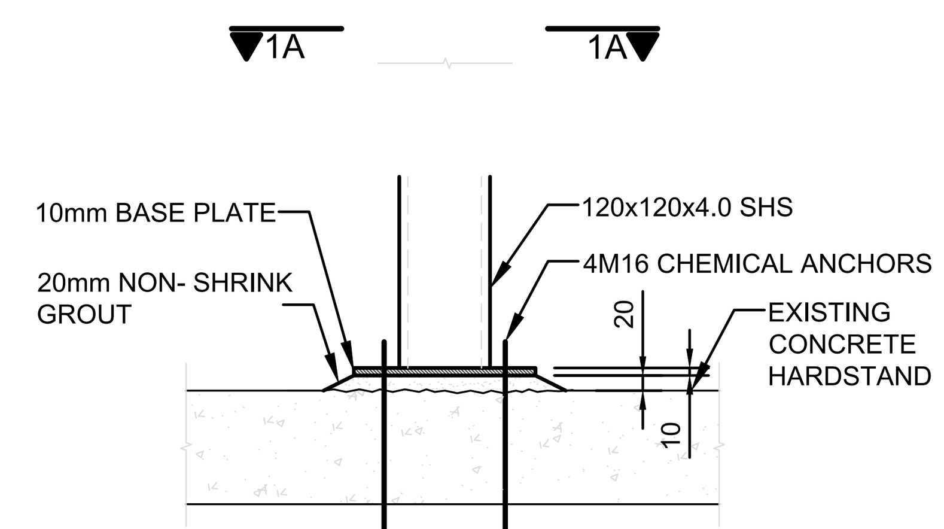
PIPE STEP SECTIONAL
DETAIL AND DIMENSIONS
SCALE 1:25



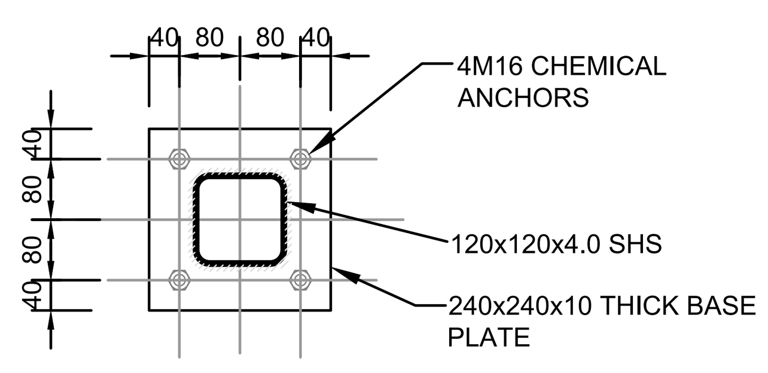
DETAIL E
SCALE 1:25



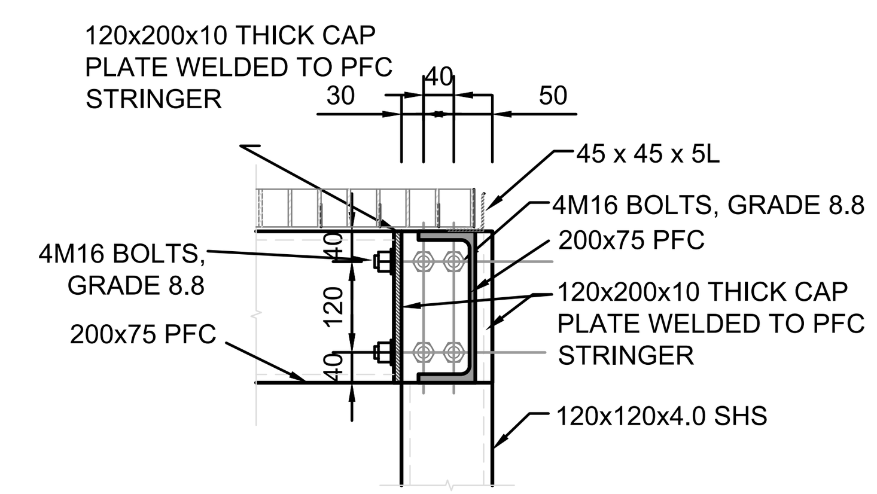
DETAIL F
SCALE 1:25



DETAIL 1
SCALE 1:10



SECTION 1A - 1A
SCALE 1:10



DETAIL 4
SCALE 1:10

ISSUED FOR TENDER

ON ORIGINAL
0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

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Drawn By: M.FUNNELL | Designed By: M.FUNNELL | Reviewed By: M.HOLMES

Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

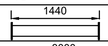
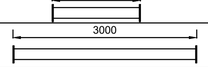
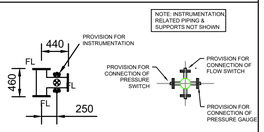
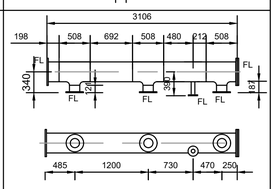
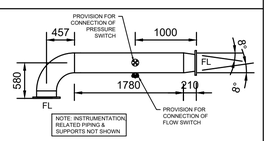
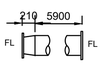
Description: ABSTRACTION WORKS
PIPE STEP LADDER AND PLATFORM DETAIL

Scale: AS SHOWN | Date: 26/06/21

Project No: J40044 / Drg. No: 403 / Rev: A

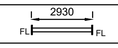
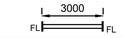
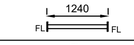
PIPEWORK SCHEDULE: ABSTRACTION WORKS PUMPSTATION - MAIN DELIVERY PIPEWORK

ALL SPECIALS TO BE MILD STEEL SUITED FOR 1.6MPa WORKING PRESSURE UNLESS OTHERWISE SPECIFIED. ALL PIPE FITTINGS AND FLANGE DRILLINGS TO SABS 1123: TABLE 1600 /3 UNLESS OTHERWISE SHOWN.

ITEM	QUANTITY	MATERIAL; COATING & LINING	DESCRIPTION	SKETCH
1	2	AS PER SPECIFICATION	ABSTRACTION WORKS SUBMERSIBLE PUMPSETS WITH FLANGED DUCK FOOT BEND AND DRILLED BASE FOOTING INCLUDING HOLDING DOWN BOLTS AND ANCILLARY PUMP GUIDE RAIL TO SUIT DELIVERY PIPEWORK FOR SUBMERSIBLE PUMPSET AS DESIGNED AND TENDERED IN ACCORDANCE TO THE SPECIFICATION	
1A	1	AS PER SPECIFICATION	DN100 FLANGED DUCK FOOT BEND AND DRILLED BASE FOOTING INCLUDING HOLDING DOWN BOLTS AND ANCILLARY PUMP GUIDE RAIL TO SUIT DELIVERY PIPEWORK FOR SUBMERSIBLE PUMPSET AS DESIGNED AND TENDERED IN ACCORDANCE TO THE SPECIFICATION	
2	3	HOT DIPPED GALVANISED	DN100 X DN150 FLANGED REDUCER	
3	3	HOT DIPPED GALVANISED	DN150 SPOOL PIECE FLANGED BOTH ENDS	
4	9	HOT DIPPED GALVANISED	DN150 SPOOL PIECE FLANGED BOTH ENDS	
5	3	AS PER SPECIFICATION	DN150 FLANGED DISMANTLING JOINT (NOMINAL F/F 207mm)	
6	2	HOT DIPPED GALVANISED	DN150 EQUAL FLANGED TEE, BARREL 460mm F/F, BRANCH 440mm C/F; INCLUDING 4 EQUIDISTANT DN25 STUB FLANGES 250mm C/F; FITTING TO INCLUDE: • 4 NO. DN25 FLANGED STUB AND BLANK FLANGE FOR INSTRUMENTATION (LENGTH TO SUIT BOLTING MINIMUM 50mm LONG) • (INSTRUMENTS TO INCLUDE 1 X PRESSURE GAUGE, 1 X PRESSURE SWITCH AND 1 X FLOW SWITCH MEASURED ELSEWHERE)	
7	3	HOT DIPPED GALVANISED	DN150 BLANK FLANGE; WITH HOLE DRILLED CENTRALLY TO SUIT ID OF DN80 PIPE WELDED OVER OPENING; DN80 PIPE TO BE FLANGED	
9	4	AS PER SPECIFICATION	DN80 FLANGED TRIPLE-ACTING SS AIR VALVE WITH "ANTI-SHOCK" FUNCTION AND ANTI THEFT TYPE WITH INCLUSIVE QUATER TURN WAFER BUTTERFLY VALVE, "VARIANT 080LT16" OR SIMILAR APPROVED	
11	3	AS PER SPECIFICATION	DN150 FLANGED NOZZLE CHECK VALVE; F/F DIMENSIONS TO EN 558/ISO 5752 SERIES 14	
12	3	AS PER SPECIFICATION	DN150 FLANGED RESILIENT SEAL VALVE TO SUIT SABS 664, WITH HANDWHEEL AND RISING SPINDLE	
13	1	HOT DIPPED GALVANISED	SPECIAL: DN300 FLANGED MANIFOLD 3106mm F/F, WITH 3 x DN150 FL BRANCHES AND 1 x DN50 FLLEVEL INVERT BRANCH. EACH DN150 BRANCH EXTENDS 340mm C/F AND DN50 BRANCH 390mm C/F. ALL DIMENSIONS TO BE DETERMINED ON SITE.	
14	1	HOT DIPPED GALVANISED	DN300 FLANGED LONG RADIUS STEEL BEND WITH ONE LONG LEG, WELDED TO DN300 X DN250 FLANGED CONCENTRIC REDUCER AT 8 DEG CONE ANGLE. INCLUDING 2 EQUIDISTANT DN25 STUB FLANGES 1000mm FROM REDUCER FLANGE; FITTING TO INCLUDE: • 2 NO. DN25 FLANGED STUB AND BLANK FLANGE FOR INSTRUMENTATION (LENGTH TO SUIT BOLTING MINIMUM 50mm LONG) (INSTRUMENTS TO INCLUDE 1 X FLOW SWITCH AND 1 X PRESSURE SWITCH MEASURED ELSEWHERE)	
16	1	AS PER SPECIFICATION	DN300 FLANGED MAGNETIC FLOW METER; COMPLETE WITH MCC-MOUNTED TRANSMITTER AND GMS CONDUIT, APPROX. 480mm F/F "KROHNE WATERFLUX 3000" OR SIMILAR APPROVED	
17	1	HOT DIPPED GALVANISED	DN300 X DN250 FLANGED CONCENTRIC REDUCER WELDED TO ONE LONG LEG, FL/PE REDUCER AT 8 DEG ANGLE CONE	

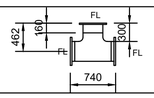
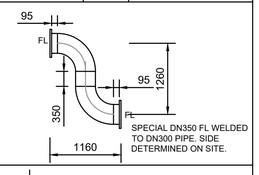
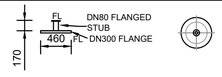
PIPEWORK SCHEDULE: ABSTRACTION WORKS PUMPSTATION - ANCILLARY EQUIPMENT AND PIPEWORK

ALL SPECIALS TO BE MILD STEEL SUITED FOR 1.6MPa WORKING PRESSURE UNLESS OTHERWISE SPECIFIED. ALL PIPE FITTINGS AND FLANGE DRILLINGS TO SABS 1123: TABLE 1600/3 UNLESS OTHERWISE SHOWN.

ITEM	QUANTITY	MATERIAL; COATING & LINING	DESCRIPTION	SKETCH
30	1	AS PER SPECIFICATION	ABSTRACTION WORKS SUBMERSIBLE SUMP PUMPSET WITH FLANGED DUCK FOOT BEND AND DRILLED BASE FOOTING INCLUDING HOLDING DOWN BOLTS AND ANCILLARY PUMP GUIDE RAIL TO SUIT DELIVERY PIPEWORK FOR SUBMERSIBLE PUMPSET AS DESIGNED AND TENDERED IN ACCORDANCE TO THE SPECIFICATION	
31	2	HOT DIPPED GALVANISED	DN50 SPOOL PIECE FLANGED BOTH ENDS	
32	2	AS PER SPECIFICATION	DN50 FLANGED DISMANTLING JOINT NOMINAL F/F 200mm	
33	1	AS PER SPECIFICATION	DN50 FLANGED BALL VALVE, WITH QUARTER TURN HANDLE; CI BODY, SS BALL, TEFLON SEAL	
34	1	HOT DIPPED GALVANISED	DN50 x 90 DEGREE LONG RADIUS BEND WITH ONE LONG LEG FLANGE BOTH ENDS	
40	1	AS PER SPECIFICATION	DN50 FLANGED WEDGE GATE VALVE TO SUIT SABS 664, WITH HANDWHEEL AND RISING SPINDLE	
41	1	HOT DIPPED GALVANISED	DN50 FLANGED LONG RADIUS STEEL 90 DEG "S" BEND 240mm C/C AND F/F. ALL DIMENSIONS TO BE CONFIRMED ON SITE.	
43	1	HOT DIPPED GALVANISED	DN50 x 90 DEGREE FLANGED LONG RADIUS BEND	
44	2	HOT DIPPED GALVANISED	DN50 SPOOL PIECE FLANGED BOTH ENDS	
45	1	HOT DIPPED GALVANISED	DN50 SPOOL PIECE FLANGED BOTH ENDS	
46	2	HOT DIPPED GALVANISED	DN50 FLANGED 45 DEG BEND	
47	2	HOT DIPPED GALVANISED	DN50XDN80 FL/PE REDUCER	

PIPEWORK SCHEDULE: ABSTRACTION WORKS PUMPSTATION - MAIN DELIVERY PIPEWORK

ALL SPECIALS TO BE MILD STEEL SUITED FOR 1.6MPa WORKING PRESSURE UNLESS OTHERWISE SPECIFIED. ALL PIPE FITTINGS AND FLANGE DRILLINGS TO SABS 1123: TABLE 1600 /3 UNLESS OTHERWISE SHOWN.

ITEM	QUANTITY	MATERIAL; COATING & LINING	DESCRIPTION	SKETCH
18	1	AS PER SPECIFICATION	DN250 FLANGED DISMANTLING JOINT (NOMINAL F/F 207mm)	
19	1	HOT DIPPED GALVANISED	DN300 FLANGED EQUAL TEE	
20	1	HOT DIPPED GALVANISED	DN300 FLANGED LONG RADIUS STEEL 90 DEG "S" BEND 1260mm C/C AND F/F. SPECIAL FLANGE ON ONE SIDE: DN350 FLANGE (520mm) ON 323mm OD PIPE (STEEL TO HDPE CONNECTION). ALL DIMENSIONS TO BE CONFIRMED ON SITE.	
22	1	HOT DIPPED GALVANISED	DN300 BLANK FLANGE; WITH HOLE DRILLED CENTRALLY TO SUIT ID OF DN80 PIPE WELDED OVER OPENING; DN80 PIPE TO BE FLANGED, AND FLANGE TO SUIT DN80	
23	1	HDPE	355mm NB REINERT-RITZ (OR SIMILAR APPROVED) HP FLANGE WITH PE100 WELDING STUB AND PERMANENTLY FITTED BACKING FLANGE, DESIGNED FOR FULL PRESSURE RESISTANCE, DRILLED IN ACCORDANCE WITH SANS 1123. THE BODY OF THE PE FITTING MUST BE MANUFACTURED IN THE INJECTION MOULDING PROCESS OR FROM A PIECE OF HOMOGENEOUS SEMIFINISHED MATERIAL. SEMI-FINISHED MATERIALS MANUFACTURED	
24	1	HOT DIPPED GALVANISED	DN300 BLANK FLANGE	
25	14	HOT DIPPED GALVANISED	DN25 BLANK FLANGE; PROVISION TO BE MADE FOR INSTRUMENTATION TAPPINGS TO SUIT PROVIDED INSTRUMENTS	
26	1	AS PER SPECIFICATION	DN300 FLANGED DISMANTLING JOINT (NOMINAL F/F 207mm)	

PIPEWORK NOTES:

1. ALL STEEL PIPES & FITTINGS DN150 AND SMALLER TO BE MINIMUM MEDIUM DUTY TO SABS 62 UNLESS OTHERWISE SPECIFIED.
2. ALL STEEL PIPES & FITTINGS LARGER THAN DN150 TO HAVE EITHER A MINIMUM 4.5mm WALL THICKNESS TO SABS 719 GRADE B OR TO HAVE A DIAMETER TO THICKNESS RATIO OF 125, WHICHEVER IS THE GREATER
3. SURFACE PREPARATION FOR APPLICATION OF CORROSION PROTECTION MATERIALS SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS.
4. ALL WELDED FITTINGS & FLANGES TO BE DOCUMENTED AS PER SPECIFICATIONS & WELDERS MUST BE QUALIFIED TO WQR. ALL WELDS MUST BE 100% VISUALLY INSPECTED INSIDE & OUT AND 100% DYE PENETRANT INSPECTED BEFORE GALVANISING.
5. ALL WELDING SHALL CONFORM TO SABS 0167-1984 AND SABS 044 SPECIFICATIONS.
6. ALL FLANGES TO BE MANUFACTURED & DRILLED TO SABS 1123
7. ALL THREADS TO BE BRITISH STANDARD PIPE(BSP) THREADS.
8. ALL STEEL PIPES & FITTINGS SMALLER THAN DN50 SHALL BE HOT DIPPED GALVANISED TO ISO 1461 : 2009 WITH A COATING NO LESS THAN 700 g/m² OR THICKNESS OF 80 MICRONS.
9. ALL STEEL PIPES & FITTINGS SMALLER THAN DN350 BUT LARGER THAN DN 50 TO BE FBE COATED AND LINED TO MINIMUM THICKNESS OF 350 MICRON
10. ALL STEEL PIPES & FITTINGS DN350 AND LARGER TO BE EPOXY COATED AND LINED WITH A MINIMUM DRY FILM THICKNESS OF 450 MICRONS UNLESS OTHERWISE SPECIFIED IN THE SPECIFICATIONS
11. ALL BURIED STEEL PIPES CAST THROUGH CONCRETE WALLS, REGARDLESS OF DIAMETER, TO BE WRAPPED WITH DENSO STEELCOAT 500, OR SIMILAR APPROVED AND WRAPPING TO EXTEND 100mm FROM INNER AND OUTER FACES OF CONCRETE UNLESS OTHERWISE SPECIFIED.
12. ALL STEEL PIPES CAST IN CONCRETE SHALL BE POSITIONED WITH OUTER SURFACE NO CLOSER THAN 25mm TO ANY REINFORCING OR OTHER STEEL IN THE CONCRETE.
13. ALL STEEL COMPONENTS, BOLTS, NUTS & WASHERS TO BE HOT DIP GALVANISED TO ISO 1461 : 2009 UNLESS OTHERWISE SPECIFIED IN THE SPECIFICATIONS.
14. ALL BOLTED CONNECTIONS TO HAVE WASHERS UNDER BOTH THE HEAD OF THE BOLT AND THE NUT.
15. ALL BURIED FITTINGS AND PIPES TO BE PROTECTED BY "DENSO" PETROLATUM SYSTEM INCLUDING MASTIC PROFILING PUDDY, PETROLATUM TAPE AND ULTRA FLEX PSA 180 TAPE INSTALLED TO MANUFACTURERS SPECIFICATIONS.
16. ALL GMS NUTS, BOLTS, WASHERS, THREADED BARS AND ALL OTHER GMS OR UNCOATED METAL SURFACES, IN EXPOSED SITUATIONS, SHALL, AFTER SUCCESSFUL PRESSURE- TESTING AND AFTER THOROUGH BRUSHING / CHIPPING TO REMOVE CONCRETE SPLATTER ETC, DE-GREASING AND DETERGENT CLEANING AND CLEAN WATER RINSING, SHALL BE COMPLETELY AND GENEROUSLY HAND-PAINT COATED BY AN APPROVED HEAVY-DUTY, SELF-HEALING, SURFACE TOLERANT, FLEXIBLE POLYMER-MODIFIED WAX CORROSION-INHIBITOR SUCH AS 'CHESTERTON 740 HEAVY DUTY RUST GUARD'
17. ALL DIMENSIONS IN MILLIMETRES.
18. ALL PIPEWORKS & FITTINGS TO BE MEASURED & CHECKED ON SITE PRIOR TO INSTALLATION AND ADVISE THE ENGINEER OF ANY DISCREPANCIES PRIOR TO FABRICATION.
19. 2 STRIPS OF NEOPRENE 25 OR AN APPROVED RUBBER OF ONE LAYER BETWEEN 2mm AND 5mm TO BE PLACED BETWEEN THE PIPEWORK AND SUPPORTS.
20. WHERE PIPE SUPPORTS ARE CAST INSITU, DENSO STEELCOAT 500, OR SIMILAR APPROVED, IS TO BE USED AT INTERFACE WITH PIPES AND VALVES. WRAPPING TO EXTEND 100mm FROM EDGE SUPPORT.
21. IF THE PIPELINE HAS CATHODIC-PROTECTION, THE FIRST EXPOSED FLANGED JOINT SHALL BE FITTED WITH AN INSULATING GASKET AND BOLT SET, COMPLETE WITH SPARK-GAP DEVICE IN ORDER TO ELECTRICALLY-INSULATE THE CHAMBER PIPEWORK FROM THE PROTECTED PIPELINE OUTSIDE.
22. DAMAGED COATINGS AND LININGS SHALL BE REPAIRED IN ACCORDANCE WITH THE SPECIFICATIONS.
23. COLLARS, WRAPPERS AND CROTCH PLATES ARE TO BE MANUFACTURED FROM A MINIMUM OF SABS 719 GRADE B STEEL, OR OF THE SAME GRADE AS THE MAIN PIPE WHICHEVER HAS THE HIGHER YIELD STRESS STRENGTH AND WELDED IN ACCORDANCE WITH THE SPECIFICATIONS
24. PIPE SUPPORT POSITIONS TO BE DETERMINED ON SITE AND APPROVED BY ENGINEER

ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

LABELS

ME	- MACHINED ENDS
FL	- FLANGE
PE	- PLAIN ENDED
PF	- PUDDLE FLANGE
C/F	- CENTRE TO FACE
D/FL	- DOUBLE FLANGE
C/C	- CENTRE TO CENTRE
F/F	- FACE TO FACE
RF	- RESTRAINING FLANGE

REFERENCE DRAWINGS

DRAWING No.	TITLE/DESCRIPTION
J40044-400	MAIN PUMPS AND PIPEWORK

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By		
N.MKHWANAZI		
Drawn By	Designed By	Reviewed By
M.FUNNELL	M.FUNNELL	M.HOLMES

Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

Description: ABSTRACTION WORKS
MAIN PUMPS AND PIPEWORK SCHEDULE

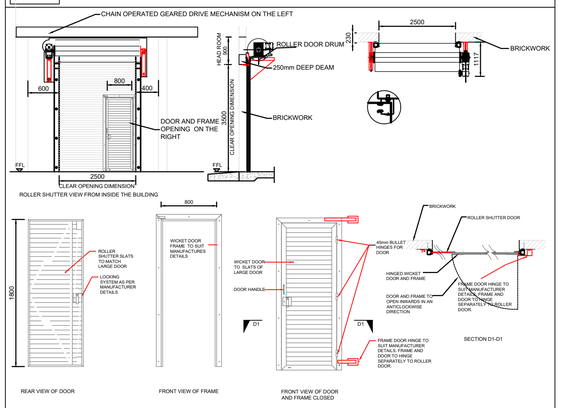
Scale	Date
AS SHOWN	26/06/21

Project No	Drg. No	Rev
J40044	404	A

FINISHES SCHEDULE

	FLOORS		WALLS			CEILINGS	
	4.5MM TO 6MM SIKAFLOOR 21N PURCHEM OR SIMILAR APPROVED ON POWER FLOATED CONCRETE FLOOR COLOURING TO MATCH DESIGNATED WORKING AREA AND WALKWAY REQUIREMENTS AS SPECIFIED	STEEL FLOATED CONCRETE SLAB	CONCRETE WALLS - OFF SHUTTER CONCRETE (FORMWORK DESIGN TO BE APPROVED PRIOR TO CASTING)	EXTERNAL FACE OF BRICK WALLS - "COROBRICK MONTANA TRAVERTINE" FACE OR SIMILAR APPROVED WITH RECESSED HORIZONTAL AND VERTICAL JOINTS	INTERNAL FACE OF BRICK WALLS - "COROBRICK AGATE - SATIN" OR SIMILAR APPROVED WITH FLUSH HORIZONTAL AND VERTICAL JOINTS		EXPOSED PURLINS
LOADING BAY AREA	○			○	○		○
WET WELL		○	○				○

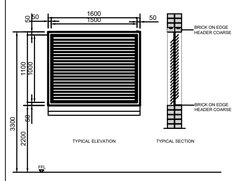
RD1 DOOR SCHEDULE



QUANTITY:	1 No.	LOCATION:	Entrance to loading bay

DOOR DETAILS:	GMS DOUBLE SKINNED ROLLER SHUTTER DOOR "XPANDA" OR SIMILAR APPROVED WITH WICKET DOOR. MECHANISMS INTERNAL. DOOR TO SUIT 2500mm WIDE, 3500mm HIGH OPENING. DOOR TO WITHSTAND WIND LOADS OF EN 12424 CLASS 2
FRAME / GUIDE AND FINISH:	THE CURTAIN TO BE SECURED BY TWO VERTICAL GUIDE RAILS. THE GUIDE RAILS SHALL BE SURFACE-MOUNTEDON THE BRICK WORK INSIDE THE PUMP STATION. THE SIDE GUIDES SHALL BE GALVANISED MILD STEEL WITH A MINIMUM THICKNESS OF 3mm WITH WEAR RESISTANT REMOVABLE PLASTIC GUIDES. MIN 75mm DEPTH WITH FORMED TOP-ENTRY BELLMOUTH BOLTED INTO BRICK WORK AND CONCRETE WORK.
DOOR AND FINISH:	DOOR CURTAIN CONSISTING OF HINGE-LIKE INTERCONNECTED GMS SLATS. ROBUST PLASTIC WEAR AND CORROSION RESISTANCE (OR SIMILAR APPROVED) END-CLIPS. SLAT PROFILE MINIMUM WIDTH OF 94MM AND HEIGHT 100mm. DOOR SHEETING MINIMUM 0.4mm THICK
DRUM DETAILS:	GALVANISED MILD STEEL DRUM OF DIAMETER AND THICKNESS TO ENSURE MINIMAL DEFLECTION UNDER DEAD LOAD AND OPERATION. HELICALLY-WOUND COUNTER-BALANCE SPRINGS TO BE CONTAINED WITHIN THE DRUM.MOUNTING BRACKETS TO BE MIN 8mm THICK GMS AND FIRMLY ANCHORED MIN 10mm DIA X 150mm DEPTH INTO WALL. COUNTER BALANCE SPRING SYSTEM HOUSED IN BARREL TO CARRY WEIGHT OF DOOR. DOUBLE-SKINNED BOX PROFILE MADE OF ALUMINIUM WITH PERMANENTLY ELASTIC AND FROST-PROOF EPDM PROFILE HOSE SEAL FOR A SEALED BOTTOM DOOR EDGE
DRIVE:	MANUALLY OPERATED GEARED CHAIN DRIVE WITH INTERGRATED ANTI-DROP DEVICE MIN IP54. CHAIN TO EXTEND FROM TOP DRIVE TO 1.2m ABOVE GROUND. TESTED IN ACCORDANCE WITH APPLICABLE ISO STANDARDS. INCLUSIVE OF A GMS MOUNTING BRACKET. THE CHAIN SHALL
CONTROL:	MANUALLY CONTROLLED THROUGH PULL CHAIN SYSTEM.
WICKET GATE:	THE DOOR SIZE IS 800mm WIDE X 1.800mm HIGH. WICKET GATE TO COMPLY WITH PEDESTRIAN FIRE ESCAPE REGULATIONS, AND TO BE FITTED WITH A PANIC BAR OR LEVER. THE WICKET DOOR SHALL ALLOW ACCESS THROUGH THE ROLLER SHUTTER DOOR WITHOUT PHYSICALLY OPENING THE ROLLER SHUTTER DOOR. THE WICKET DOOR SHALL BE HINGED TO THE DOOR FRAME AND OPENED WITH THE FRAME REMAINING IN POSITION. THE DOOR FRAME SHALL ALSO BE HINGED SEPARATELY TO THE ROLLER SHUTTER AND AND NOT INTERFERE WITH THE ROLLER SHUTTER GUIDES AND APPURTENANCES WHEN OPENED.
WICKET GATE DOOR AND FINISH:	WICKET DOOR SLATS SIZE AND PROFILE TO MATCH ROLLER SHUTTER DOOR CURTAIN CONSISTING OF HINGE-LIKE INTERCONNECTED GMS SLATS.
IRONMONGERY:	- 4 LEVER EUROLOCK "UNION L-2209-78" OR SIMILAR APPROVED ACTIVATING A LOCK SYSTEM - GMS BUTT HINGES SUPPLIED BY DOOR FRAME MANUFACTURER

L1 LOUVER SCHEDULE



QUANTITY:	4 No.	LOCATION:	ABSTACTION WORKS ELECTRICAL PLATFORM

DETAILS:	STATIONARY TYPE WEATHER EXHAUST LOUVERS. DOWNWARD ANGLED OUTWARD FACING AIRFOIL STYLE BLADES
MANUFACTURE:	
MATERIAL:	STEEL
SIZE:	1000mm HIGH x 1500mm WIDE
FINISH:	GALVANIZED MILD STEEL
MOUNTING:	EXTERNALLY MOUNTED TO BRICK WALL AS REQUIRED WITH FLANGED MOUNTING AND SILICONE SEAL
FASTENERS:	ALL FASTENERS SHOULD HAVE RUBBER SEALING WASHERS WHICH SHOULD BE FREE OF CARBON FILLERS. FASTENERS SHOULD BE AS DURABLE AS ROOF SHEETING
ADDITIONAL FEATURES:	TO BE SUPPLIED WITH INSECT MESH C/W LIGHT MESH FILTER TO REMOVE LARGE PARTICLES

ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

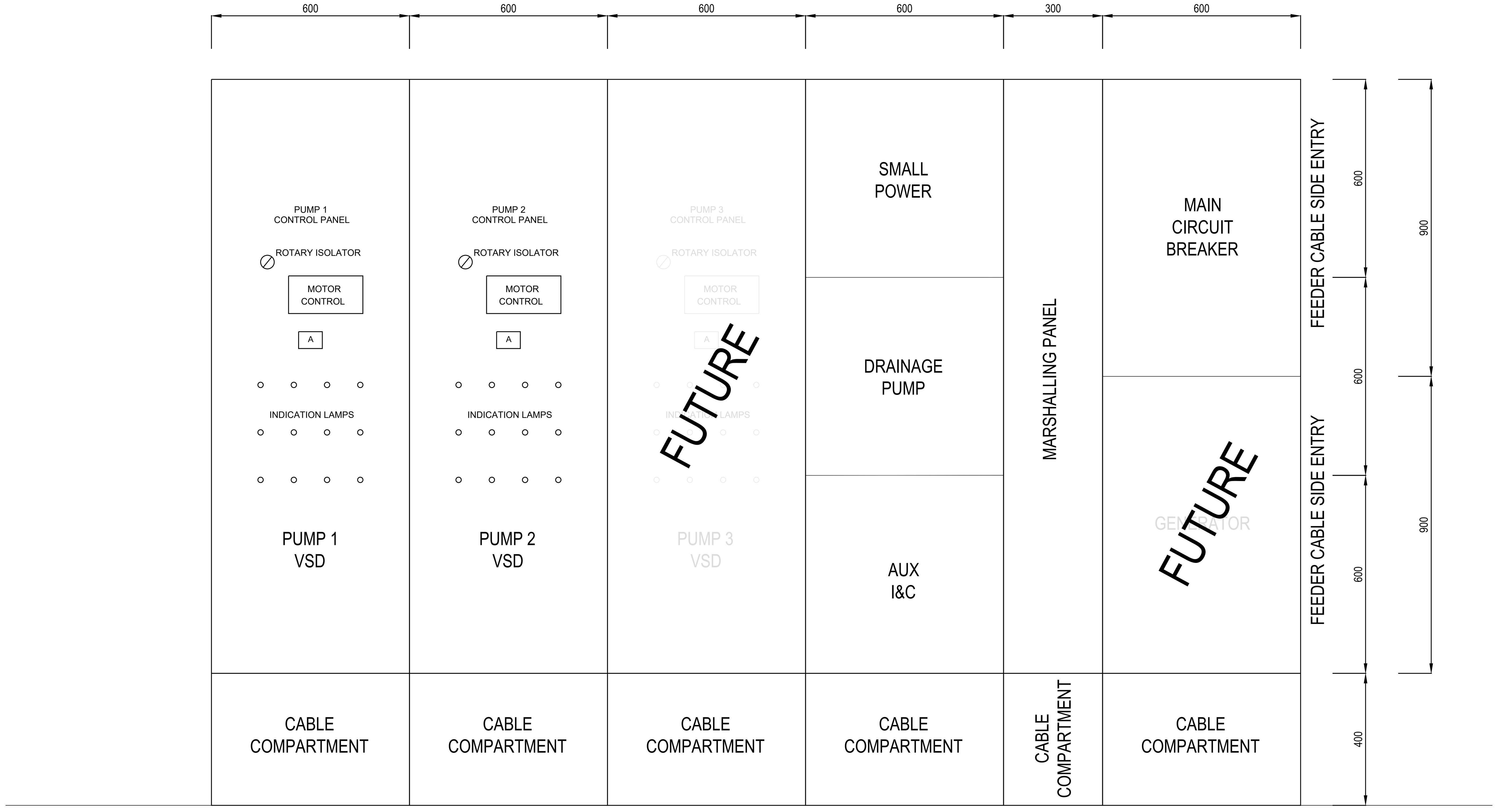
Approved By		
N.MKHWANAZI		
Drawn By	Designed By	Reviewed By
M.FUNNELL	M.FUNNELL	M.HOLMES

Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

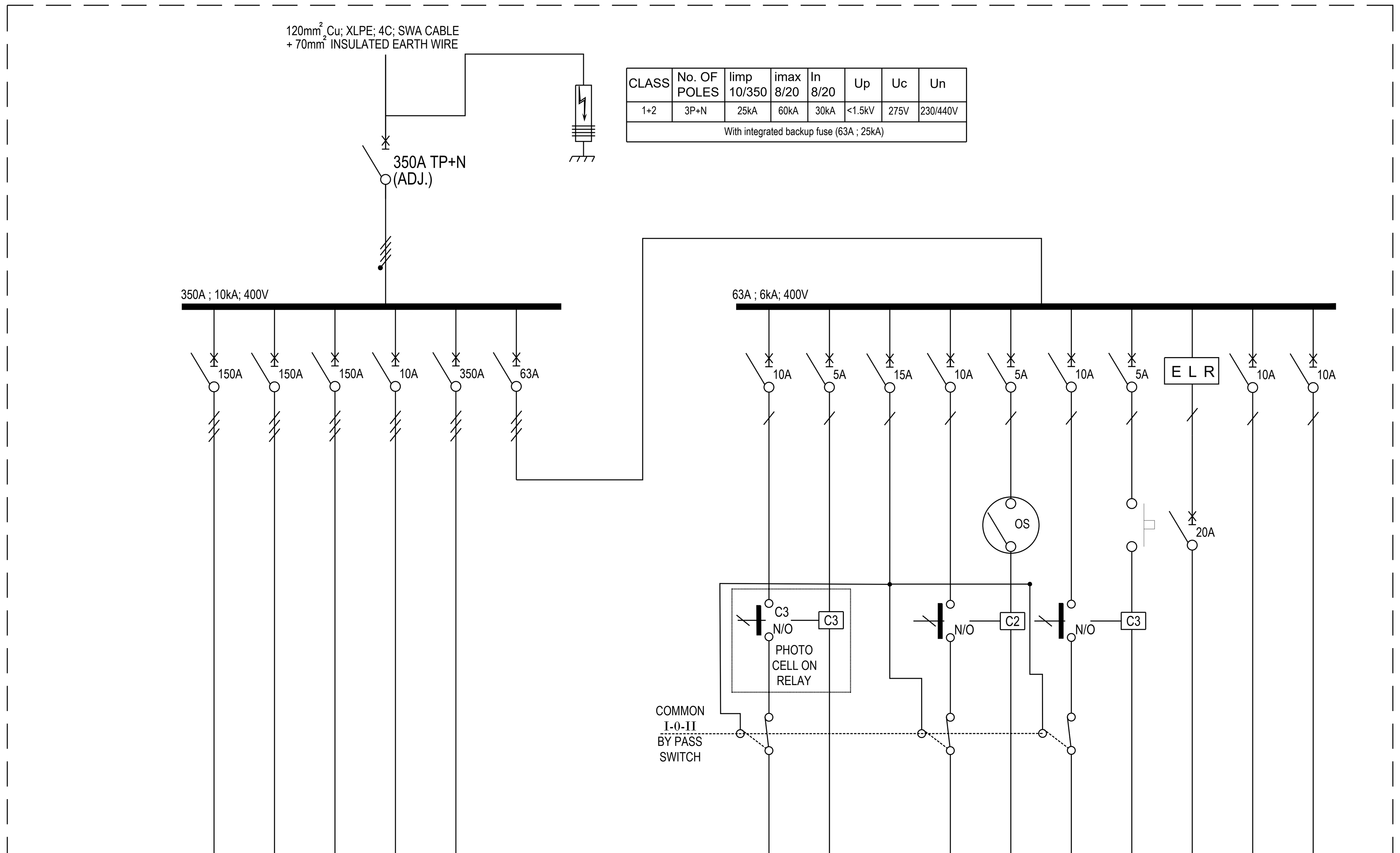
Description: ABSTRACTION WORKS
FINISHING SCHEDULE

Scale	Date
AS SHOWN	26/06/21

Project No	Drg. No	Rev
J40044	405	A



ELECTRICAL PANEL



CLASS	No. OF POLES	limp 10/350	imax 8/20	In 8/20	Up	Uc	Un
1+2	3P+N	25kA	60kA	30kA	<1.5kV	275V	230/440V
With integrated backup fuse (63A ; 25kA)							

CIRCUIT NUMBER	PUMP 1 VSD	PUMP 2 VSD	PUMP 3 VSD	DRAINAGE PUMP	GENERATOR CHANGE OVER		OUTSIDE LIGHTS XL1	PHOTO CELL		INTERNAL LIGHTS L1	LIGHTS CONTROL L1	WET WELL LIGHTS L2	LIGHTS CTRL L2	SSO P1	AUX 1	AUX 2
CONDUCTOR mm²	SUBMERSIBLE PUMP CABLE TAILS AS PER MANUFACTURERS RECOMMENDATIONS LENGTH AS PER PROJECT SPECIFICATIONS			2.5	N/A		1.5	1.5		1.5	1.5	1.5	1.5	2.5	2.5	2.5
NUMBER OF CORES				4	N/A		2	2		2	2	2	2	2	2	2
CABLE TYPE				PVC	N/A		PVC	PVC		PVC	PVC	PVC	PVC	PVC	PVC	PVC
EARTH WIRE mm²				2.5	N/A		1.5	1.5		1.5	1.5	1.5	1.5	2.5	2.5	2.5
CONDUIT/SLEEVE DIA (mm)	AS PER PROJECT SPECIFICATIONS			50	N/A		20	20		20	20	20	20	20	20	20

ELECTRICAL PANEL SLD

ISSUED FOR TENDER

ALL DIMENSIONS AND LEVELS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR BEFORE COMMENCING ANY WORK.

ON ORIGINAL
0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By: A. NEL | Designed By: A. NEL | Reviewed By: M.HOLMES

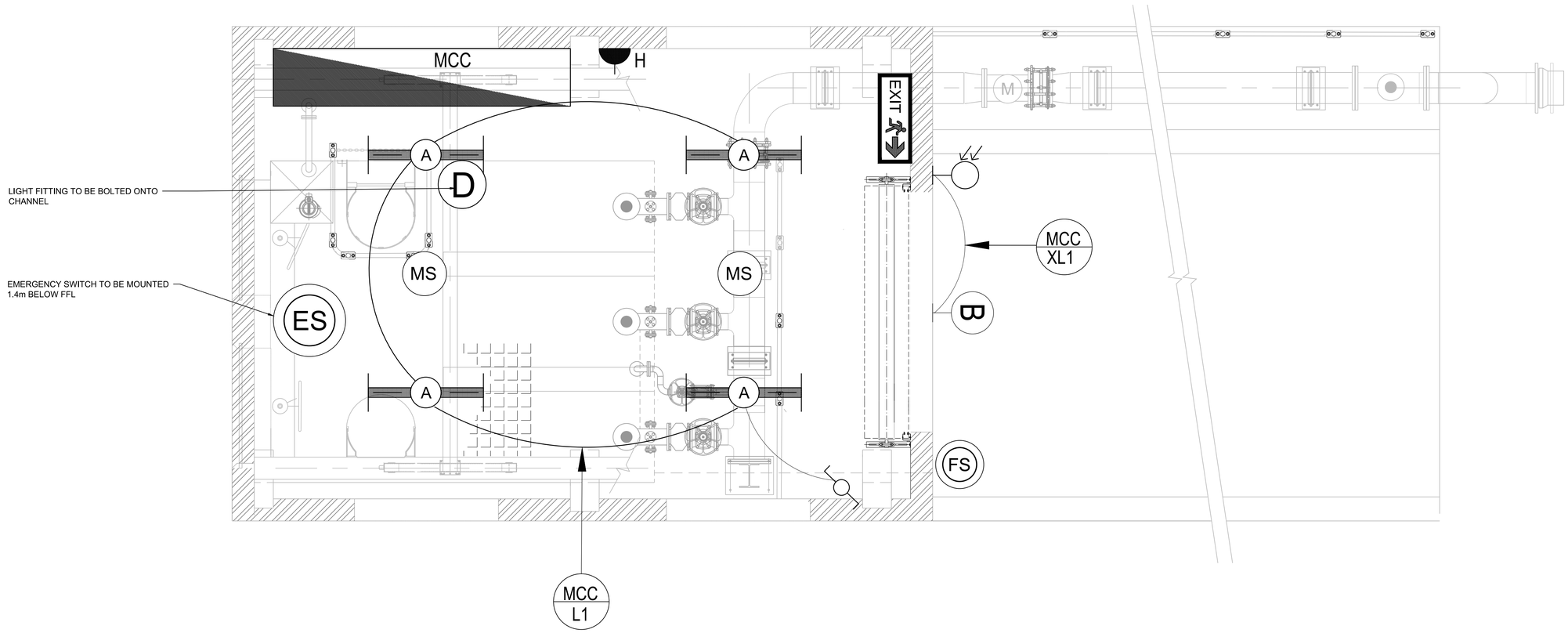
Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

Description: ABSTRACTION WORKS
ELECTRICAL PANEL AND ELECTRICAL PANEL SLD

Scale: AS SHOWN | Date: 26/06/21

Project No: J40044 / Drg. No: 410 / Rev: A

LEGEND			
ITEM	**DESCRIPTION**	**Manufacturer**	**MODEL**
A	TYPE A: LED VAPOULINE	BEKA OR EQUAL AND APPROVED	LED 4 FT 46W
LED	TYPE B: INDU FLOOD WALL/RAIL MOUNTED,WITH STIRRUP MOUNTING BRACKET	BEKA OR EQUAL AND APPROVED	LED FLOOD 70W
EXIT	TYPE C: WALL MOUNTED SELF CONTAINED BATTERY EXIT SIGNS	BEKA EMERGENCY / VOLTEX, OR EQUAL AND APPROVED	ARGOS (BEKA) or E10M-2PL9-EXIT (VOLTEX)
D	TYPE D: SUMP LIGHT	BEKA OR EQUAL AND APPROVED	LED FLOOD 70W
H	TYPE E: ROYCE THOMSON P5 TYPE PHOTO ELECTRIC CELL COMPLETE WITH "HUBBEL" TYPE PLUG SET SUITABLE FOR MOUNTING ON AND INCLUDING GALVANISED PRESSED STEEL CONDUIT BOX AND NEOPRENE GASKET	ROYCE THOMSON OR EQUAL AND APPROVED	Royce Thomson P5
F	TYPE F: ABB 3 POSITION ROTARY SWITCH IN ABB ENCLOSURE COMPLETE	ABB OR EQUAL AND APPROVED	OC25G02PNBN00NU1
MS	TYPE G: OCCUPANCY SENSOR	SCHNEIDER ELECTRIC OR EQUAL AND APPROVED	SAE_UE_MS_CSAWE
H	TYPE H: INDUSTRIAL SOCKET OUTLET IN SURFACE MOUNT METAL BOX COMPLETE (COLOUR ELECTRIC ORANGE)	CRABTREE CLASSIC OR EQUAL AND APPROVED	7393.0000
ES	TYPE I: TWIST RELEASE EMERGECY STOP INCLUSIVE OF SHROUD AND ENCLOSURE COMPLETE	ABB OR EQUAL AND APPROVED	CE3T-10R-02; MA1-8053; MEPY1-0
FS	TYPE J: FIREMANS SWITCH INCLUSIVE OF THREADED BLANKING PLUGS	ABB OR EQUAL AND APPROVED	KSE325TPN



ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client

HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By	Designed By	Reviewed By
A. NEL	A. NEL	M.HOLMES

Project

GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

Description

ABSTRACTION WORKS

POWER AND LIGHTING LAYOUT

Scale	Date
1 : 25	26/06/21

Project No	Drg. No	Rev
J40044	411	A

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LEGEND	
T	TOP MOUNTING
S	SIDE MOUNTING
O	OFFSET SIDE MOUNTING
S	STAIR MOUNTING
P	PEG MOUNTING

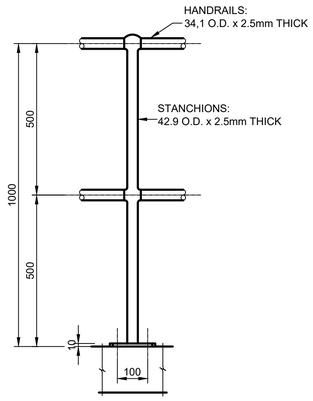
SCHEDULE

FLAT FORM STANCHIONS	
MT 90	TOP MOUNTED
MS 90	SIDE MOUNTED
MO 90	OFFSET SIDE MOUNTED
MP 90	PEG MOUNTED
STAIRWAY MOUNTED STANCHIONS	
MTA 30/35/40/45	ANGLE TOP MOUNTED
MSL & MSR 30/35/40/45	SIDE MOUNTED
MST 30/35/40/45	TOP MOUNTED
STAIRWAY MOUNTED TO STAIRCASE/LADDERS	
MLT 90	TOP MOUNTING FOR LADDERS
MLS 90	SIDE MOUNTING FOR LADDERS
MST 90	TOP MOUNTED
MSS 90	SIDE MOUNTED
ITEM 12	35 O.D. x 150 SOLID PEG

NOTES:

1. HEIGHT : HANDRAILING TO PLATFORMS,WALKWAYS,LANDINGS AND UNGUARDED EDGES OF RAISED FLOORS MUST BE NOT LESS THAN 1,0m HIGH ABOVE FINISHED FLOOR LEVEL. HANDRAILINGS TO STAIRS MUST HAVE A HEIGHT OF NOT LESS THAN 1,0m MEASURED VERTICALLY FROM THE PITCH LINE TO THE UPPER SURFACE OF THE HANDRAIL .
2. HAND AND KNEERAILS TUBULAR HAND AND KNEERAILS ARE TO BE MANUFACTURED FROM TUBING WITH A WALL THICKNESS OF 2,5mm AND OUTSIDE DIAMETER OF 34,1mm O.D. JOINTS MUST BE BUTTED USING TUBULAR STEEL FERRULES AND PINNED .
3. STANDARD TUBULAR STANCHIONS STANDARD TUBULAR STANCHIONS ARE TO BE MANUFACTURED FROM TUBING WITH A WALL THICKNESS OF 2,5mm AND WITH AN OUTSIDE DIAMETER OF 42.9 O.D. THE STANCHION MUST HAVE BALL-TYPE NODES AT THE HANDRAIL AND KNEERAIL JOINTS AND HAVE FLAT HORIZONTAL OR VERTICAL FIXING PLATES AT THE BASE FOR BOLTING TO THE SUPPORTING STRUCTURE .
4. THE MAXIMUM SPACING BETWEEN STANCHIONS IS 1,8m APART.
5. HANDRAIL STANCHIONS AND ACCESSORIES TO BE HOT-DIPPED GALVANISED IN ACCORDANCE WITH SANS 121 (ISO 1461)
6. PAINTING : HANDRAILS - 1 UNDERCOAT (RED OXIDE) AND 2 FINISHING COATS COLOUR - GOLDEN YELLOW(B49)
   STANCHIONS - 1 UNDERCOAT AND 2 FINISHING COAT
   COLOUR - BLACK
7. WHERE A HIGHER DEGREE OF SAFETY IS REQUIRED, SUCH AS FIRE ESCAPE STAIRWAYS, THE BALUSTRADE MUST HAVE CLOSELY SPACED VERTICAL AND HORIZONTAL MEMBERS THAT WILL NOT PERMIT THE PASSAGE OF A 125mm DIAMETER BALL (NBR REGULATION M7 (1))

THE TYPICAL DETAILS INDICATED ON THIS DRAWING PROVIDE GUIDELINES ONLY.
THIS DRAWING MUST NOT BE USED WITHOUT PRIOR CONSENT OF THE ENGINEERING MANAGER OR HIS DELEGATED REPRESENTATIVE
THE ENGINEER/REPRESENTATIVE WILL DETERMINE THE APPROPRIATE APPLICATION TO SUIT SITE REQUIREMENTS



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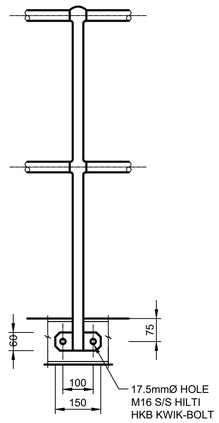
TYPE MT90



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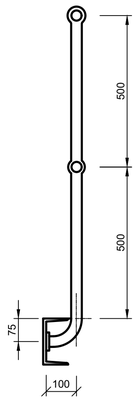

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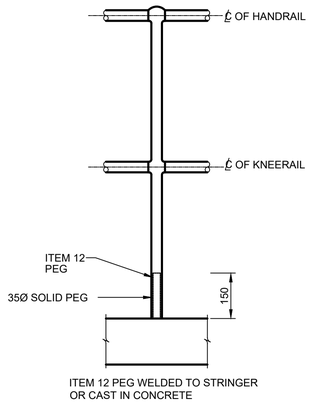
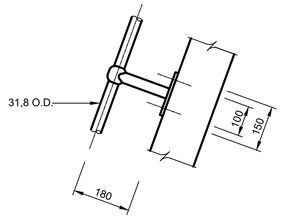
TYPE MO90



PEG MOUNTED

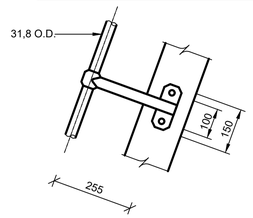
TYPE MP90

PLATFORM MOUNTED STANCHIONS



TOP MOUNTING FOR LADDERS

TYPE MLT 90

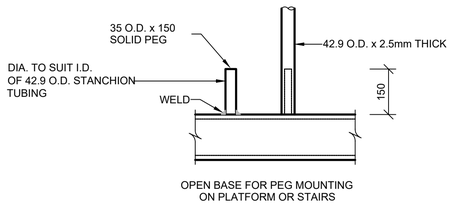


SIDE MOUNTING FOR LADDERS

TYPE MLS 90

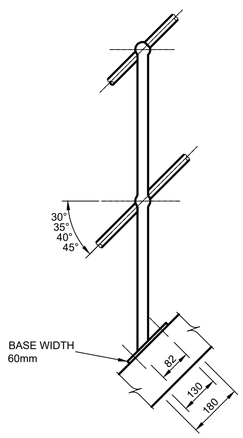
STANCHION AND BASE MOUNTING FOR LADDERS

(FOR USE ON LADDERS BETWEEN 70° AND 90° INCLINE)



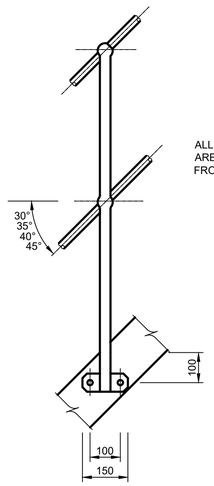
OPEN BASE FOR PEG MOUNTING
ON PLATFORM OR STAIRS

TYPE P



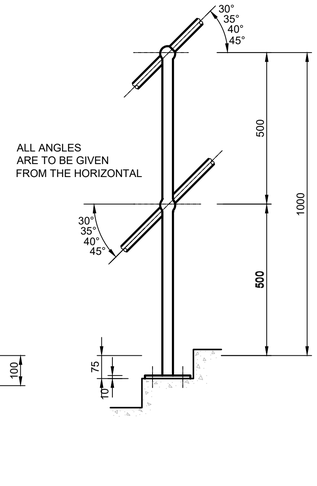
ANGLE TOP MOUNTED

TYPE MTA 30/35/40/45



SIDE MOUNTED

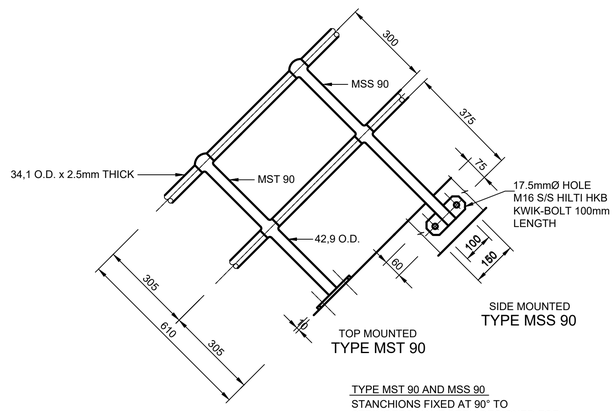
TYPE MSL AND
MSR 30/35/40/45



TOP MOUNTED

TYPE MST 30/35/40/45

STAIRWAY MOUNTED STANCHIONS



SIDE MOUNTED
TYPE MSS 90

TOP MOUNTED
TYPE MST 90

TYPE MST 90 AND MSS 90
STANCHIONS FIXED AT 90° TO STRINGERS HAVE BEEN DESIGNED FOR USE ON STAIRCASES WITH ANGLES GREATER THAN 45°

STAIRWAY MOUNTED STANCHIONS
90° TO STRINGER

ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

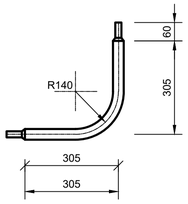
Drawn By	Designed By	Reviewed By
C.ROSS	M.HOLMES	M.HOLMES

Project: **GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5**

Description: **STANDARD DETAILS**
GALVANISED BALL TYPE HANDRAIL, STANCHIONS BASE MOUNTING DETAILS

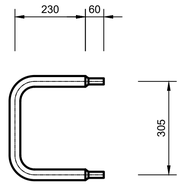
Scale	Date
NTS	26/06/21

Project No	Drg. No	Rev.
J40044	900	A



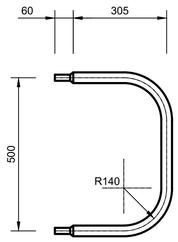
90° LONG RADIUS CORNER BEND

ITEM 1



90° STRAIGHT CLOSURE

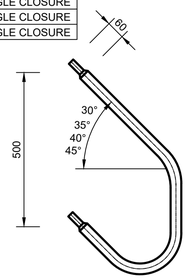
ITEM 2B



90° STRAIGHT CLOSURE

ITEM 2M

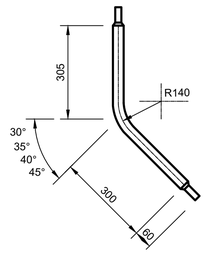
ITEM	ANGLE	
3M	45°	ANGLE CLOSURE
3AM	40°	ANGLE CLOSURE
3BM	35°	ANGLE CLOSURE
3CM	30°	ANGLE CLOSURE



ANGLE CLOSURE

ITEM 3

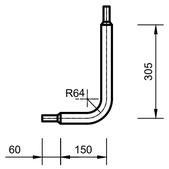
LEGEND	
T	TOP MOUNTING
S	SIDE MOUNTING
O	OFFSET SIDE MOUNTING
S	STAIR MOUNTING
P	PEG MOUNTING



STAIRWAY BEND

ITEM 4

ITEM	ANGLE	
4	45°	STAIRWAY BEND
4A	40°	STAIRWAY BEND
4B	35°	STAIRWAY BEND
4C	30°	STAIRWAY BEND

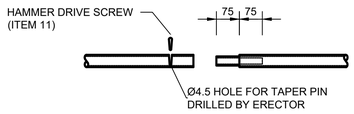


90° SHORT RADIUS BEND
(FOR STAIR RETURN AND
KINK BENDS)

ITEM 5

KINK BEND

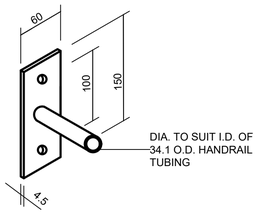
REFER TO ITEM 5



Ø27 FERRULES FOR Ø34,1 HANDRAIL AND KNEERAIL

STANDARD HANDRAIL JOINT

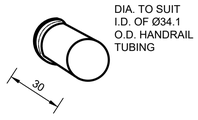
ITEM 6



60 x 4.5 x 150 PLATE WITH 14Ø
HOLES FOR M12 BOLTS

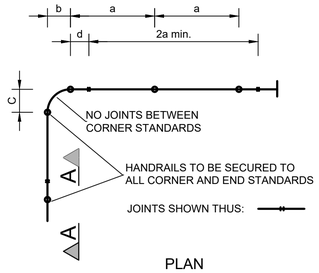
WALL END PLATE

ITEM 7

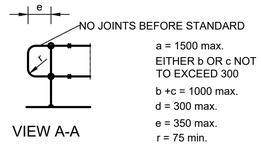


RUBBER END PLUG

ITEM 10



PLAN



VIEW A-A

a = 1500 max.
EITHER b OR c NOT
TO EXCEED 300
b +c = 1000 max.
d = 300 max.
e = 350 max.
r = 75 min.

TYPICAL LAYOUT DETAIL

ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd

Revisions

Client

HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By	Designed By	Reviewed By
C.ROSS	M.HOLMES	M.HOLMES

Project

GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

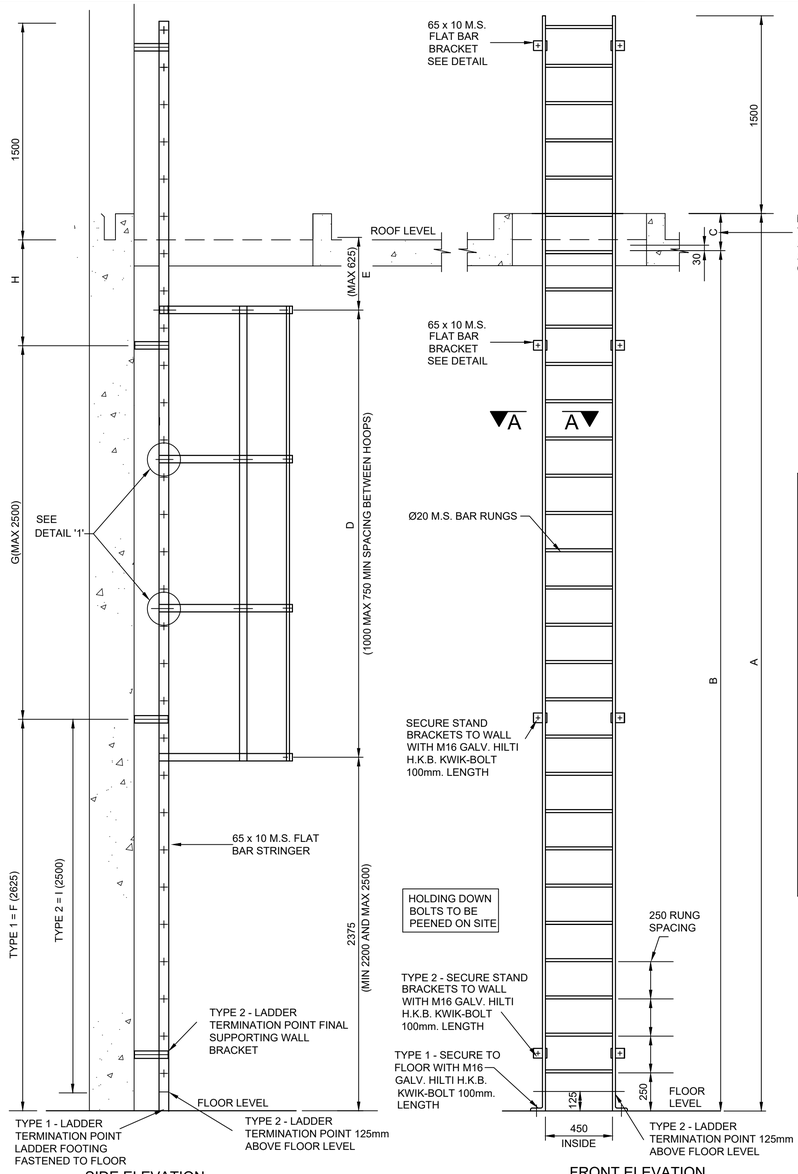
Description

STANDARD DETAILS

BALL TYPE HANDRAIL BENDS, STAIRS RETURN & KINK BENDS

Scale	Date
NTS	26/06/21

Project No	Drg. No	Rev
J40044	901	A

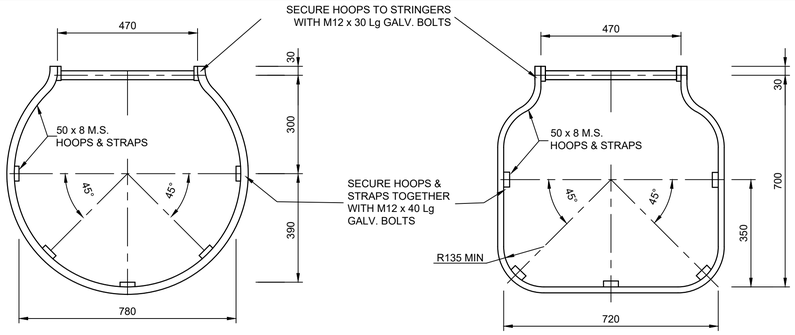


SIDE ELEVATION

FRONT ELEVATION
(HOOPS & STRAPS OMITTED FOR CLARITY)

MILD STEEL LADDER FOR PERMANENT INTERNAL ACCESS

SCALE 1 : 20



CIRCULAR HOOP

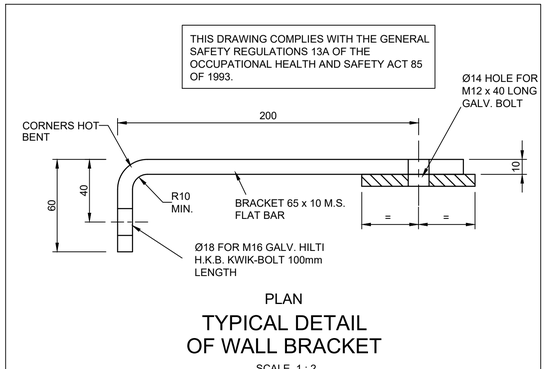
RECTANGULAR HOOP

NOTE: * THESE DIMENSIONS MEASURED AT RIGHT ANGLES TO THE OF ℄ THE STRINGERS

HOOP DIMENSIONS

SCALE 1 : 10

THIS DRAWING COMPLIES WITH THE GENERAL SAFETY REGULATIONS 13A OF THE OCCUPATIONAL HEALTH AND SAFETY ACT 85 OF 1993.

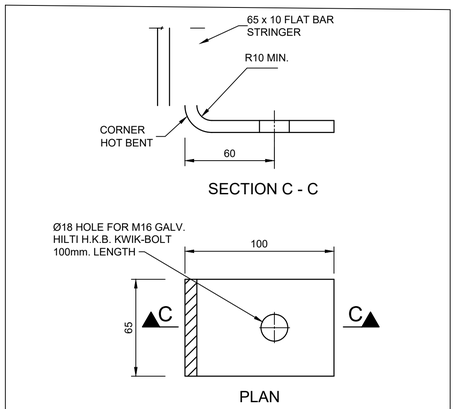


PLAN

TYPICAL DETAIL OF WALL BRACKET

SCALE 1 : 2

USED FOR LADDER TERMINATION TYPE 2



SECTION C - C

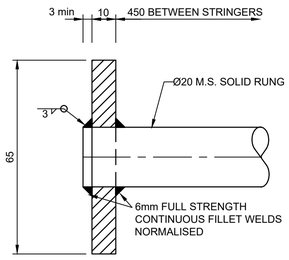
PLAN

TYPICAL DETAIL OF LADDER FOOT

SCALE 1 : 2

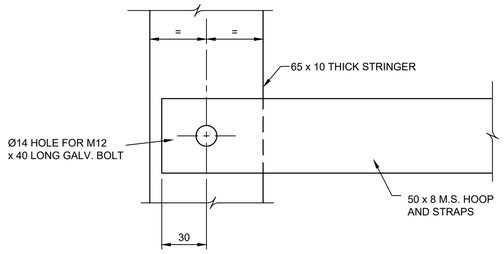
USED FOR LADDER TERMINATION TYPE 1

3D VIEW



TYPICAL DETAIL OF WELDED ATTACHMENT OF RUNG TO STRINGER A - A

SCALE 1 : 1



DETAIL "1"

SCALE 1 : 2

QTY	A	B	C	D	E	F	G	H	I	TERMINATION TYPE	LOCATION
1	4000	4000	0	1500	625	1825	1800	375	1700	2	GMS ABSTRACTION EXTERNAL TYPE CAGED ACCESS LADDER AND EXTENDED RUNGS FROM PLATFORM LEVEL 3 TO PLATFORM LEVEL 2
1	4000	4000	0	4500	625	1825	1800	375	N/A	1	GMS ABSTRACTION EXTERNAL TYPE CAGED ACCESS LADDER AND EXTENDED RUNGS FROM PLATFORM LEVEL 2 TO WET WELL FLOOR

ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 30 40 50MM

GENERAL NOTES:

STRINGERS
1. STRINGERS TO BE FABRICATED FROM 65 x 10 THICK M.S. FLAT BAR IN CONTINUOUS LENGTHS. IF JOINED, FISH PLATES ARE TO BE USED ON INSIDE OF STRINGERS.
2. JOINTS TO BE BOLTED, RIVETED OR WELDED. BOLTS OR RIVETS TO BE NOT LESS THAN 2 x M12 ON EACH SIDE OF JOINT.

RUNGS
1. RUNGS TO BE FABRICATED FROM Ø20mm SOLID M.S. ROUND BARS.
2. RUNGS TO BE FITTED INTO HOLES DRILLED IN STRINGERS & WELDED. HOLES DRILLED TO ALLOW 0.8mm CLEARANCE.

SAFETY HOOPS
1. HOOPS & STRAPS TO BE FABRICATED FROM 50 x 8mm THK M.S. FLATS.
2. ANY LADDER RISING MORE THAN 3.0m, REQUIRES SAFETY HOOPS.
3. LOWER MOST HOOP AT 2.375m, (MIN 2200 AND MAX 2500)
4. HOOPS AND STRAPS MUST BE BOLTED.

HOLES :
1. ALL BOLT HOLES TO BE DRILLED.

BOLTS :
1. ALL BOLTS TO BE GRADE 304 STAINLESS STEEL.

FINISH:
1. ALL BURRS, WELD-FLASH & SHARP EDGES TO BE REMOVED & MADE SMOOTH BY THE FINISHING TREATMENT. TO BE HOT-DIPPED GALVANISED TO SANS 121 (ISO 1461) MINIMUM 90 MICRON.

NB. *ALL STEELWORK SHALL BE IN ACCORDANCE WITH SANS 10162 'THE STRUCTURAL USE OF STEEL' MATERIAL SPECIFICATION : MILD STEEL TO 350W

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

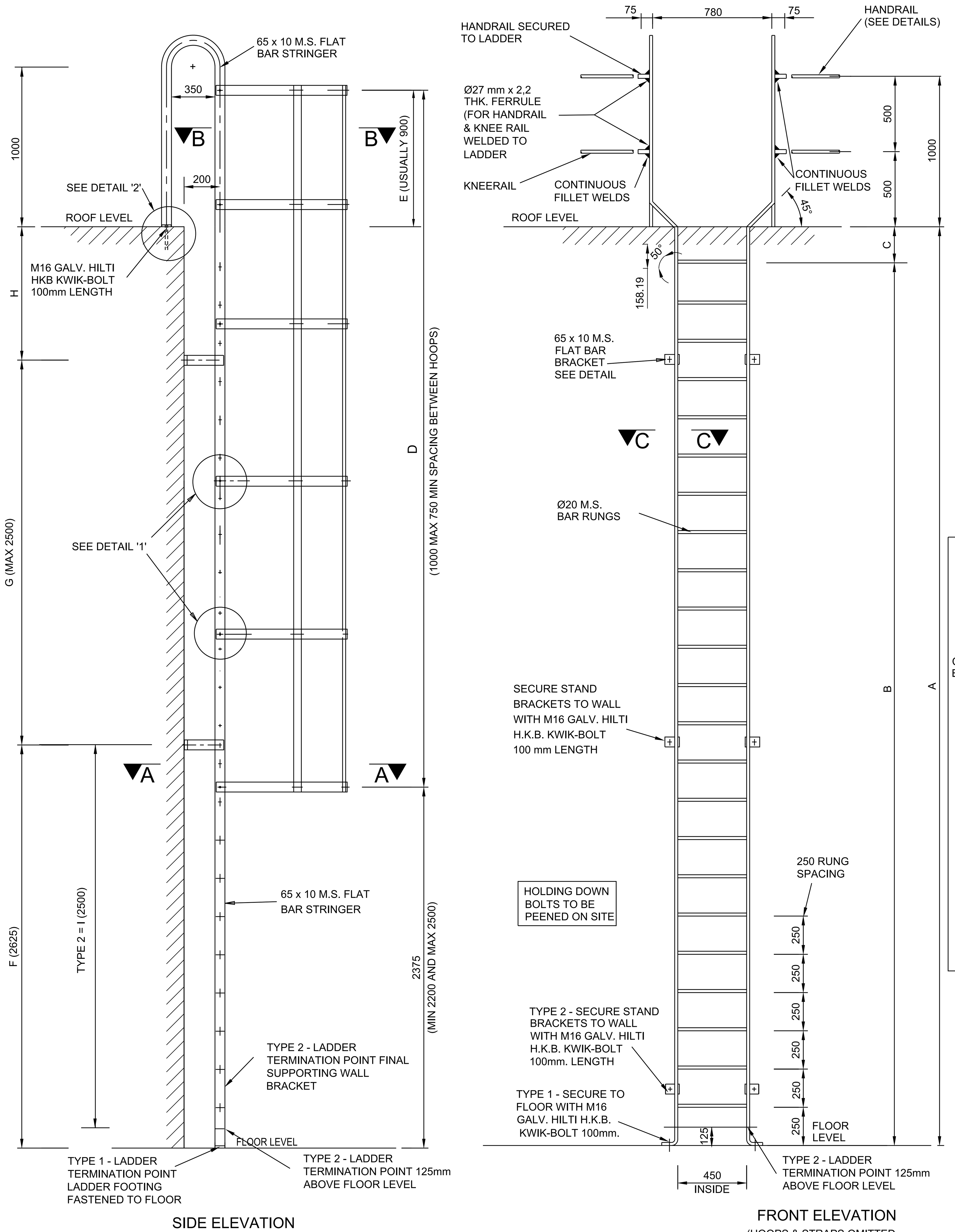
Drawn By	Designed By	Reviewed By
C.ROSS	M.FUNNELL	M.HOLMES

Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

Description: STANDARD DETAILS
GALVANISED LADDER DETAILS (INTERNAL TYPE)

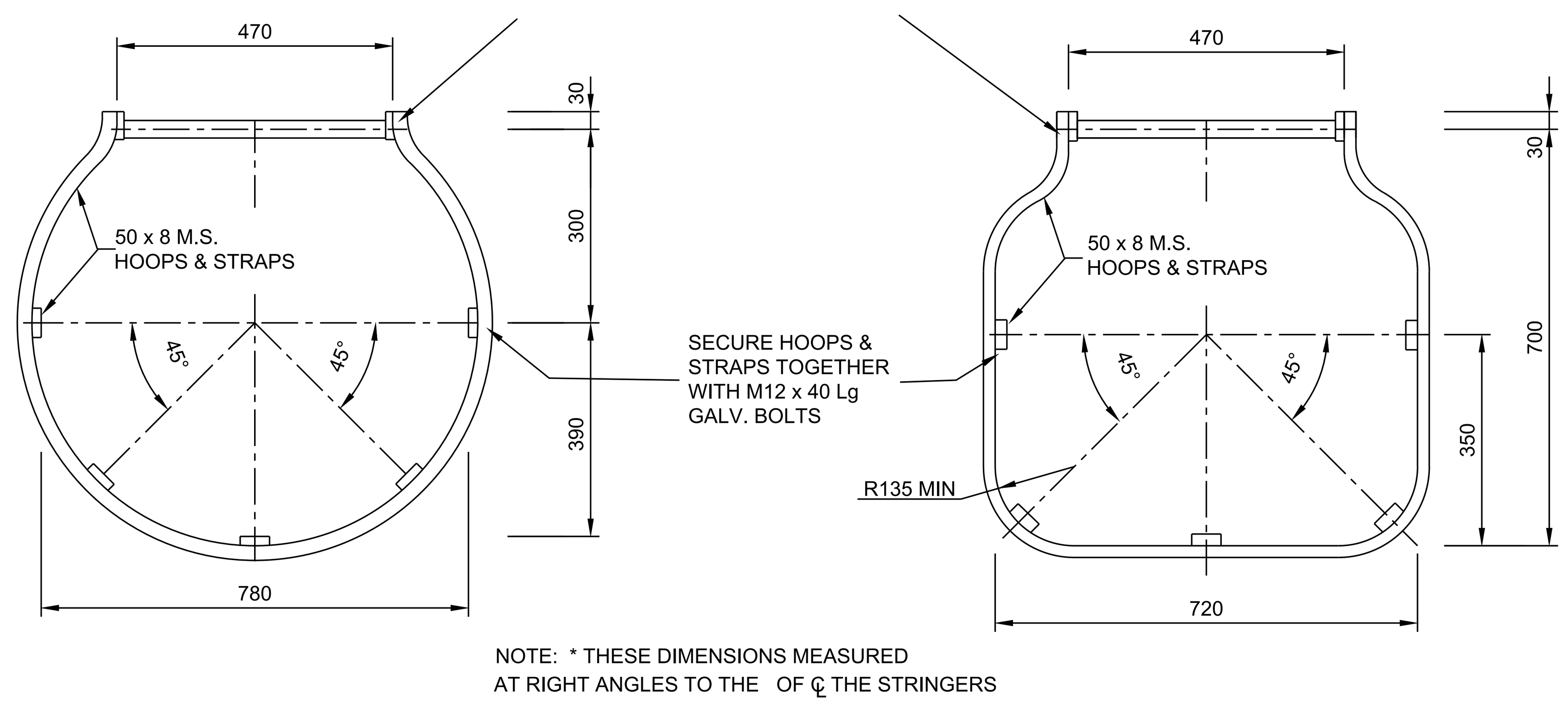
Scale	Date
NTS	26/06/21

Project No	Drg. No	Rev
J40044	902	A



MILD STEEL GALVANISED LADDER FOR PERMANENT EXTERNAL ACCESS

SCALE 1:20

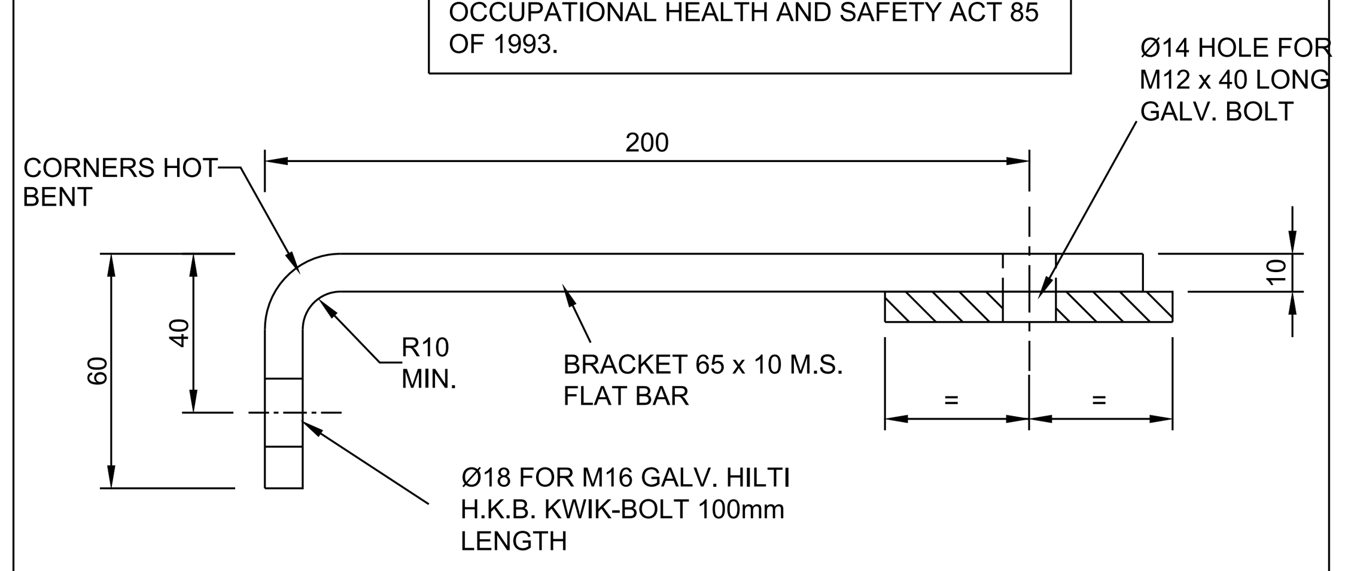


HOOP DIMENSIONS

SCALE 1 : 10

THIS DRAWING COMPLIES WITH THE GENERAL SAFETY REGULATIONS 13A OF THE OCCUPATIONAL HEALTH AND SAFETY ACT 85 OF 1993.

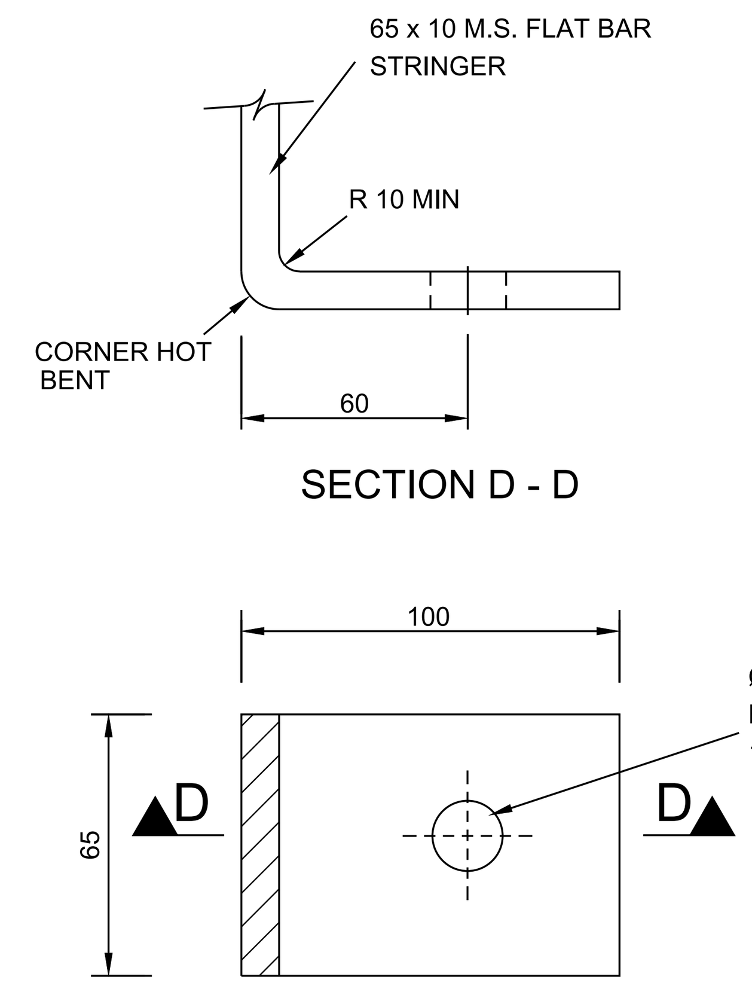
THIS DRAWING COMPLIES WITH THE GENERAL SAFETY REGULATIONS 13A OF THE OCCUPATIONAL HEALTH AND SAFETY ACT 85 OF 1993.



TYPICAL DETAIL OF WALL BRACKET

SCALE 1 : 2

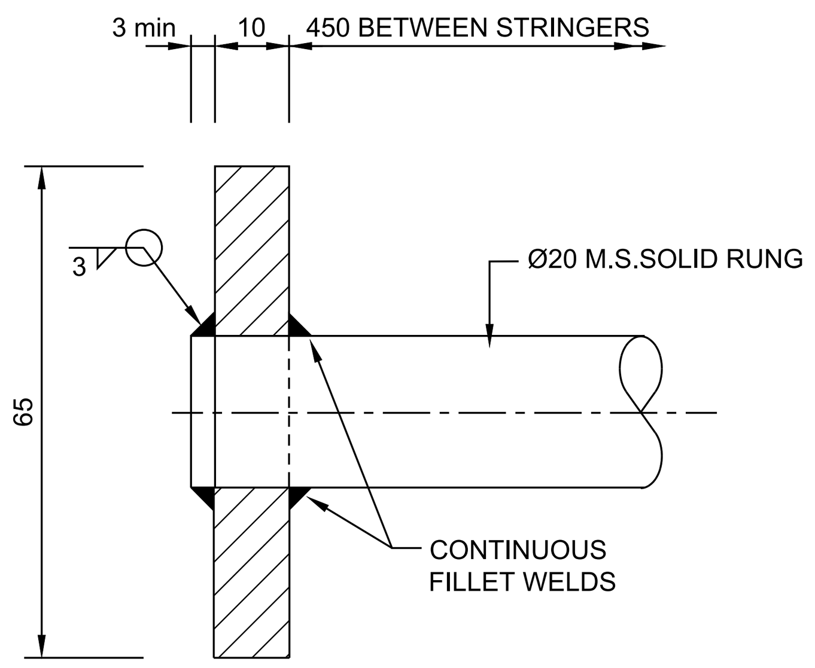
USED FOR LADDER TERMINATION TYPE 2



TYPICAL DETAIL OF LADDER FOOT

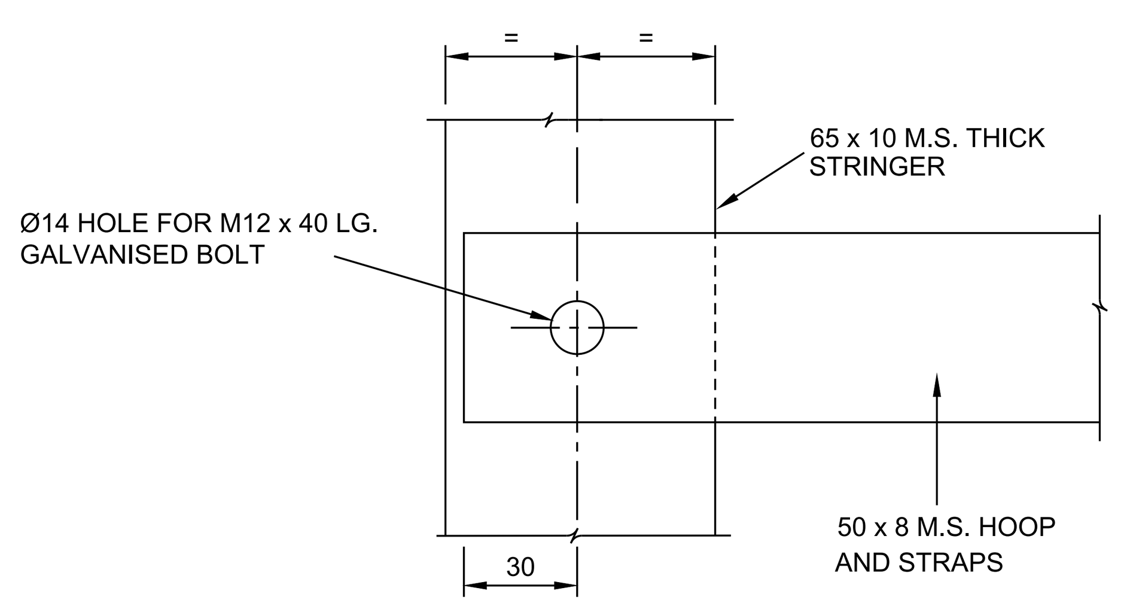
SCALE 1:2

USED FOR LADDER TERMINATION TYPE 1



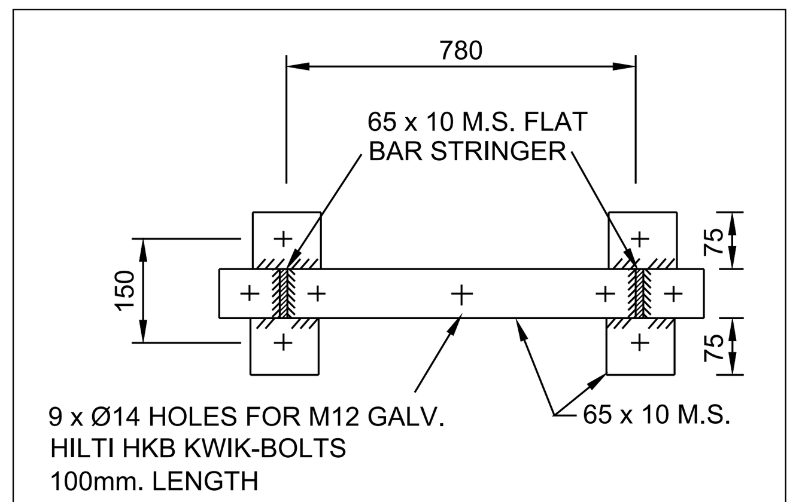
TYPICAL DETAIL OF WELDED ATTACHMENT OF RUNG TO STRINGER C - C

1 : 1



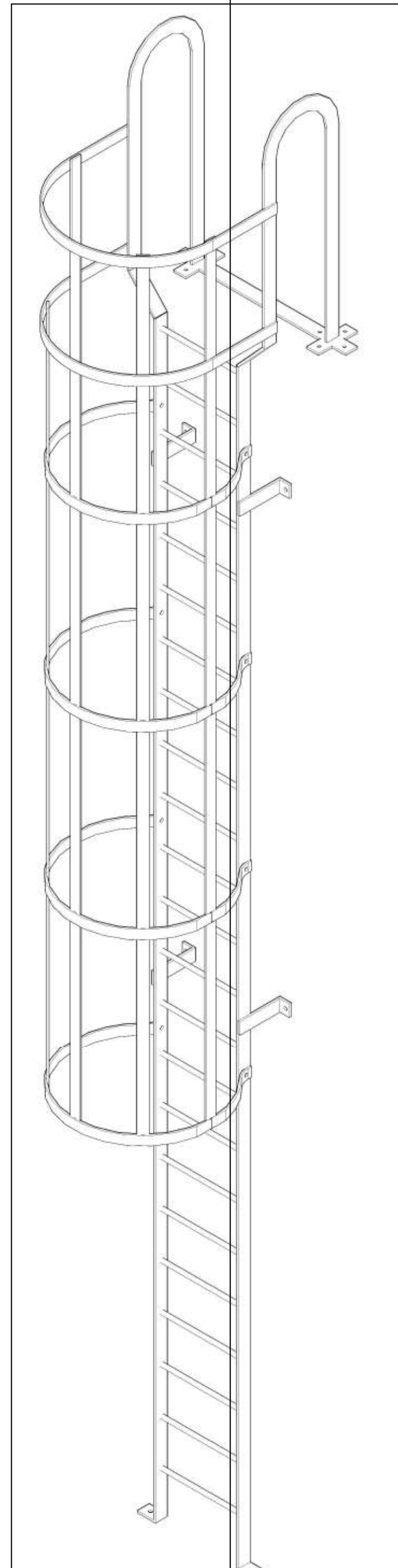
DETAIL '1'

SCALE 1 : 2



DETAIL '2'

N.T.S.



3D VIEW

QTY	A	B	C	D	E	F	G	H	I	TERMINATION TYPE	LOCATION
1	3350	3350	0	1000	0	1475	1500	375	1350	2	GMS ABSTRACTION EXTERNAL TYPE CAGED ACCESS LADDER FROM PLATFORM LEVEL 3 TO PLATFORM LEVEL 2

ON ORIGINAL
0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

STRINGERS
1. STRINGERS TO BE FABRICATED FROM 65 x 10 THICK M.S. FLAT BAR IN CONTINUOUS LENGTHS. IF JOINED, FISH PLATES ARE TO BE USED ON INSIDE OF STRINGERS.
2. JOINTS TO BE BOLTED, RIVETED OR WELDED. BOLTS OR RIVETS TO BE NOT LESS THAN 2 x M12 ON EACH SIDE OF JOINT.

RUNGS
1. RUNGS TO BE FABRICATED FROM Ø20mm SOLID M.S. ROUND BARS.
2. RUNGS TO BE FITTED INTO HOLES DRILLED IN STRINGERS & WELDED. HOLES DRILLED TO ALLOW 0.8mm CLEARANCE.

SAFETY HOOPS
1. HOOPS & STRAPS TO BE FABRICATED FROM 50 x 8mm THK M.S. FLATS.
2. ANY LADDER RISING MORE THAN 3.0m, REQUIRES SAFETY HOOPS.
3. LOWER MOST HOOP AT 2.375m, (MIN 2200 AND MAX 2500)
4. HOOPS AND STRAPS MUST BE BOLTED.

HOLES :
1. ALL BOLT HOLES TO BE DRILLED.

BOLTS :
1. ALL BOLTS TO BE GRADE 304 STAINLESS STEEL.

FINISH:
1. ALL BURRS, WELD-FLASH & SHARP EDGES TO BE REMOVED & MADE SMOOTH BY THE FINISHING TREATMENT. TO BE HOT-DIPPED GALVANISED TO SANS 121 (ISO 1461) MINIMUM 90 MICRON.

NB. *ALL STEELWORK SHALL BE IN ACCORDANCE WITH SANS 10162 'THE STRUCTURAL USE OF STEEL' MATERIAL SPECIFICATION : MILD STEEL TO 350W

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB
ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI
Drawn By: C.ROSS
Designed By: M.FUNNELL
Reviewed By: M.HOLMES

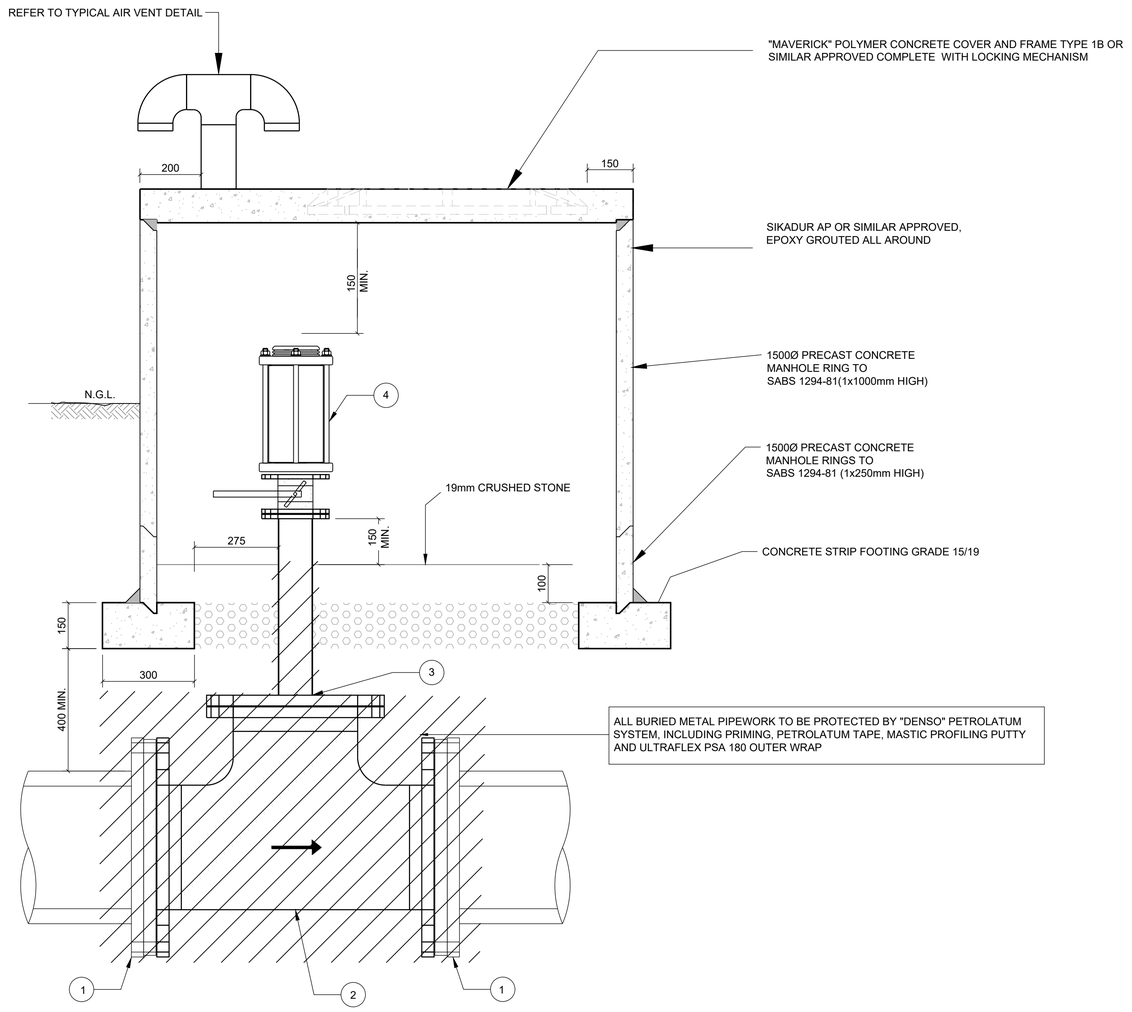
Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

Description: STANDARD DETAILS
GALVANISED LADDER DETAILS WITH HOOP TYPE ENTRANCE RAIL (EXTERNAL TYPE)

Scale: AS SHOWN
Date: 26/06/21
Project No: J40044
Drg. No: 903
Rev: A

ISSUED FOR TENDER

C:\OneDrive\gibb.co.za\J40044 - Documents\J40044\J40044-04_Project Execution\U Design\Drawings\900 Standard Details\J40044-903 GALV LADDER EXT 8m.dwg | CHERYL ROSS | 09/07/2021 09:18:16

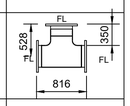
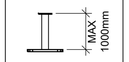


AIR VALVE DETAIL

SCALE - 1:10

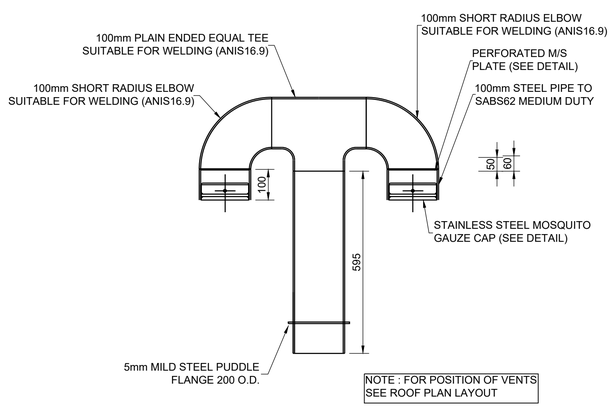
PIPEWORK SCHEDULE: AIR VALVE DETAIL

ALL SPECIALS TO BE MILD STEEL SUITED FOR 1.0MPa WORKING PRESSURE UNLESS OTHERWISE SPECIFIED.
ALL PIPE FITTINGS AND FLANGE DRILLINGS TO SABS 1123: TABLE 1000 /3 UNLESS OTHERWISE SHOWN.

ITEM	QTY	MATERIAL; COATING & LINING	DESCRIPTION	SKETCH
1	2	HDPE	355mm NB REINERT-RITZ (OR SIMILAR APPROVED) HP FLANGE WITH PE100 WELDING STUB AND PERMANENTLY FITTED BACKING FLANGE, DESIGNED FOR FULL PRESSURE RESISTANCE, DRILLED IN ACCORDANCE WITH SANS 1123. THE BODY OF THE PE FITTING MUST BE MANUFACTURED IN THE INJECTION MOULDING PROCESS OR FROM A PIECE OF HOMOGENEOUS SEMIFINISHED MATERIAL. SEMI-FINISHED MATERIALS MANUFACTURED	
2	1	HOT DIPPED GALVANISED	DN350 FLANGED EQUAL TEE	
3	1	HOT DIPPED GALVANISED	DN350 BLANK FLANGE; WITH HOLE DRILLED CENTRALLY TO SUIT ID OF DN80 PIPE WELDED OVER OPENING; DN80 PIPE TO BE FLANGED, AND FLANGE TO SUIT DN80 FLANGED AIR VALVE	
4	1	AS PER SPECS	DN80 FLANGED TRIPLE-ACTING SS AIR VALVE WITH "ANTI-SHOCK" FUNCTION AND ANTI THEFT TYPE COMPLETE WITH INCLUSIVE 80mm QUATER TURN WAFER BUTTERFLY VALVE F/F TO ISO 5752-13, "VARIANT 080LT16" OR SIMILAR APPROVED	

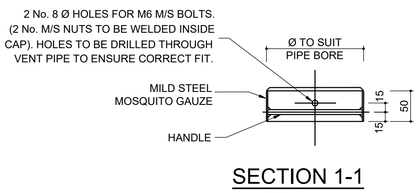
PIPE NOTES

1. ALL STEEL PIPES & FITTINGS DN150 AND SMALLER TO BE MINIMUM MEDIUM DUTY TO SABS 62 UNLESS OTHERWISE SPECIFIED.
2. ALL STEEL PIPES & FITTINGS LARGER THAN DN150 TO HAVE EITHER A MINIMUM 4.5mm WALL THICKNESS TO SABS 719 GRADE B OR TO HAVE A DIAMETER TO THICKNESS RATIO OF 125, WHICHEVER IS THE GREATER
3. SURFACE PREPARATION FOR APPLICATION OF CORROSION PROTECTION MATERIALS SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS.
4. ALL WELDED FITTINGS & FLANGES TO BE DOCUMENTED AS PER SPECIFICATIONS & WELDERS MUST BE QUALIFIED TO WQR. ALL WELDS MUST BE 100% VISUALLY INSPECTED INSIDE & OUT AND 100% DYE PENETRANT INSPECTED BEFORE GALVANISING.
5. ALL WELDING SHALL CONFORM TO SABS 0167-1984 AND SABS 044 SPECIFICATIONS.
6. ALL FLANGES TO BE MANUFACTURED & DRILLED TO SABS 1123
7. ALL THREADS TO BE BRITISH STANDARD PIPE(BSP) THREADS.
8. ALL STEEL PIPES & FITTINGS SMALLER THAN DN50 SHALL BE HOT DIPPED GALVANISED TO ISO 1461 : 2009 WITH A COATING NO LESS THAN 700 g/m² OR THICKNESS OF 80 MICRONS.
9. ALL STEEL PIPES & FITTINGS SMALLER THAN DN350 BUT LARGER THAN DN 50 TO BE FBE COATED AND LINED TO MINIMUM THICKNESS OF 350 MICRON
10. ALL STEEL PIPES & FITTINGS DN350 AND LARGER TO BE EPOXY COATED AND LINED WITH A MINIMUM DRY FILM THICKNESS OF 450 MICRONS UNLESS OTHERWISE SPECIFIED IN THE SPECIFICATIONS
11. ALL BURIED STEEL PIPES CAST THROUGH CONCRETE WALLS, REGARDLESS OF DIAMETER, TO BE WRAPPED WITH DENSO STEELCOAT 500, OR SIMILAR APPROVED AND WRAPPING TO EXTEND 100mm FROM INNER AND OUTER FACES OF CONCRETE UNLESS OTHERWISE SPECIFIED.
12. ALL STEEL PIPES CAST IN CONCRETE SHALL BE POSITIONED WITH OUTER SURFACE NO CLOSER THAN 25mm TO ANY REINFORCING OR OTHER STEEL IN THE CONCRETE.
13. ALL STEEL COMPONENTS, BOLTS, NUTS & WASHERS TO BE HOT DIP GALVANISED TO ISO 1461 : 2009 UNLESS OTHERWISE SPECIFIED IN THE SPECIFICATIONS.
14. ALL BOLTED CONNECTIONS TO HAVE WASHERS UNDER BOTH THE HEAD OF THE BOLT AND THE NUT.
15. ALL BURIED FITTINGS AND PIPES TO BE PROTECTED BY "DENSO" PETROLATUM SYSTEM INCLUDING MASTIC PROFILING PUDDY, PETROLATUM TAPE AND ULTRA FLEX PSA 180 TAPE INSTALLED TO MANUFACTURERS SPECIFICATIONS.
16. ALL GMS NUTS, BOLTS, WASHERS, THREADED BARS AND ALL OTHER GMS OR UNCOATED METAL SURFACES, IN EXPOSED SITUATIONS, SHALL, AFTER SUCCESSFUL PRESSURE- TESTING AND AFTER THOROUGH BRUSHING / CHIPPING TO REMOVE CONCRETE SPLATTER ETC, DE-GREASING AND DETERGENT CLEANING AND CLEAN WATER RINSING, SHALL BE COMPLETELY AND GENEROUSLY HAND-PAINT COATED BY AN APPROVED HEAVY-DUTY, SELF-HEALING, SURFACE TOLERANT, FLEXIBLE POLYMER-MODIFIED WAX CORROSION-INHIBITOR SUCH AS 'CHESTERTON 740 HEAVY DUTY RUST GUARD'
17. ALL DIMENSIONS IN MILLIMETRES.
18. ALL PIPEWORKS & FITTINGS TO BE MEASURED & CHECKED ON SITE PRIOR TO INSTALLATION AND ADVISE THE ENGINEER OF ANY DISCREPANCIES PRIOR TO FABRICATION.
19. 2 STRIPS OF NEOPRENE 25 OR AN APPROVED RUBBER OF ONE LAYER BETWEEN 2mm AND 5mm TO BE PLACED BETWEEN THE PIPEWORK AND SUPPORTS.
20. WHERE PIPE SUPPORTS ARE CAST INSITU, DENSO STEELCOAT 500, OR SIMILAR APPROVED, IS TO BE USED AT INTERFACE WITH PIPES AND VALVES. WRAPPING TO EXTEND 100mm FROM EDGE SUPPORT.
21. IF THE PIPELINE HAS CATHODIC-PROTECTION, THE FIRST EXPOSED FLANGED JOINT SHALL BE FITTED WITH AN INSULATING GASKET AND BOLT SET, COMPLETE WITH SPARK-GAP DEVICE IN ORDER TO ELECTRICALLY-INSULATE THE CHAMBER PIPEWORK FROM THE PROTECTED PIPELINE OUTSIDE.
22. DAMAGED COATINGS AND LININGS SHALL BE REPAIRED IN ACCORDANCE WITH THE SPECIFICATIONS.
23. COLLARS, WRAPPERS AND CROTCH PLATES ARE TO BE MANUFACTURED FROM A MINIMUM OF SABS 719 GRADE B STEEL, OR OF THE SAME GRADE AS THE MAIN PIPE WHICHEVER HAS THE HIGHER YIELD STRESS STRENGTH AND WELDED IN ACCORDANCE WITH THE SPECIFICATIONS
24. PIPE SUPPORT POSITIONS TO BE DETERMINED ON SITE AND APPROVED BY ENGINEER



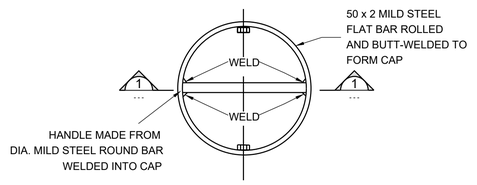
AIR VENT DETAIL

SCALE 1 : 10



SECTION 1-1

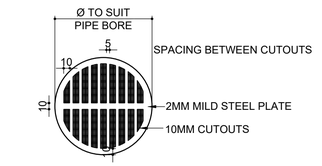
SCALE 1 : 5



PLAN

DETAILS OF MOSQUITO GAUZE CAP

SCALE 1 : 5



PERFORATED PLATE DETAIL

SCALE 1 : 5

0 0.1 0.2 0.3 0.4 0.5m

AT ORIGINAL 1 : 5 SCALE

0 0.1 0.2 0.3 0.4 0.5 1m

AT ORIGINAL 1 : 10 SCALE

0 0.5 1m 2m

AT ORIGINAL 1 : 20 SCALE

ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client

HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By	Designed By	Reviewed By
C.ROSS	M.HOLMES	M.HOLMES

Project

GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

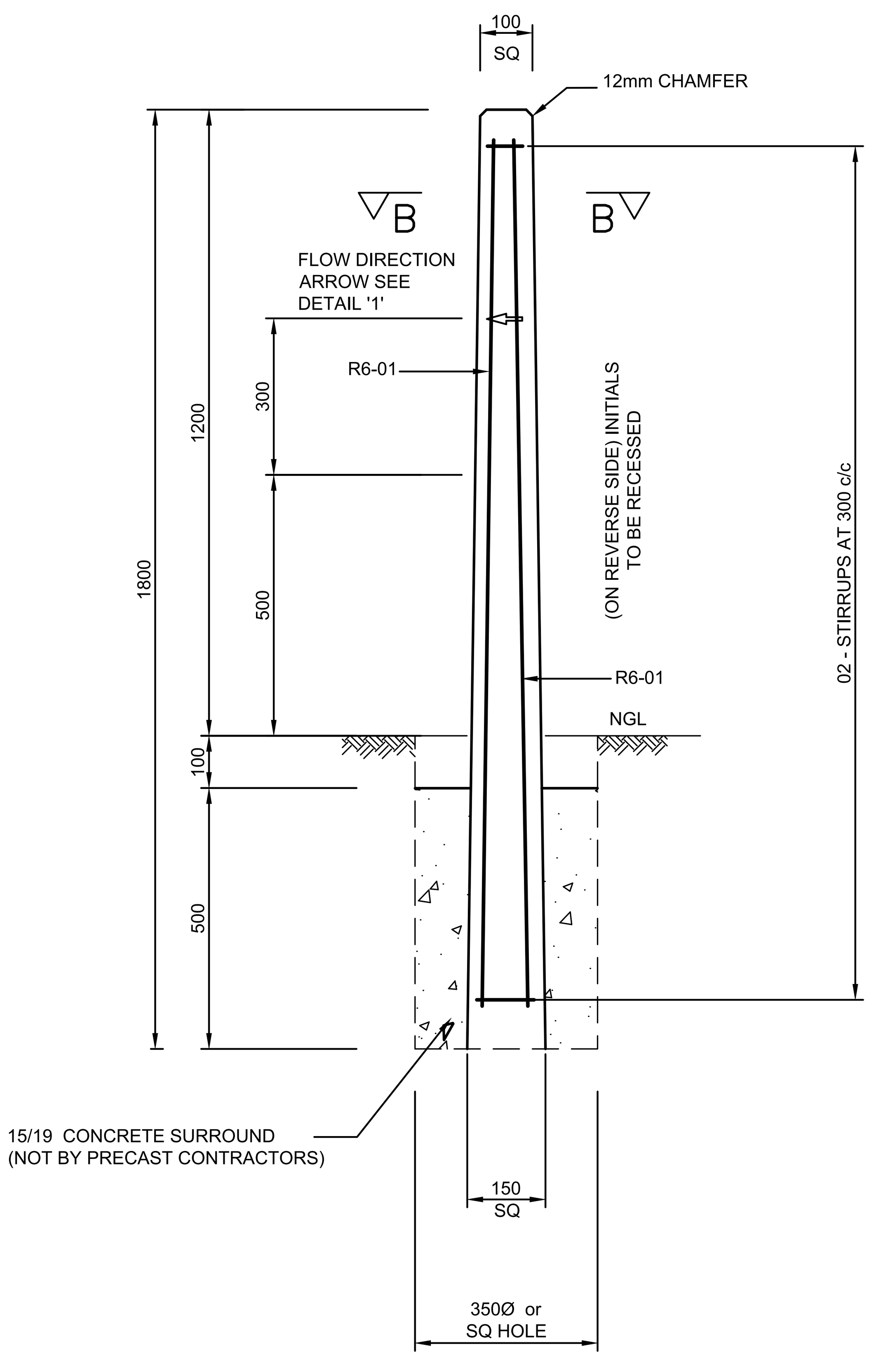
Description

STANDARD DETAILS

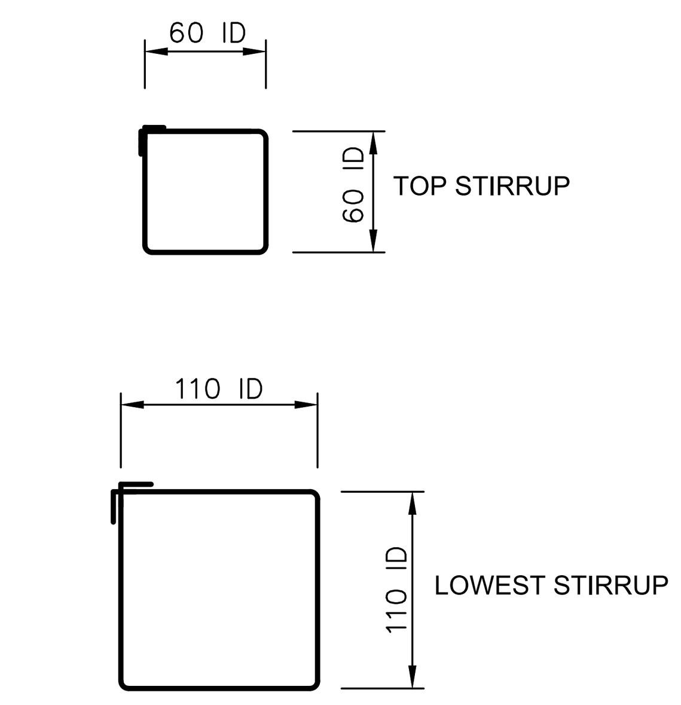
AIR VALVE DETAIL

Scale: AS SHOWN | Date: 26/06/21

Project No: J40044 / Drg. No: 904 / Rev: A



ELEVATION
1 : 10



1 : 5

(OTHER STIRRUP DIMENSIONS PRO-RATA)
I.D. - INTERNAL DIMENSIONS

MEMBER	BAR MARK	TYPE AND SIZE	No. OF MBRS	No. IN EACH	TOTAL No.	LENGTH OF EACH BAR(*)	SHAPE CODE	A	B	C	D	E/R	TOTAL LENGTH
	01	R6	1	4	4	1 700	20	1 700					6.8
	02	(16 GAUGE WIRE) TO BE TIED AS SHOWN											

ALL BENDING DIMENSIONS ARE IN ACCORDANCE WITH SABS 82
* LENGTH SPECIFIED TO NEAREST 50 mm

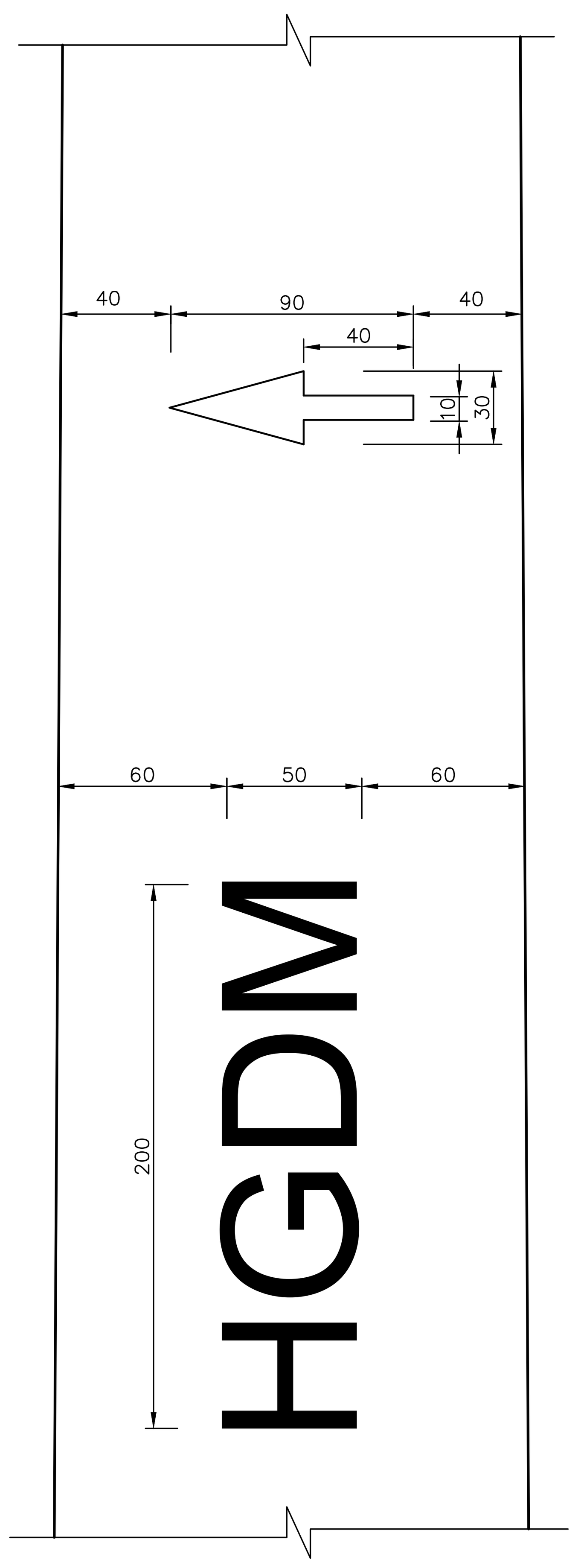
BAR DIAMETER	R8	R10	Y10	Y12	Y16	Y20	Y25	Y32
UNIT MASS (kg/m)	0.395	0.616	0.616	0.888	1.579	2.466	3.854	6.313

TOTAL MASS	
MS	
HTS	-

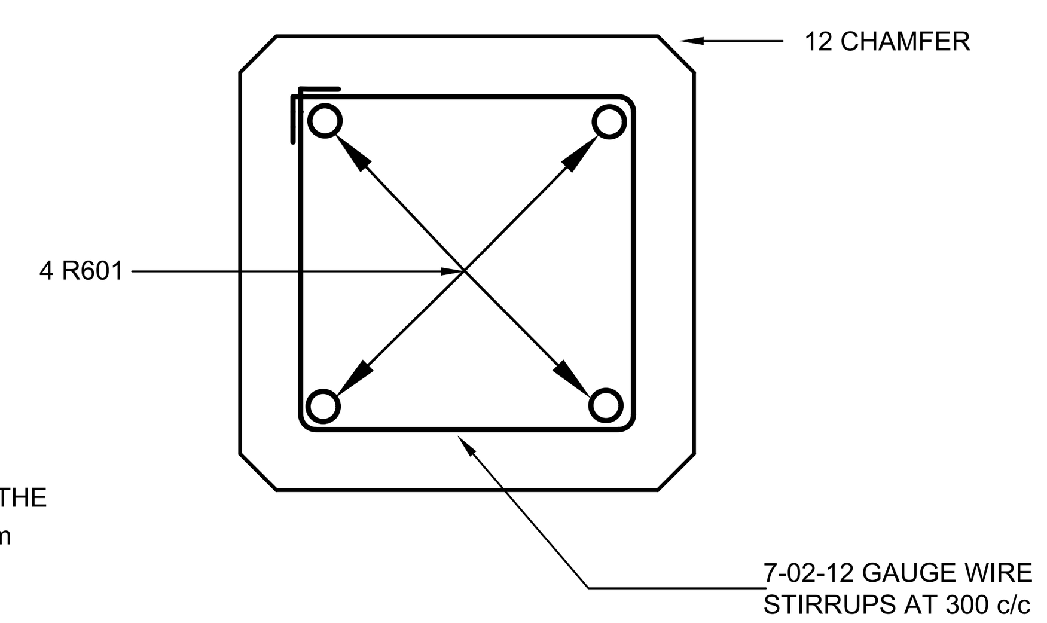
CONCRETE MIX: USING PC15SL AND 12mm CRUSHED STONE

BATCHING	CEMENT PC15SL	CEMENT SAND	CRUSHED STONE
SMALL BATCHES	1 PART	1¾ PARTS	1¾ PARTS
1-POCKET BATCHES	1 POCKET	1 BARROW	1 BARROW * i.e. SEE NOTE BELOW
TO BATCH 1m³	10 POCKETS	0.65m³	0.65m³

* (i.e. BUILDERS BARROW FILLED LEVEL)



FLOW DIRECTION ARROW AND HGDM
(RECESSED 4mm BOTH SIDES)
DETAIL '1'
1:2



NOTE :
MINIMUM COVER TO THE
REINFORCING = 20mm

SECTION B - B
PRECAST CONCRETE PIPELINE
MARKER POSTS
1 : 5

ISSUED FOR TENDER

ALL DIMENSIONS AND LEVELS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR BEFORE COMMENCING ANY WORK.

ON ORIGINAL
0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

PAINTING:-
1. POST TO BE PAINTED WITH WHITE ROAD MARKING PAINT FOR BULK SUPPLY SCHEMES.
2. YELLOW ROAD MARKING PAINT FOR RETICULATION SUPPLY SCHEMES.
3. GREEN ROAD MARKING PAINT FOR FIRE WATER PIPELINES

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB
ENGINEERING & ARCHITECTURE

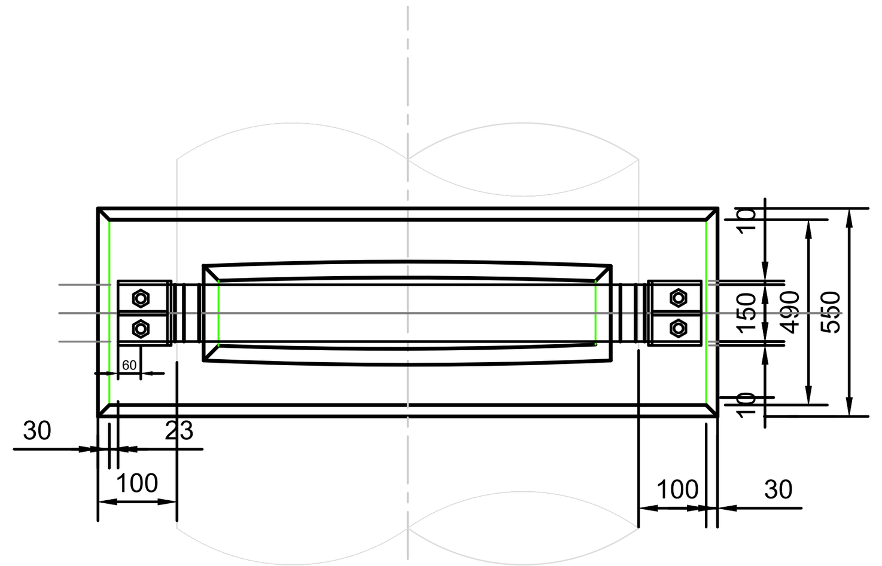
Approved By: N.MKHWANAZI
Drawn By: C.ROSS | Designed By: M.HOLMES | Reviewed By: M.HOLMES

Project:
GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

Description:
STANDARD DETAILS
PRECAST MARKER POST AND REINFORCEMENT DETAILS

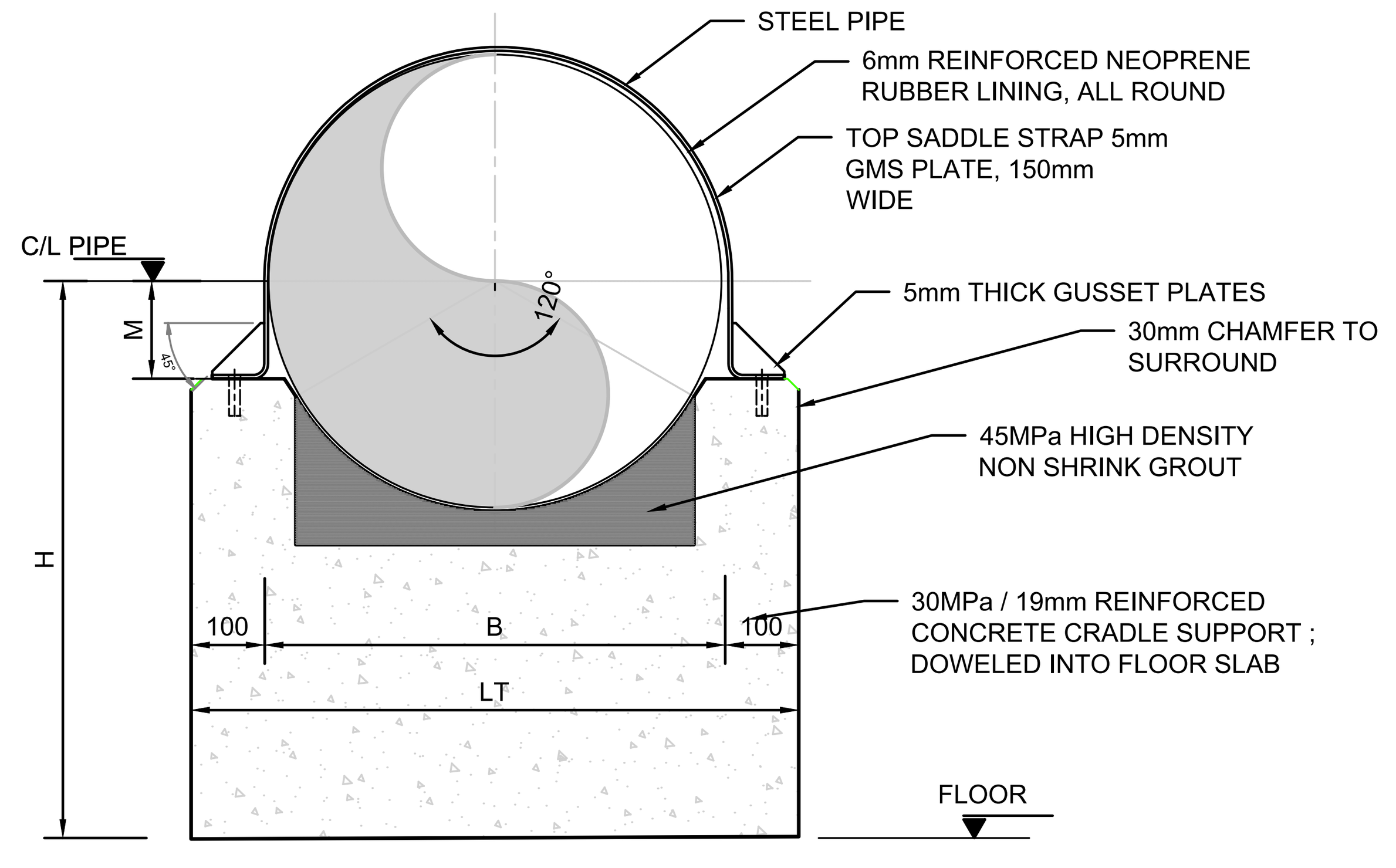
Scale: AS SHOWN | Date: 26/06/21

Project No: J40044 / Drg. No: 905 / Rev: A

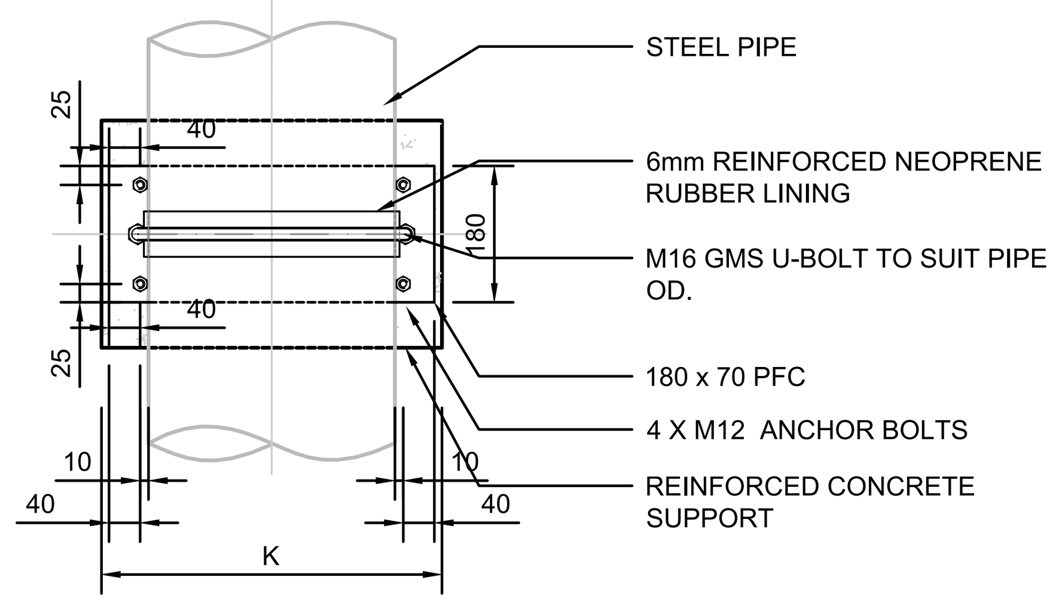


PLAN
CONCRETE PIPE SUPPORT
SCALE 1:20

LOCATION AND NUMBER OF CONCRETE PIPE SUPPORTS		DIMENSIONS (mm)			
No.	LOCATION	H	B	LT	M



SECTION
TYPE 1
CONCRETE PIPE SUPPORT
SCALE 1:20

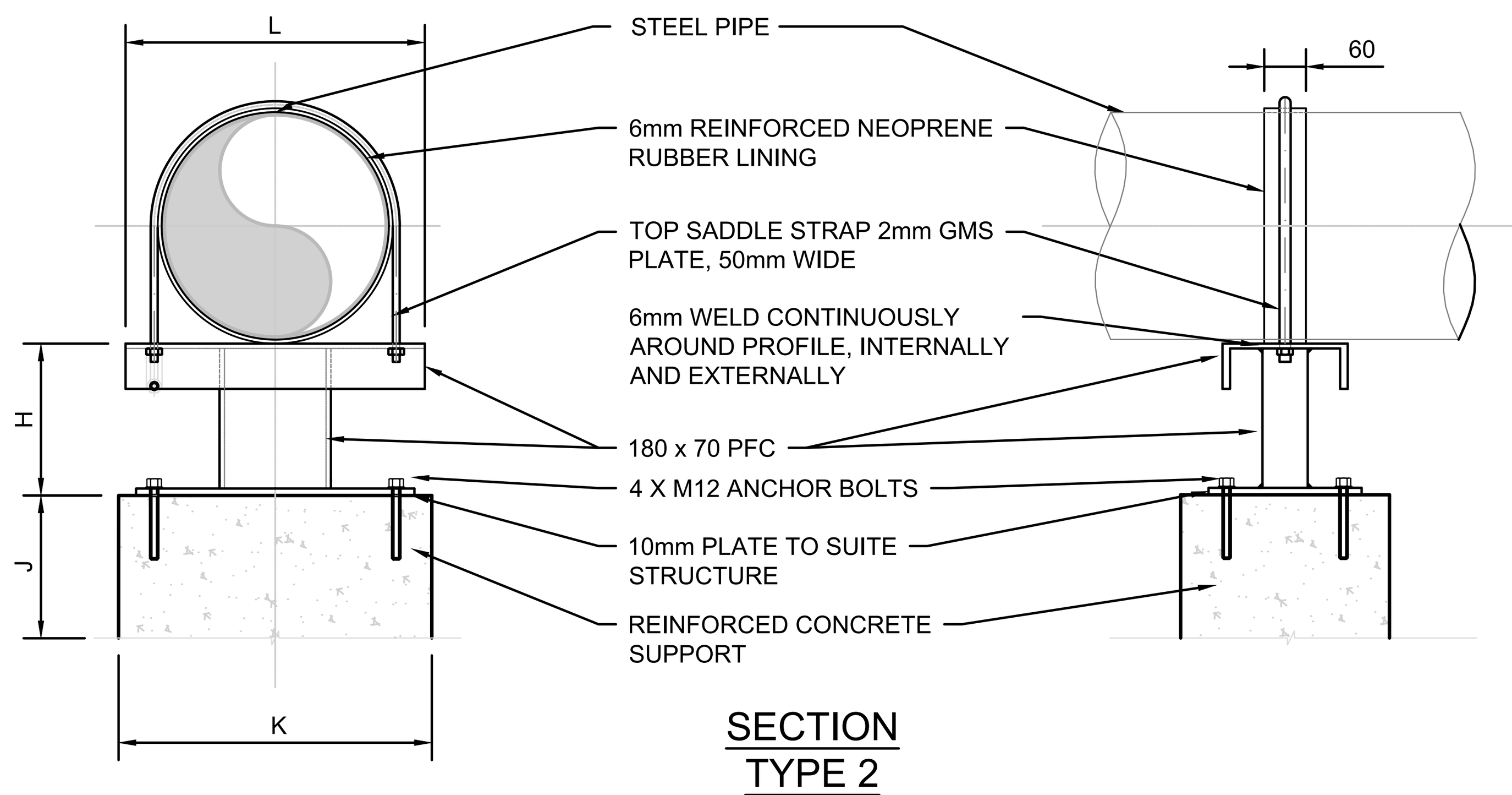


PLAN
STEEL PIPE SUPPORT
SCALE 1:10

LOCATION AND NUMBER OF STEEL PIPE SUPPORTS					
No.	Location	"H"	"J"	"K"	"L"
9	ABSTRACTION PUMPSTATION; MAIN VERTICAL DELIVERY; TO DN150 PIPE	206	0	0	265
3	ABSTRACTION PS; DELIVERY MANIFOLD; TO DN300 PIPE	272	0	0	430
2	ABSTRACTION PS; OUTSIDE DELIVERY PIPE; TO DN300 PIPE	272	0	0	430

NOTE: SUPPORTS FOR THE FOLLOWING ARE NOT SCHEDULED HERE AND ARE TO BE INCLUDED WITH RESPECTIVE ITEMS:

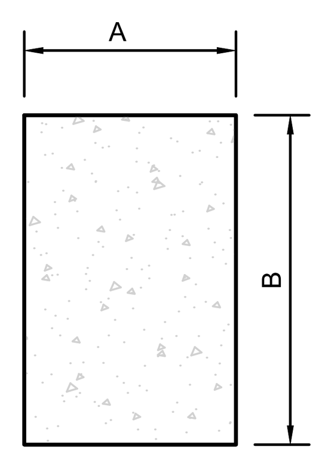
1. DELIVERY PIPING FOR ABSTRACTION PUMPSTATION
2. DELIVERY PIPING FOR SUMP PUMPS
3. SUPPORTS TO PRESSURE GAUGES & OTHER INSTRUMENTS



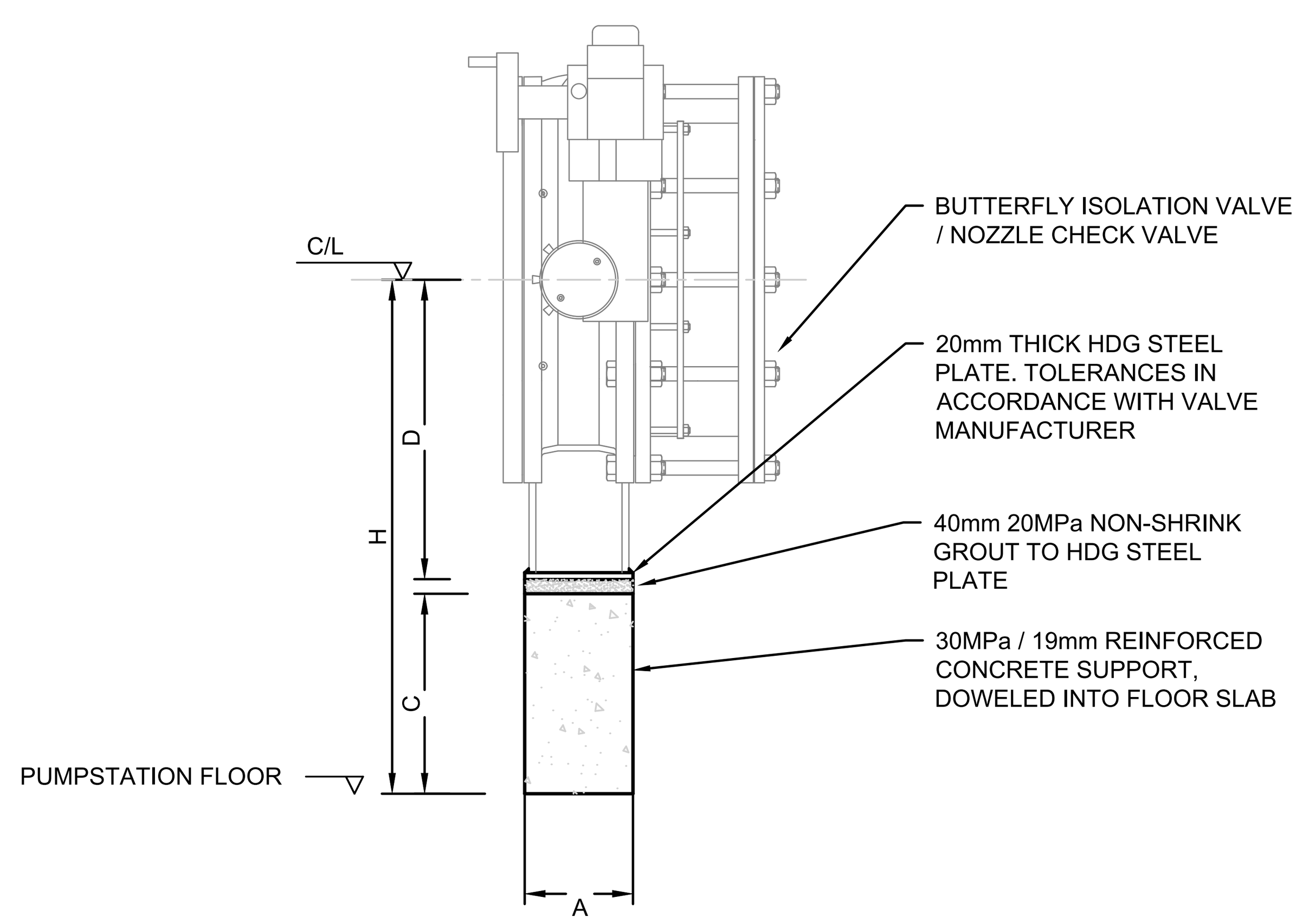
SECTION
TYPE 2
STEEL PIPE SUPPORT
SCALE 1:10

LOCATION AND NUMBER OF CONCRETE VALVE SUPPORTS		DIMENSIONS (mm)				
No.	Location	H	A	B	C*	D*
2	ABSTRACTION PUMPSTATION; DELIVERY LINE; TO DN150 RESILIENT VALVE	440	230	280	200	200
2	ABSTRACTION PUMPSTATION; DELIVERY LINE; TO DN150 NONRETURN VALVE	440	170	280	200	200
1	ABSTRACTION PUMPSTATION; SCOUR LINE; TO DN50 WEDGE GATE VALVE	309	100	100	226.5	82.5

*DIMENSION SUBJECT TO VALVE SUPPLIER & EXTENSION FOOT SUPPORT DETAILS.



PLAN
VALVE SUPPORT
SCALE 1:20



SECTION
TYPE 3
VALVE SUPPORT WITH FOOT EXTENSION
SCALE 1:20

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ALL DIMENSIONS AND LEVELS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR BEFORE COMMENCING ANY WORK.

ON ORIGINAL
0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB
ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By: C.ROSS | Designed By: M.HOLMES | Reviewed By: M.HOLMES

Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

Description: STANDARD DETAILS
PIPE SUPPORT DETAILS
SHEET 1 OF 2

Scale: AS SHOWN | Date: 26/06/21

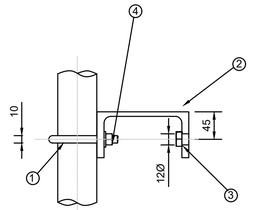
Project No: J40044 / Drg. No: 906 / Rev: A

ISSUED FOR TENDER

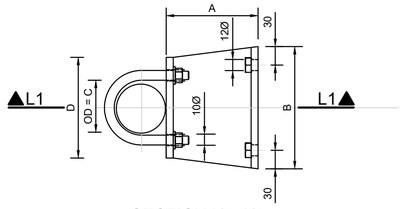
MATERIAL LIST PER SUPPORT			
ITEM	TOTAL QUANTITY	DESCRIPTION	MATERIAL
1	1	U BOLT M10 x ?? I.D.	SS
2	1	150x50x6 PFC	350WA
3	2	M12 x 40 C/W BOLT AND WASHER	GR. 8.4
4	2	M10 x 40 C/W NUT AND WASHER	GR. 8.4

NOTES

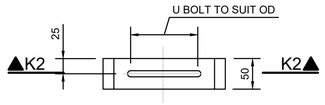
1. SURFACE PROTECTION TO BE HOT DIP GALVANISED.
2. QUANTITY OF CLAMPS AS INDICATED AND DESCRIBED ON DRAWINGS OR AS PER SUPPLIERS RECOMMENDATIONS
3. ALL PIPES TO BE SURROUNDED BY 6mm THICK REINFORCED NEOPRENE RUBBER LINING AT THE UBOLT PIPE INTERSECTION



SECTION L2 - L2
SCALE 1:5



SECTION K2- K2
SCALE 1:5



PLAN
SCALE 1:5

PIPE SUPPORT DIMENSIONS					
No.	DESCRIPTION	A	B	C	D
3	DN50 SCOUR PIPE	155	200	60	160

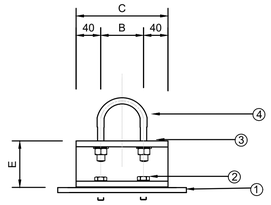
TYPE 6
INDICATIVE SMALL DIAMETER PIPE SUPPORT
SCALE 1:5

MATERIAL LIST PER BEAM SUPPORT			
ITEM	TOTAL QUANTITY	DESCRIPTION	MATERIAL
1	1	PLATE 190 x 78 x 6	350WA
2	2	M10 CHEMICALLY ANCHORED BOLT	GR. 8.4
3	1	FxDx7 PFC C mm long	350WA
4	1	U BOLT M8 x 60 I.D.	GR. 8.4

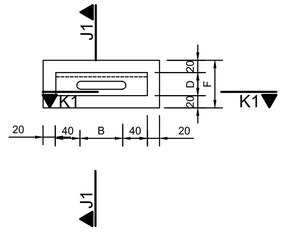
PIPE SUPPORT DIMENSIONS							
No.	DESCRIPTION	A	B	C	D	E	F
2	DN50 SUMP DRAIN PIPE	89	68	148	38	76	76

NOTES

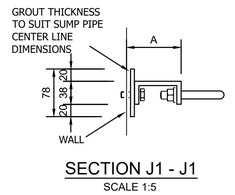
1. SURFACE PROTECTION TO BE HOT DIP GALVANISED.
2. QUANTITY OF CLAMPS AS INDICATED AND DESCRIBED ON DRAWINGS OR AS PER SUPPLIERS RECOMMENDATIONS
3. WELDS TO HAVE ALL ROUND COVERAGE
4. ALL PIPES TO BE SURROUNDED BY 6mm THICK REINFORCED NEOPRENE RUBBER LINING AT AT THE UBOLT PIPE INTERSECTION



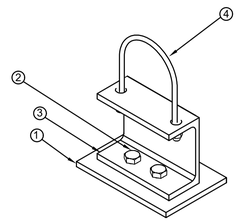
SECTION K1 - K1
SCALE 1:5



PLAN
SCALE 1:5

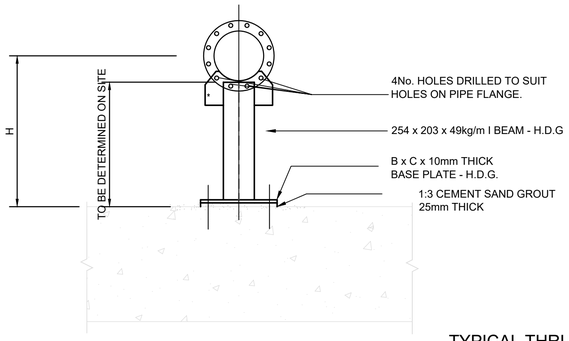


SECTION J1 - J1
SCALE 1:5



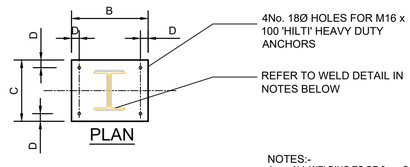
ISOMETRIC VIEW
SCALE 1:5

TYPE 7
INDICATIVE SMALL DIAMETER PIPE SUPPORT
SCALE 1:5



SECTION

* 10mm THICK PLATE DIMENSIONS TO BE DETERMINED BY CONTRACTOR) WELDED TO VERTICAL SUPPORT AND BOLTED TO PIPE FLANGE



PLAN

TYPE 4
TYPICAL THRUST SUPPORT FOR PIPES
SCALE 1:20

NOTES:-

1. ALL WELDING TO BE 8mm CONTINUOUS FILLET.
2. WELDS TO BE ALL ROUND COVERAGE
3. ROUGH WELDS TO BE GROUND SMOOTH TO SABS 044 GRIND TO ROUND PROFILE.
4. ALL COMPONENTS TO BE FREE OF BURRS AND SHARP EDGES.
5. ALL WELDS TO FORM THE ENTIRE PERIPHERY (CONNECTION FACE) OF THE STRUCTURAL MEMBER TO THE BASE PLATE
6. FABRICATOR TO SUPPLY ALL BOLTS, NUTS AND WASHERS FOR ASSEMBLY AND ERECTION BAGGED IN HESSIAN, LABELLED AND DELIVERED TO SITE.
7. TO BE HOT DIP GALVANISED TO CLIENT SPECIFICATION OR GIBB 007.
8. BOLT HOLE LOCATION DETERMINED ON SITE

LOCATION AND NUMBER OF CONCRETE PIPE SUPPORTS		DIMENSIONS (mm)			
No.	LOCATION	H	B	C	D
1	ABSTRACTION PS; DELIVERY MANIFOLD; TO DN300 PN16 PIPE	440	500	400	50

ISSUED FOR TENDER

ON ORIGINAL
0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By	Designed By	Reviewed By
C.ROSS	M.FUNNELL	M.HOLMES

Project: **GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5**

Description: **STANDARD DETAILS**
PIPE SUPPORT DETAILS
SHEET 2 OF 2

Scale: AS SHOWN | Date: 26/06/21

Project No: J40044 | Drg. No: 907 | Rev: A

FITTINGS SCHEDULE FOR ISOLATION VALVE ASSEMBLY TYPE 1

uPVC PIPES TO SABS 996 OF THE FOLLOWING Ø (mm)	ITEM 1: DUCTILE IRON FLANGE ADAPTOR (FBE COATED) (mm)	ITEM 2: RESILIENT SEAL OR WEDGE GATE VALVE TO SABS 664 (mm) (AS APPLICABLE)	ITEM 3: uPVC PIPE PN 9 (or similar approved)
50	50 x 2"	50	160
63	63 x 2"	50	160
75	75 x 3"	80	200
90	90 x 3"	80	200
110	110 x 4"	100	200
160	160 x 6"	150	315
200	200 x 8"	200	315
250	250 x 10"	250	TO SUIT VALVE BONNET
315	300 x 12"	300	TO SUIT VALVE BONNET

FITTINGS SCHEDULE FOR ISOLATION VALVE ASSEMBLY TYPE 2

HDPE PIPES TO SABS 533 PE100 OF THE FOLLOWING Ø (mm)	ITEM 1: COMPRESSION FLANGE ADAPTOR (mm)	ITEM 2: RESILIENT SEAL OR WEDGE GATE VALVE TO SABS 664 (mm) (AS APPLICABLE)	ITEM 3: uPVC PIPE PN 9 (or similar approved)
50	50 x 2"	50	160
63	63 x 2"	50	160
75	75 x 3"	80	200
90	90 x 3"	80	200

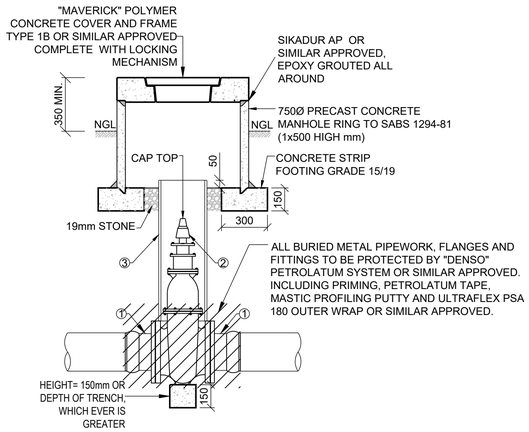
FITTINGS SCHEDULE FOR ISOLATION VALVE FOR ASSEMBLY TYPE 3

PIPES OF RELEVANT TYPES AND CLASS OF THE FOLLOWING Ø (mm)	ITEM 1: FLANGE ADAPTOR OR VJ FLANGE ADAPTOR OF RELEVANT DIAMETERS (FBE COATED) (mm)	ITEM 2: RESILIENT SEAL OR WEDGE GATE VALVE TO SABS 664 (mm) (AS APPLICABLE)	ITEM 3: uPVC PIPE PN 9 (or similar approved)
300	300 x 12"	300	TO SUIT VALVE BONNET
350	350 x 14"	350	TO SUIT VALVE BONNET
400	400 x 16"	400	TO SUIT VALVE BONNET
450	450 x 18"	450	TO SUIT VALVE BONNET

FITTINGS SCHEDULE FOR ISOLATION VALVE FOR ASSEMBLY TYPE 4

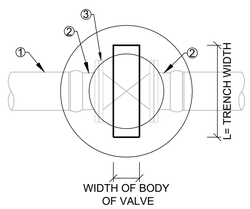
PIPES OF RELEVANT TYPES AND CLASS OF THE FOLLOWING OD (mm) HDPE PIPE	ITEM 1: XXXmm NB REINERT-RITZ (OR SIMILAR APPROVED) HP FLANGE WITH PE100 WELDING STUB AND PERMANENTLY FITTED BACKING FLANGE, DESIGNED FOR FULL PRESSURE RESISTANCE, DRILLED IN ACCORDANCE WITH SANS 1123. THE BODY OF THE PE FITTING MUST BE MANUFACTURED IN THE INJECTION MOULDING PROCESS OR FROM A PIECE OF HOMOGENEOUS SEMIFINISHED MATERIAL. SEMI-FINISHED MATERIALS MANUFACTURED (mm)	ITEM 2: RESILIENT SEAL OR WEDGE GATE VALVE TO SABS 664 (mm) (AS APPLICABLE)	ITEM 3: uPVC PIPE PN 9 (or similar approved)
200	200 x 200FL	200	TO SUIT VALVE BONNET
250	250 x 250FL	250	TO SUIT VALVE BONNET
315	315 x 300FL	300	TO SUIT VALVE BONNET
355	355 x 350FL	350	TO SUIT VALVE BONNET

ALL SPECIALS TO BE SUITABLE FOR 1.0 MPa WORKING PRESSURE AS SHOWN ON THE LONG SECTIONS OR PLAN. ALL FLANGES TO BE SABS 1123: TABLE 1000/3 AS APPLICABLE.



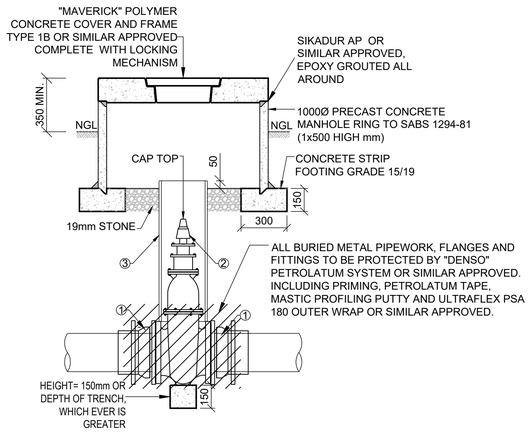
TYPE 1: ISOLATION VALVE DETAIL FOR PVC PIPES

SCALE - 1:20



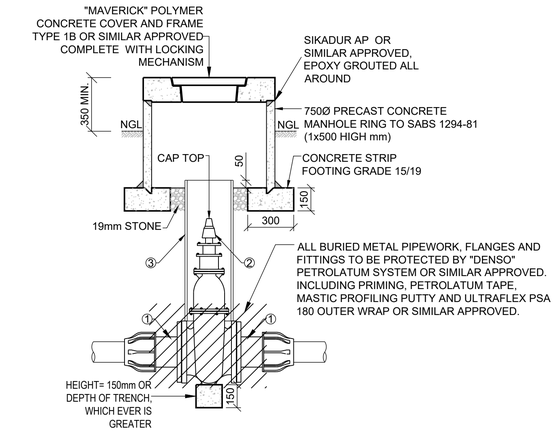
PLAN OF CONCRETE VALVE SUPPORT

SCALE - 1:20



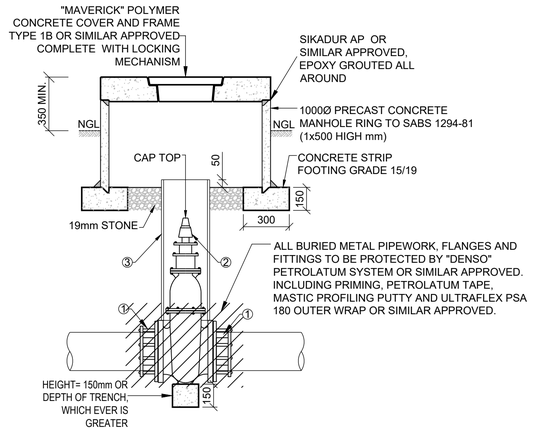
TYPE 4: ISOLATION VALVE DETAIL FOR LARGE HDPE PIPES

SCALE - 1:20



TYPE 2: ISOLATION VALVE DETAIL FOR HDPE PIPES

SCALE - 1:20



TYPE 3: ISOLATION VALVE DETAIL FOR GRP, DI, PIPES

SCALE - 1:20

ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

1. ALL DIMENSIONS IN mm, UNLESS OTHERWISE STATED.
2. DO NOT SCALE OFF THE DRAWING.
3. CONTRACTOR TO VERIFY ALL SETTING OUT DETAILS AND LEVELS WITH THE ENGINEER PRIOR TO CONSTRUCTION.
4. ALL HDPE PIPES TO BE SABS 533 PE 100 RATING UNLESS OTHERWISE STATED.
5. ALL uPVC PIPES TO BE SABS 966, PART 1.
6. ALL mPVC PIPES TO BE SABS 966, PART 2.
7. ALL DUCTILE IRON PIPES TO EN 545.
8. ALL GRP PIPES TO BE SABS 17481.
9. ALL STEEL PIPES TO BE SABS 719
10. ALL CO-ORDINATES, DIMENSION AND LEVELS MUST BE VERIFIED BY THE CONTRACTOR ON SITE BEFORE ANY WORK COMMENCES. ANY DISCREPANCIES MUST BE DISCUSSED WITH THE ENGINEER.
11. ALL STRUCTURAL STEELWORK TO BE HOT DIPPED GALVANISED TO SABS 763.
12. ALL BOLTS TO BE HOT DIPPED GALVANISED AND HAVE WASHERS INSTALLED BENEATH BOTH THE NUT AND BOLT HEAD.

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client: HARRY GWALA DISTRICT MUNICIPALITY

GIBB ENGINEERING & ARCHITECTURE

Approved By: N.MKHWANAZI

Drawn By	Designed By	Reviewed By
M.FUNNELL	M.FUNNELL	M.HOLMES

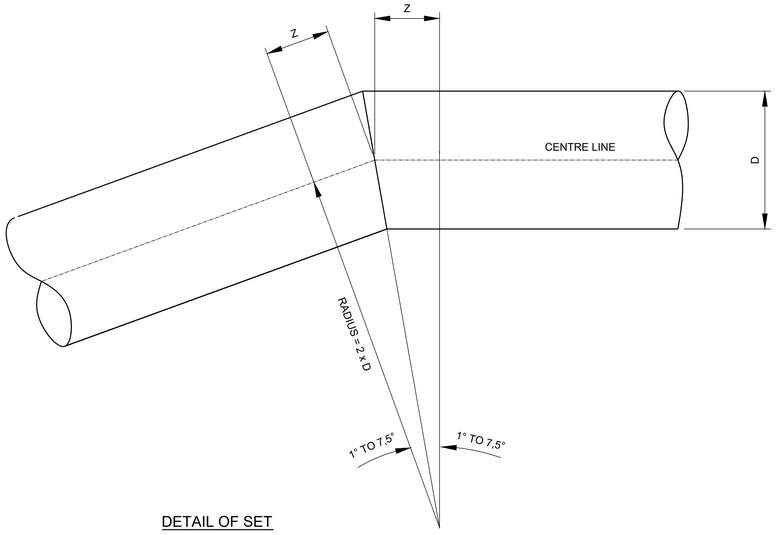
Project: GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

Description: STANDARD DETAILS

ISOLATION VALVE DETAILS

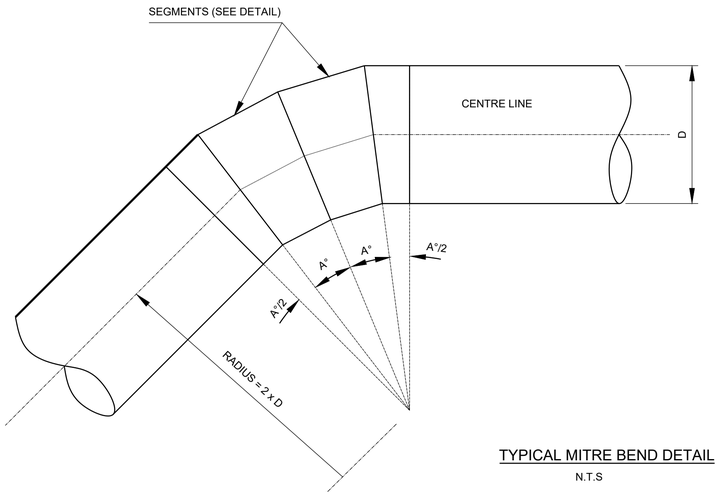
Scale	Date
AS SHOWN	26/06/21

Project No	Drg. No	Rev
J40044	908	A



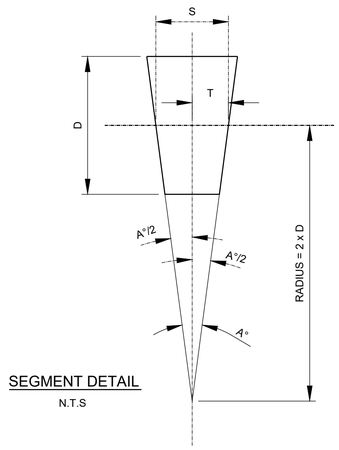
DETAIL OF SET

N.T.S



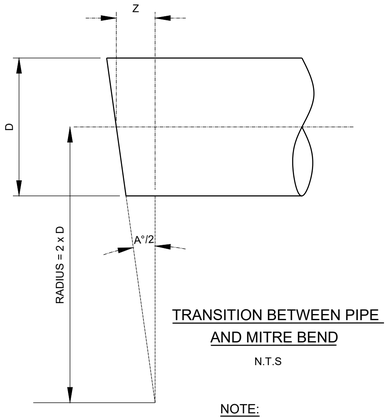
TYPICAL MITRE BEND DETAIL

N.T.S



SEGMENT DETAIL

N.T.S



TRANSITION BETWEEN PIPE AND MITRE BEND

N.T.S

NOTE:

B° = 15° MAX
B°/2 = 7,5° MAX

EXAMPLE TO DETERMINE A AND NUMBER OF SEGMENTS

a) 90° BEND

1) 90°/ 7.5° = 12, therefore minimum of 12 faces required
2) (12/2)+1 = 7 segments required
3) 7 - 2 = 5 full segments required + 2 end segments
4) A°/2 + A°/2 + 5 x A° = 90°
   Thus A° = 15°
   A°/2 = 7.5°

b) 42° BEND

1) 42°/ 7.5° = 5.6, therefore minimum of 6 faces required
2) (6/2)+1 = 4 segments required
3) 4 - 2 = 2 full segments required + 2 end segments
4) A°/2 + A°/2 + 2 x A° = 42°
   Thus A° = 14°
   A°/2 = 7°

c) 22.5° BEND

1) 22.5°/ 7.5° = 3, therefore minimum of 4 faces required (Must be even number)
2) (4/2)+1 = 3 segments required
3) 3 - 2 = 1 full segments required + 2 end segments
4) A°/2 + A°/2 + 1 x A° = 22.5°
   Thus A° = 11.25°
   A°/2 = 5.6°

d) 4° BEND

1) 4°/ 7.5° = 0.5, therefore minimum of 1 faces required
2) (1/2)+1 = 2 segments required
3) 2 - 2 = 0 full segments required + 2 end segments
4) A°/2 + A°/2 + 0 x A° = 4°
   Thus A° = 4°
   A°/2 = 2°

DEFLECTION °	NUMBER OF FULL SEGMENTS OVER AND ABOVE THE 2 ENDS
> 0 - 15	0
> 15 - 22.5	1
> 22.5 - 30	1
> 30 - 37.5	2
> 37.5 - 45	2
> 45 - 52.5	3
> 52.5 - 60	3
> 60 - 67.5	4
> 67.5 - 75	4
> 75 - 82.5	5
> 82.5 - 90	5

ISSUED FOR TENDER

ON ORIGINAL

0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

Client

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Project

GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

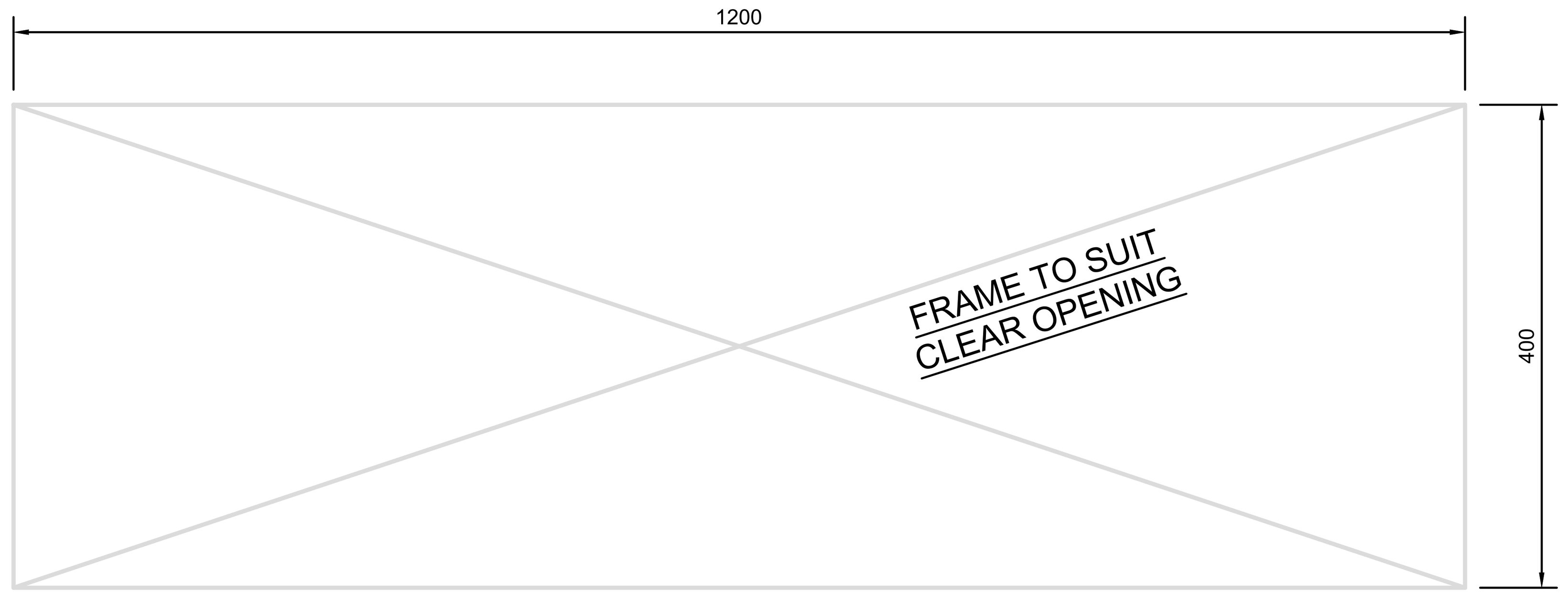
Description

STANDARD DETAILS

HDPe WELDED BEND DETAILS

Scale: AS SHOWN | Date: 26/06/21

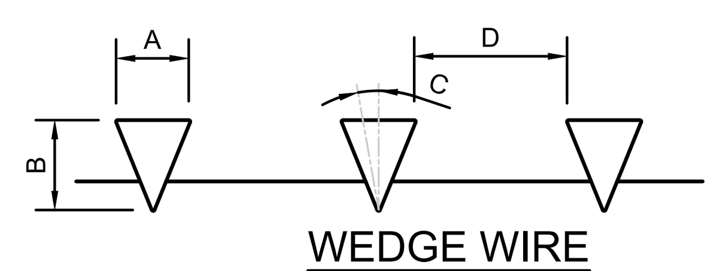
Project No: J40044 | Drg. No: 909 | Rev: A



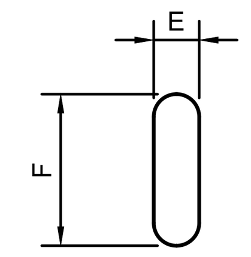
CLEAR OPEINING
SCALE 1 : 5

MATERIAL LIST PER SCREEN			
ITEM	TOTAL QTY	DESCRIPTION	MATERIAL
1	2	80x60x6 L	SS316L
2	2	80X60X6 L	SS316L
3	9	FxE FLAT BAR	SS316L
4	16	M12 "HILTI - HAS-U A4" 160mm ANCHOR ROD WITH "HILTI - HIT-RE 500 V4" EPOXY ANCHOR OR SIMILAR APPROVED	SS316L
5	1	80x6 PLATE	SS316L
6	3	M12 NUT BOLT AND WASHER	SS316L
7	20	WEDGE WIRE	SS316L

WEDGE WIRE DIMENSION			
A	B	C	D
10	12	0	10



WEDGE WIRE
DETAIL 1
NTS

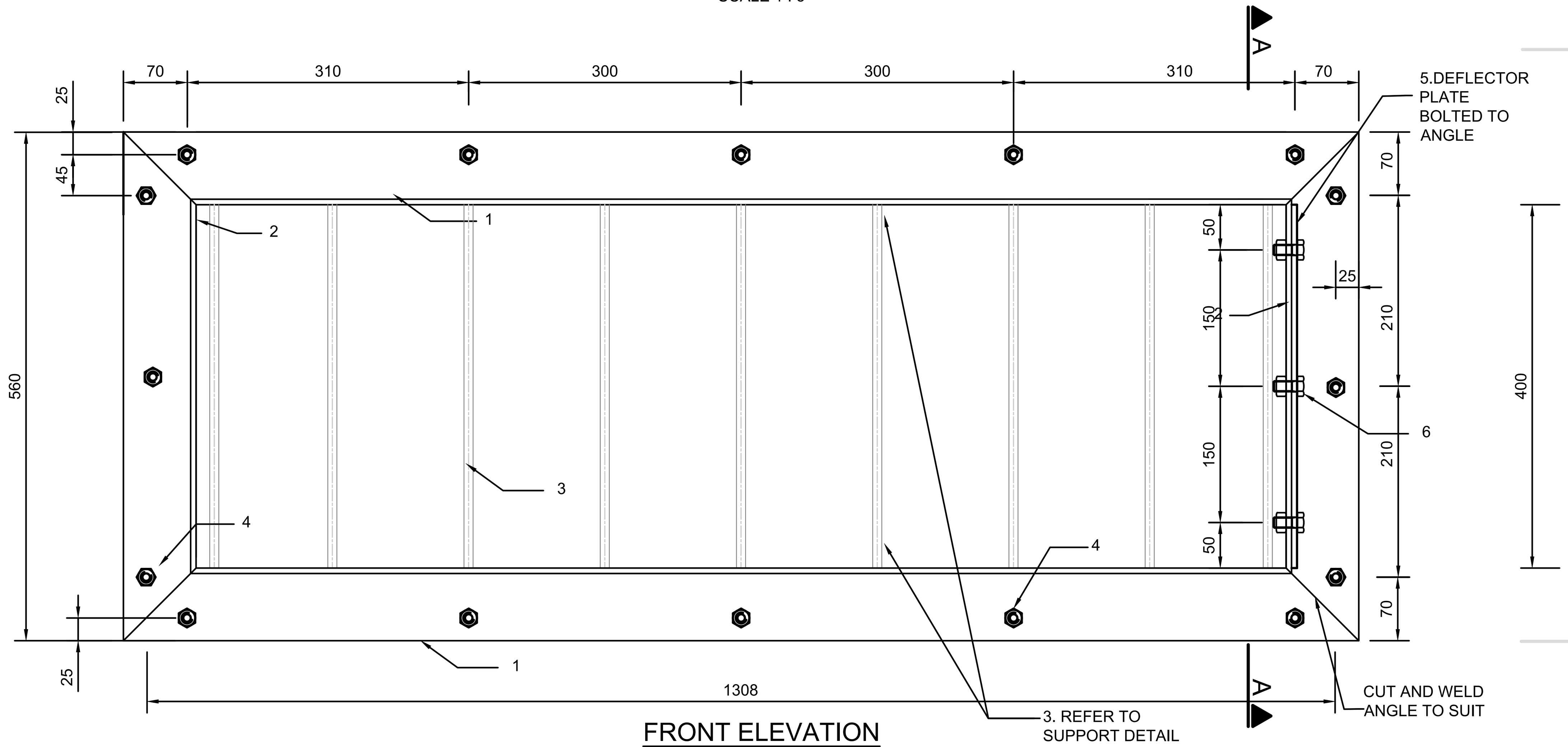


SUPPORT DIMENSION		
E	F	
10	60	

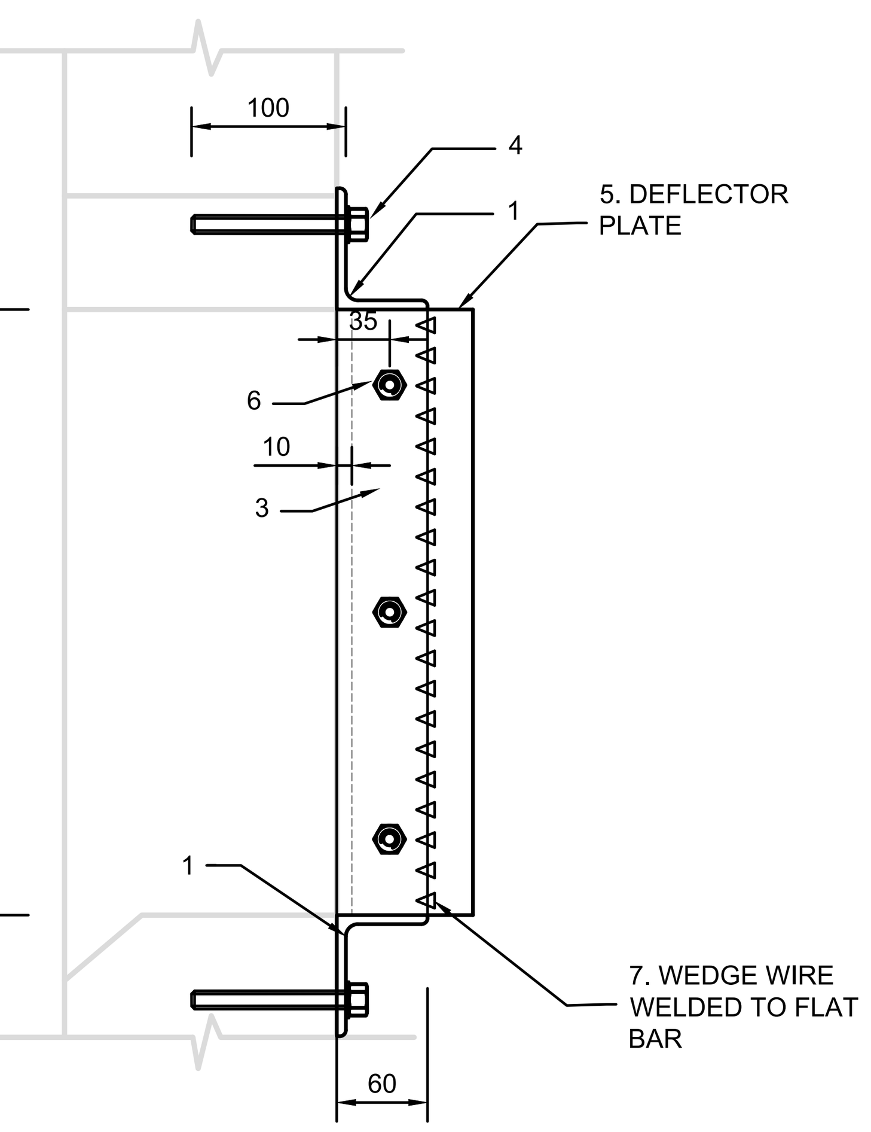
SUPPORT DETAIL 2
NTS

NOTES:-

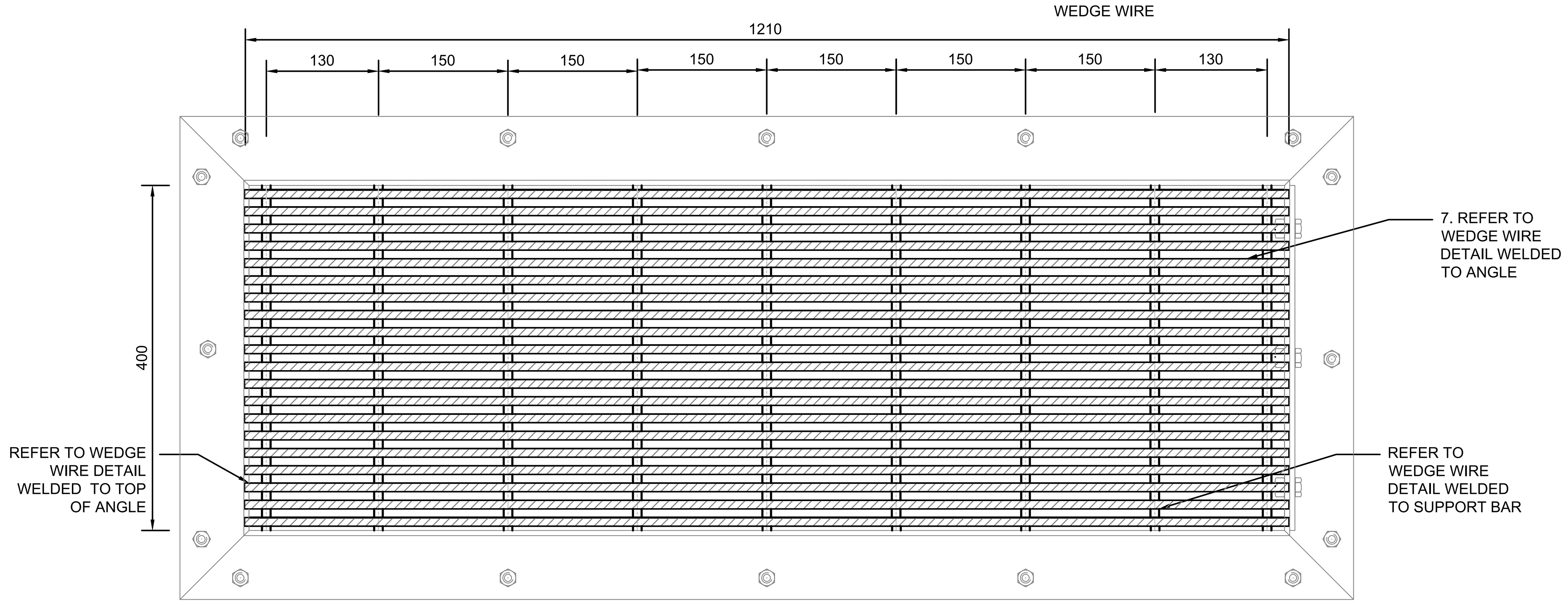
1. ALL WELDING TO BE 8mm CONTINUOUS FILLET.
2. ROUGH WELDS TO BE GROUND SMOOTH TO SABS 044 GRIND TO ROUND PROFILE.
3. ALL COMPONENTS TO BE FREE OF BURRS AND SHARP EDGES.
4. ALL WELDS TO FORM THE ENTIRE PERIPHERY (CONNECTION FACE) OF THE STRUCTURAL MEMBER TO THE BASE PLATE
5. FABRICATOR TO SUPPLY ALL BOLTS, NUTS AND WASHERS FOR ASSEMBLY AND ERECTION BAGGED IN HESSIAN, LABELLED AND DELIVERED TO SITE.
6. SURFACE PROTECTION TO BE PICKLED AND PASSIVATED AND TO CONFORM TO TO GIBB 007 SPECIFICATION.



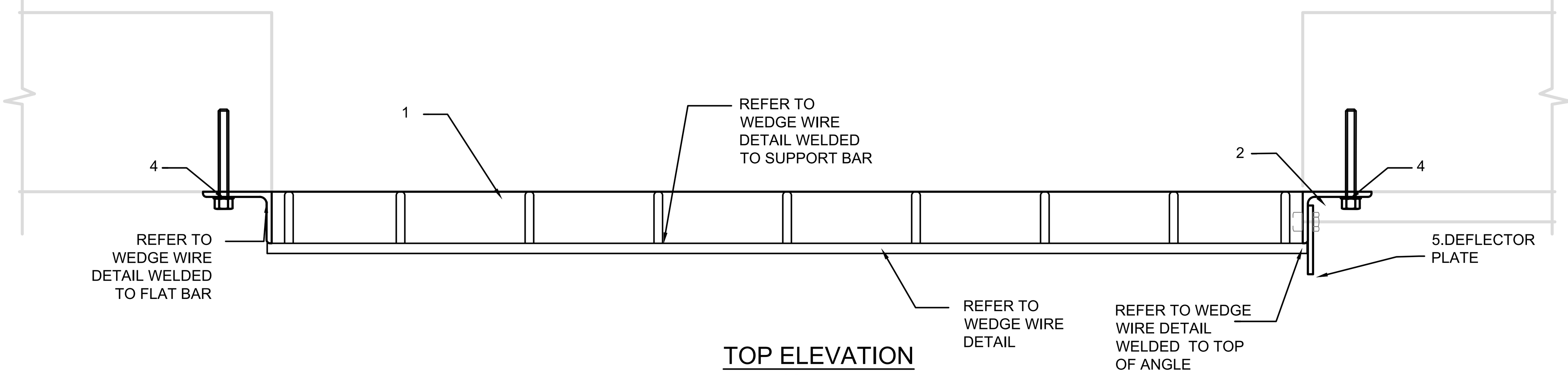
FRONT ELEVATION
FRAME DETAIL
SCALE 1 : 5



SECTION A - A
SCALE 1 : 5



FRONT ELEVATION
WEDGE WIRE AND SUPPORT POSITION
SCALE 1:5



TOP ELEVATION
SCALE 1:5

ISSUED FOR TENDER

ALL DIMENSIONS AND LEVELS ARE TO BE VERIFIED ON SITE BY THE CONTRACTOR BEFORE COMMENCING ANY WORK.

ON ORIGINAL
0 5 10 15 20 25 30 40 50MM

GENERAL NOTES:

No	Date	Details	Chd	Appd
A	30-06-21	ISSUED FOR TENDER	MH	NM

Revisions

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Project
GREATER MNQUMENI WATER SUPPLY SCHEME: PHASE 5

Description
STANDARD DETAILS
WEDGE WIRE SCREEN DETAIL

Scale: AS SHOWN
Date: 26/06/21

Project No: J40044 / Drg. No: 910 / Rev: A