



NEC3 Engineering & Construction Contract

**Between Airports Company South Africa
(Registration no: 1993/004149/06)**

and _____

(Reg No. _____)

**for The Replacement of Ablution Extraction Fans and
Associated Equipment at Cape Town International
Airport for a Period of 10 months.**

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CONTRACT No. _____

Part C1: Agreements & Contract Data

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C1.1 Form of Offer and Acceptance

Offer

The Employer, identified in the Acceptance signature block, has solicited offers to enter into a contract for the procurement of:

The Replacement of Ablution Extraction Fans and Associated Equipment at Cape Town International Airport for a Period of 10 months.

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

By the representative of the tenderer, deemed to be duly authorised, signing this part 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.

Options B	The offered total of the Prices exclusive of VAT is	R
	Sub total	R
	Value Added Tax @ 15% is	R
	The offered total of the amount due inclusive of VAT is ¹	R
	(in words)	

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 including the Schedule of Deviations (if any) to the tenderer before the end of the period of validity stated in the Tender Data, or other period as agreed, whereupon the tenderer becomes the party named as the *Contractor* in the *conditions of contract* identified in the Contract Data.

Signature(s)

Name(s)

Capacity

**For the
tenderer:**

(Insert name and address of organisation)

Name &
signature of
witness

Date

Tenderer's CIDB registration number:

Acceptance

By signing this part of this 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:

Part C1	Agreements and Contract Data, (which includes this Form of Offer and Acceptance)
Part C2	Pricing Data
Part C3	Scope of Work: Works Information
Part C4	Site Information

and drawings and documents (or parts thereof), which may be incorporated by reference into the above listed Parts.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Returnable 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 Form of Offer and Acceptance. No amendments to or deviations from said documents are valid unless contained in this Schedule.

The tenderer shall within two weeks of 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 securities, 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.

Unless the tenderer (now *Contractor*) within five working 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.

Signature(s)

Name(s)

Capacity

**for the
Employer**

Airports Company South Africa,
Cape Town International Airport
Southern Office Block, Administration Building
7525

Name &
signature of
witness

Date

Note: If a tenderer wishes to submit alternative tenders, use another copy of this Form of Offer and Acceptance.

Schedule of Deviations to be completed by the Employer prior to contract award

Note:

1. This part of the Offer & Acceptance would not be required if the contract has been developed by negotiation between the Parties and is not the result of a process of competitive tendering.
2. 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 Conditions of Tender.
3. A tenderer's covering letter must not be included in the final contract document. Should any matter in such letter, which constitutes a deviation as aforesaid be the subject of agreement reached during the process of Offer and Acceptance, the outcome of such agreement shall be recorded here and the final draft of the contract documents shall be revised to incorporate the effect of it.

1.

No.	Subject	Details
1		
2		
3		
4		
5		
6		
7		

By the duly authorised representatives signing this Schedule of Deviations below, the Employer and the tenderer agree to and accept this Schedule of Deviations as the only 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 confirmation, clarification or changes 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 Form shall have any meaning or effect in the contract between the parties arising from this Agreement.

For the tenderer:**For the Employer**

Signature

Name

Capacity

On behalf
of*(Insert name and address of organisation)*Name &
signature
of witness

Airports Company South Africa,
Cape Town International Airport
Southern Office Block, Administration
Building
7525

Date

C1.2 ECC3 Contract Data

Part one - Data provided by the *Employer*.

Completion of the data in full, according to the Options chosen, is essential to create a complete contract.

Clause	Statement	Data
1	General	
	The <i>conditions of contract</i> are the core clauses and the clauses for main Option	
		B: Priced contract with bill of quantities
	dispute resolution Option	W1: Dispute resolution procedure
	and secondary Options	
		X2 Changes in the law
		X7: Delay damages
		X16: Retention
		X17: Low performance damages
		X18: Limitation of liability
		Z: Additional conditions of contract
	of the NEC3 Engineering and Construction Contract, April 2013 (ECC3)	
10.1	The <i>Employer</i> is (Name):	Airports Company South Africa SOC Limited (reg. no: 1993/004149/06), a juristic person incorporated in terms of the company laws of the Republic of South Africa
	Address	Registered office at Airports Company South Africa SOC Limited Cape Town International Airport Private Bag X9002, Cape Town 7525
10.1	The <i>Project Manager</i> is: (Name)	: Zutari
	Address	: 1 Pearce St, Berea, East London, 5241
	Tel	: 043 721 0900
	Fax	: TBC

e-mail : mohammed.rawat@zutari.com

10.1	The <i>Supervisor</i> is: (Name)	: TBC												
	Address	: TBC												
	Tel No.	: TBC												
	Fax No.	: TBC												
	e-mail	: TBC												
11.2(13)	To Provide the works is to complete the <i>works</i> in accordance with the contract.	The Replacement of Ablution Extraction Fans and Associated Equipment at Cape Town International Airport for a Period of 10 months.												
11.2(14)	The following matters will be included in the Risk Register	• Availability of existing as built survey and services. • Access to Site (approvals and permits, police clearance required) • Tie-in with existing infrastructure • Delay in supply of material and/or equipment • Progress of the works against the program												
11.2(15)	The <i>boundaries of the site</i> are	Cape Town International Airport												
11.2(16)	The Site Information is in	Part C4: Site Information												
11.2(19)	The Works Information is in	Part 3: Scope of Work and all documents and drawings to which it makes reference.												
12.2	The <i>law of the contract</i> is the law of	the Republic of South Africa												
13.1	The <i>language of this contract</i> is	English												
13.3	The <i>period for reply</i> is	2 weeks												
2	The Contractor's main responsibilities	Data required by this section of the core clauses is provided by the <i>Contractor</i> in Part 2 and terms in <i>italics</i> used in this section are identified elsewhere in this Contract Data.												
3	Time													
11.2(3)	The <i>completion date</i> for the whole of the <i>works</i> is	10 Months from contract <i>start date</i>												
11.2(9)	The <i>key dates</i> and the <i>conditions</i> to be met are:	<table> <thead> <tr> <th></th><th><i>Condition to be met</i></th><th><i>key date</i></th></tr> </thead> <tbody> <tr> <td>1</td><td>Start Date</td><td>2 weeks after contract start date</td></tr> <tr> <td>2</td><td>Submission of Programme</td><td>2 weeks after contract start date</td></tr> <tr> <td>3</td><td>Programme Updates</td><td>At intervals no longer than 4 weeks</td></tr> </tbody> </table>		<i>Condition to be met</i>	<i>key date</i>	1	Start Date	2 weeks after contract start date	2	Submission of Programme	2 weeks after contract start date	3	Programme Updates	At intervals no longer than 4 weeks
	<i>Condition to be met</i>	<i>key date</i>												
1	Start Date	2 weeks after contract start date												
2	Submission of Programme	2 weeks after contract start date												
3	Programme Updates	At intervals no longer than 4 weeks												

30.1	The <i>access dates</i> are:	Part of the Site		Date
		1	C-Gate, Baggage Hall Staff, Domestic Arrivals	Contract start date
		2	Parkade 1 & 2	Contract start date
		3	Police Station	Contract start date
		4	International Departure Gates A1-A3	Contract start date
		5	Domestic Departure Gates A5-A12	Contract start date
		6	Mugg and Bean- 3rd Floor North	Contract start date
		7	Southern Office Building (SOB) 1	Contract start date
		8	Southern Office Building (SOB) Plantroom	Contract start date
		9	Check-in: Second Floor South	Contract start date
		10	KFC- 3rd Floor	Contract start date
		11	Airline offices- First Floor- North And Central	Contract start date
		12	Check-in: Second Floor North	Contract start date
		13	Domestic Baggage Reclaim- Ground Floor- South	Contract start date
		14	OCC- Fourth Floor	Contract start date
		15	International Arrivals & Immigration- Ground Floor North	Contract start date
		16	International Arrivals Concourse	Contract start date
		17	South Toilet Blocks- Roof	Contract start date
		18	North Toilet Blocks- Roof	Contract start date
31.1	The <i>Contractor</i> is to submit a first programme for acceptance within		Two (2) weeks of the Contract Date. - The Employer has issued a Bulk Purchase agreement (BPA) - The Construction Works Permit has been issued to the Contractor by the Department of Labour. - Once <i>Employer</i> training requirements, e.g. (AVOP, Security Awareness Training, Airside Induction Training, PARTAC, etc) have be completed by the <i>Contractor's</i> staff.	

		Safety File has been approved by the Client
31.2	The <i>starting date</i> is	Upon signing of contract by ACSA
32.2	The <i>Contractor</i> submits revised programmes at intervals no longer than	Four (4) weeks
35.1	The <i>Employer</i> is not willing to take over the <i>works</i> before the Completion Date.	
4	Testing and Defects	
42.2	The <i>defects date</i> is	52 weeks after Completion of whole of the <i>works</i> .
43.2	The <i>defect correction period</i> is	Two (2) weeks
	except that the <i>defect was notified before completion the period</i> is	Water related leaks is One (1) week
	and the <i>defect correction period</i> for	Electrical related fault is One (1) week
5	Payment	
50.1	The <i>assessment interval</i> is	Every four (4) weeks, on the 15th day of each successive month.
51.1	The <i>currency of this contract</i> is the	South African Rand.
51.2	The period within which payments are made is	Four (4) weeks.
6	Compensation events	
60.1(13)	The place where weather is to be recorded is: The <i>weather measurements</i> to be recorded for each calendar month are, The <i>weather measurements</i> are supplied by The <i>weather data</i> are the records of past <i>weather measurements</i> for each calendar month which were recorded at: and which are available from:	Cape Town International Airport - the cumulative rainfall (mm) - the number of days with rainfall more than 10 mm - the number of days with minimum air temperature less than 0 degrees Celsius - the number of days with snow lying at 09:00 hours South African Time and these measurements: AccuWeather Cape Town International Airport the South African Weather Bureau and included in Annexure A to this Contract Data provided by the Employer

7	Title	There is no reference to Contract Data in this section of the core clauses and terms in italics used in this section are identified elsewhere in this Contract Data.
8	Risks and insurance	
80.1	These are additional <i>Employer's</i> risks	Refer to ACSA insurance clauses in Annexure D.
81.1	The Contractor's Risk	Add: <i>Definition of Force Majeure -</i> <i>The following additional conditions must satisfied:</i> <i>(1) The Contractor has engaged with the persons responsible for the riot, commotion, disorder, strike or lockout; has met with the persons or leaders; and has recorded the persons or leaders details, their grievances, the organisations involved, all threats made; and has requested the persons or leaders to cease all unlawful conduct; and</i> <i>(2) The Contractor has obtained proof of the riot, commotion, disorder, strike or lockout, and of any unlawful conduct; and</i> <i>(3) The Contractor has reported all threats and unlawful conduct to the South African Police Service; and</i> <i>(4) The Contractor has brought an urgent application to the court on an ex parte basis that correctly identify the respondents and define the unlawful conduct to be interdicted; and</i> 1. <i>(5) The Contractor has ensured that the court order is enforced.</i>
84.1	The <i>Employer</i> provides these insurances from the Insurance Table	Refer Annexure D to this Contract Data provided by the Employer.
84.1	The <i>Employer</i> provides these additional insurances	Refer to Insurance Schedule in Annexure D provided by the Employer.
84.1	The <i>Contractor</i> provides these additional insurances	Refer to Insurance Schedule in Annexure D to this Contract Data provided by the Employer.
84.2	The minimum limit of indemnity for insurance in respect of death of or bodily injury to employees of the <i>Contractor</i> arising out of and in the course of their employment in connection with this contract for any one event is	Refer to Insurance Schedule in Annexure D to this Contract Data provided by the Employer.
9	Termination	There is no reference to Contract Data in this section of the core clauses and terms in italics used in this section are identified elsewhere in this Contract Data.
10	Data for main Option clause	

B	Priced contract with bill of quantities		
60.6	The <i>method of measurement</i> is	Standard Unit of Measurement published by ASAQS and amended as stated in Part C2.1, Pricing Assumptions.	
11	Data for Option W1		
W1.1	The <i>Adjudicator</i> is (Name)	Both parties will agree the Adjudicator when a dispute arises. If the parties cannot reach an agreement on the Adjudicator within 30 days of a dispute arising, the Adjudicator shall be appointed by the nominating body.	
W1.2(3)	The <i>Adjudicator nominating body</i> is:	The Chairman of the Johannesburg Society of Advocates, or his successor or his nominee.	
W1.4(2)	The <i>tribunal</i> is:	Arbitration	
W1.4(5)	The <i>arbitration procedure</i> is	The arbitration procedure is set out in the rules for the conduct of arbitration, 7 th edition rule of the Association of Arbitrators (Southern Africa)	
	The place where arbitration is to be held is	Cape Town, South Africa	
	The person or organisation who will choose an arbitrator	the Chairman for the time being or his nominee of the Johannesburg Advocates’ Bar council.	
	- if the Parties cannot agree a choice or - if the arbitration procedure does not state who selects an arbitrator, is		
12	Data for secondary Option clauses		
X2	Changes in the law	There is no reference to Contract Data in this Option and terms in italics are identified elsewhere in this Contract Data.	
X7	Delay damages		
X7.1	Delay damages for late Completion of the <i>sections</i> of the <i>works</i> are:	2.5% to the maximum of 10% of the price at completion date	
X16	Retention (not used with Option F)		
	The <i>retention percentage</i> is	5% of the contract value , 2,5% will be released at Completion of the works and the remaining 2,5% will be released after the Twelve (12) months of defects liability period	
X17	Low performance damages		
X17.1	The amounts for low performance damages are:	Amount	Performance level
		R 1500,00/day	For delays in commission the system as per project plan
		R 1500,00/day	Failing to maintain the design airflow performance

		R 1500,00/day	Failure to respond and correct defects within defect correction period of Two (2) weeks
X18	Limitation of liability		
X18.1	The Contractor’s liability to the Employer for indirect or consequential loss is limited to:	Refer to insurance clauses in Annexure D, ACSA Insurance Clauses.	
X18.2	For any one event, the Contractor’s liability to the Employer for loss of or damage to the Employer’s property is limited to:	Total of the losses incurred and/or repairs to the damages caused.	
X18.3	The Contractor’s liability for Defects due to his design which are not listed on the Defects Certificate is limited to	Total of the losses incurred and/or repairs to the damages caused.	
X18.4	The Contractor’s total liability to the Employer for all matters arising under or in connection with this contract, other than excluded matters, is limited to:	The total of the Prices other than for the additional excluded matters. The Contractor’s total liability for the additional excluded matters is not limited. The additional excluded matters are amounts for which the Contractor is liable under this contract for • Defects due to his design which arise before the Defects Certificate is issued, • Defects due to manufacture and fabrication outside the Site, • loss of or damage to property (other than the works, Plant and Materials), • death of or injury to a person; • damage to third party property; and • infringement of an intellectual property right.	
X18.5	The end of liability date is	The date on which the liability in question prescribes in accordance with the Prescription Act No. 68 of 1969 (as amended or in terms of any replacement legislation) for any other.	
Z	The Additional conditions of contract are		
	Z1 to Z 16		

AMENDMENTS TO THE CORE CLAUSES

Z1 Interpretation of the law

Z1.1 Add to core clause 12.3: Any extension, concession, waiver, or relaxation of any action stated in this contract by the Parties, the *Project Manager*, the *Supervisor*, or the *Adjudicator* does not constitute a waiver of rights and does not give rise to an estoppel unless the Parties agree otherwise and confirm such agreement in writing.

- Z2 Providing the Works: Delete core clause 20.1 and replace with the following:**
- Z2.1** The *Contractor* provides the works in accordance with the Works Information and warrants that the results of the Works, when complete, shall be fit for their intended purpose.
- Z3. Other responsibilities: add the following at the end of core clause 27:**
- Z3.1** The *Contractor* shall have satisfied himself, prior to the Contract Date, as to the completeness, sufficiency and accuracy of all information and drawings provided to him as at the Contract Date.
- Z3.2** The *Contractor* shall be responsible for the correct setting out of the *Works* in accordance with the original points, lines and levels stated in the *Works* Information or notified by the *Project Manager*, *Supervisor* or the *Employer*. Any errors in the positioning of the *Works* shall be rectified by the *Contractor* at the *Contractor's* own costs.
- Z4. Extending the defects date: add the following as a new core clause 46:**
- Z4.1** If the *Employer* cannot use the *works* due to a Defect, which arises after Completion and before the *defects date*, the *defects date* is delayed by a period equal to that during which the *Employer*, due to a Defect, is unable to use the *works*.
- Z4.2** If part of the *works* is replaced due to a Defect arising after Completion and before the *defects date*, the *defects date* for the part of the *works* which is replaced is delayed by a period equal to that between Completion and the date by when the part has been replaced.
- Z4.3** The *Project Manager* notifies the *Contractor* of the change to a *defect date* when the delay occurs. The period between Completion and an extended *defects date* does not exceed twice the period between Completion and the *defects date* stated in the Contract Data.
- Z5. Termination**
- Z5.1. Add the following to core clause 91.1, at the second main bullet, fifth sub-bullet point, after the words "assets or":** "business rescue proceedings are initiated, or steps are taken to initiate business rescue proceedings".

AMENDMENTS TO THE SECONDARY OPTION CLAUSES

- Z6. Changes in Law: Add the following clause to secondary option X2 as X2.2:**
- Z6.1** A change in law is defined as:
- Z6.1.1** the adoption, enactment, promulgation, coming into effect, repeal, amendment, reinterpretation, change in application or other modification after the Contract Date of any law, excluding (i) the enactment of any bill inside the country, but only if such bill is enacted without any material changes being made to the contents of such bill from the form published in the Gazette (as defined in the Interpretation Act, 1957) as at the Contract Date, and (ii) any such modification in law relating to any taxes, charges, imposts, duties, levies or deductions that are assessed in relation to a person's income
- Z6.1.2** any permit being terminated, withdrawn, amended, modified or replaced, other than (i) in accordance with the terms upon which it was originally granted, (ii) as a result of the failure by the *Contractor* to comply with any condition set out therein, or (iii) as a result of any act or omission of the *Contractor*, any Subcontractor or any affiliate to the *Contractor*.
- Z7. Performance Bond**

- Z7.1.** Amend the first sentence of clause X13.1 to read as follows: The *Contractor* gives the *Employer* an unconditional, on-demand performance bond, provided by a bank or insurer which the *Project Manager* and the *Employer* have accepted, for the amount stated in the Contract Data and in the form set out in Annexure C.ii of this Contract Data.
- Z7.2.** Add the following new clause as Option X13.2: The *Contractor ensures* that the performance bond is valid and enforceable until the end of the *contract period*. If the terms of the performance bond specify its expiry date and the end of the *contract period* does not coincide with such expiry date, four weeks prior to the said expiry date, the *Contractor* extends the validity of the performance bond until the end of the *contract period*. If the *Contractor* fails to so extend the validity of the performance bond, the *Employer* may claim the full amount of the performance bond and retain the proceeds as cash security.
- Z8.** Limitation of liability: Insert the following new clause as Option X18.6:
- Z8.1** The *Employer's* liability to the *Contractor* for the *Contractor's* indirect or consequential loss is limited to an amount to be addressed with client.
- Z8.2** Notwithstanding any other clause in this contract, any proceeds received from any insurances or any proceeds which would have been received from any insurances but for the conduct of the *Contractor* shall be excluded from the calculation of the limitations of liability listed in the contract.

ADDITIONAL Z CLAUSES

- Z9.** Cession, delegation, and assignment
- Z9.1.** The *Contractor* shall not cede, delegate, or assign any of its rights or obligations to any person without the written consent of the *Employer*, which consent shall not be unreasonably withheld. This clause shall be binding on the liquidator/business rescue practitioner /trustee (whether provisional or not) of the *Contractor*.
- Z9.2.** The *Employer* may, on written notice to the *Contractor*, cede and delegate its rights and obligations under this contract to any person or entity.
- Z10.** Joint and several liability
- Z10.1.** If the *Contractor* constitutes a joint venture, consortium, or other unincorporated grouping of two or more persons, these persons are deemed to be jointly and severally liable to the *Employer* for the performance of the Contract.
- Z10.2.** The *Contractor* shall, within 1 week of the Contract Date, notify the *Project Manager* and the *Employer* of the key person who has the authority to bind the *Contractor* on their behalf.
- Z10.3.** The *Contractor* does not materially alter the composition of the joint venture, consortium, or other unincorporated grouping of two or more persons without prior written consent of the *Employer*.
- Z11.** Ethics
- Z11.1.** The *Contractor* undertakes:
- Z11.1.1.** not to give any offer, payment, consideration, or benefit of any kind, which constitutes or could be construed as an illegal or corrupt practice, either directly or indirectly, as an inducement or reward for the award or in execution of this contract;
- Z11.1.2.** to comply with all laws, regulations or policies relating to the prevention and combating of bribery, corruption, and money laundering to which it or the *Employer* is subject, including but not limited to the Prevention and Combating of Corrupt Activities Act, 12 of 2004.
- Z11.2.** The *Contractor's* breach of this clause constitutes grounds for terminating the *Contractor's* obligation to Provide the Works or taking any other action as appropriate against the *Contractor* (including civil

or criminal action). However, lawful inducements and rewards shall not constitute grounds for termination.

- Z11.3.** If the *Contractor* is found guilty by a competent court, administrative or regulatory body of participating in illegal or corrupt practices, including but not limited to the making of offers (directly or indirectly), payments, gifts, gratuity, commission or benefits of any kind, which are in any way whatsoever in connection with the contract with the *Employer*, the *Employer* shall be entitled to terminate the contract in accordance with the procedures stated in core clause 92.2. the amount due on termination is A1.

Z12. Confidentiality

- Z12.1.** All information obtained in terms of this contract or arising from the implementation of this contract shall be treated as confidential by the *Contractor* and shall not be used or divulged or published to any person not being a party to this contract, without the prior written consent of the *Project Manager* or the *Employer*, which consent shall not be unreasonably withheld.
- Z12.2.** If the *Contractor* is uncertain about whether any such information is confidential, it is to be regarded as such until otherwise notified by the *Project Manager*.
- Z12.3.** This undertaking shall not apply to –
- Z12.3.1.** Information disclosed to the employees of the *Contractor* for the purposes of the implementation of this agreement. The *Contractor* undertakes to procure that its employees are aware of the confidential nature of the information so disclosed and that they comply with the provisions of this clause;
- Z12.3.2.** Information which the *Contractor* is required by law to disclose, provided that the *Contractor* notifies the *Employer* prior to disclosure so as to enable the *Employer* to take the appropriate action to protect such information. The *Contractor* may disclose such information only to the extent required by law and shall use reasonable efforts to obtain assurances that confidential treatment will be afforded to the information so disclosed;
- Z12.3.3.** Information which at the time of disclosure or thereafter, without default on the part of the *Contractor*, enters the public domain or to information which was already in the possession of the *Contractor* at the time of disclosure (evidenced by written records in existence at that time);
- Z12.4.** The taking of images (whether photographs, video footage or otherwise) of the *works* or any portion thereof, in the course of Providing the Works and after Completion, requires the prior written consent of the *Project Manager*. All rights in and to all such images vests exclusively in the *Employer*.
- Z12.5.** The *Contractor* ensures that all his Subcontractors abide by the undertakings in this clause.

Z13. Employer's Step-in rights

- Z13.1.** If the *Contractor* defaults by failing to comply with his obligations and fails to remedy such default within 2 weeks of the notification of the default by the *Project Manager*, the *Employer*, without prejudice to his other rights, powers, and remedies under the contract, may remedy the default either himself or procure a third party (including any subcontractor or supplier of the *Contractor*) to do so on his behalf. The reasonable costs of such remedial works shall be borne by the *Contractor*.
- Z13.2.** The *Contractor* co-operates with the *Employer* and facilitates and permits the use of all required information, materials and other matter (including but not limited to documents and all other drawings CAD materials, data, software, models, plans, designs, programs, diagrams, evaluations, materials specifications, schedules, reports, calculations, manuals or other documents or recorded information (electronic or otherwise) which have been or are at any time prepared by or on behalf of the *Contractor* under the contract or otherwise for and/or in connection with the *works*) and generally does all things required by the *Project Manager* to achieve this end.

Z14. Liens and Encumbrances

- Z14.1.** The *Contractor* keeps the Equipment used to Provide the Services free of all liens and other encumbrances at all times. The *Contractor*, vis-a-vis the *Employer*, waives all and any liens which he may from time to time have, or become entitled to over such Equipment and any part thereof and procures that his Subcontractors similarly, vis-a-vis the *Employer*, waive all liens they may have or become entitled to over such Equipment from time to time

Z15. Intellectual Property

- Z15.1** Intellectual Property ("IP") rights means all rights in and to any patent, design, copyright, trademark, trade name, trade secret or other intellectual or industrial property right relating to the Works.
- Z15.2** IP rights remain vested in the originator and shall not be used for any reason whatsoever other than carrying out the *works*.
- Z15.3** The *Contractor* gives the *Employer* an irrevocable, transferrable, non-exclusive, royalty free licence to use and copy all IP related to the *works* for the purposes of constructing, repairing, demolishing operating and maintaining the works.
- Z15.4** The written approval of the *Contractor* is to be obtained before the *Contractor's* IP made available to any third party which approval will not be unreasonably withheld or delayed. Prior to making any *Contractor's* IP available to any third party the *Employer* shall obtain a written confidentiality undertaking from any such third party on terms no less onerous than the terms the *Employer* would use to protect its IP.
- Z15.5** The *Contractor* shall indemnify and hold the *Employer* harmless against and from any claim alleging an infringement of IP rights ("**the claim**"), which arises out of or in relation to:
- Z15.5.1** the *Contractor's* design, manufacture, construction, or execution of the Works;
- Z15.5.2** the use of the *Contractor's* Equipment, or
- Z15.5.3** the proper use of the Works.
- Z15.6** The *Employer* shall, at the request and cost of the *Contractor*, assist in contesting the claim and the *Contractor* may (at its cost) conduct negotiations for the settlement of the claim, and any litigation or arbitration which may arise from it.
- Z16. Dispute resolution: The following amendments are made to Option W1:**
- Z16.1 Under clause W1.3, in the fourth row of the first column of the adjudication table, the following words are added after the words "any other matter":** "excluding disputes relating to termination of the contract".
- Z16.2 The following clauses are added at the end of clause W1.3:**
- Z16.2.1** "The Adjudicator shall decide the dispute solely on the written submissions of the parties. No oral submissions shall be heard during adjudication."
- Z16.2.2** "Disputes relating to or arising from termination of the Contract shall not be determined by an adjudicator. Any such dispute shall be referred directly to arbitration."

Annexure A: One-in-ten-year-return weather data obtained from SA Weather Bureau for [weather station]

If any one of these *weather measurements* recorded within a calendar month, before the Completion Date for the whole of the *works* and at the place stated in this Contract Data is shown to be more adverse than the amount stated below then the *Contractor* may notify a compensation event.

	<i>Weather measurement</i>				
Month	Cumulative rainfall (mm)	Number of days with rain more than 10mm	Number of days with min air temp < 0 deg.C	Number of days with snow lying at 08:00 CAT	[Other measurements if applicable]
January	[•]	[•]	[•]	[•]	
February	[•]	[•]	[•]	[•]	
March	[•]	[•]	[•]	[•]	
April	[•]	[•]	[•]	[•]	
May	[•]	[•]	[•]	[•]	
June	[•]	[•]	[•]	[•]	
July	[•]	[•]	[•]	[•]	
August	[•]	[•]	[•]	[•]	
September	[•]	[•]	[•]	[•]	
October	[•]	[•]	[•]	[•]	
November	[•]	[•]	[•]	[•]	
December	[•]	[•]	[•]	[•]	

Only the difference between the more adverse recorded weather and the equivalent measurement given above is taken into account in assessing a compensation event.

Annexure B: Pro forma Security Bonds and Guarantee

Reference to C1.3 Forms of Securities

Annexure C: ACSA Panel of Adjudicators

One of the following adjudicators shall be selected by the referring party as and when a dispute arises. This panel is valid for a period of three years, commencing on 1 May 2020.

Potential Adjudicator	Email Address	Chamber
Adv. Mkhululi Duncan Stubbs	duncan.stubbs@gmail.com	Thulamela Chambers
Adv. Arzhar Bham SC	bhamae@law.co.za	Victoria Mxenge
Adv. Mohhamed Chohan SC	chohann@counsel.co.za	Group One
Adv. Benny Makola	benny.makola@gmail.com	Group 621
Adv. Vincent Maleka SC	ivmaleka@mweb.co.za	Thulamela Chambers
Adv. Chris Loxton SC	loxton@counsel.co.za	Group One

Annexure D: ACSA Insurance Clauses***Summary of Terms and other Matters Applicable to Employer Provided Insurance Part 1:***

Notes to Schedule:

Notwithstanding anything elsewhere contained in the Contract and without limiting the obligations liabilities or responsibilities of the Contractor in any way whatsoever (including but not limited to any requirement for the provision by the Contractor of any other insurances) the Employer shall effect and maintain as appropriate in the joint names of the Employer , Contractors and Sub-Contractors, Consultants and Sub-Consultants the following insurances which are subject to the terms, limits, exceptions and conditions of the Policy:

For OPEX projects and non-construction CAPEX projects on the **landside**:

The successful bidder must source the following insurance cover, which is the deductible in the ACSA insurance cover:

- Aviation liability insurance cover for an indemnity limit not less than R100 000 (one hundred thousand rands).
- Submit proof of insurance to ACSA before the work starts, and annually for the duration of the project.

For OPEX projects and non-construction CAPEX projects on the **airside**:

The successful bidder must source the following insurance cover, which is the deductible in the ACSA insurance cover:

- Aviation liability insurance cover for an indemnity limit not less than R300 000 (three hundred thousand rands).
- Submit proof of insurance to ACSA before the work starts, and annually for the duration of the project.

Please note that where the project covers **both landside and airside**, only the airside clause will apply.

1.1 Sub-Contractors.

The Contractor shall:

- a) ensure that all potential and appointed Sub-contractors are aware of the whole contents of these Insurance Clauses, and
- b) enforce the compliance by subcontract agreement between the Contractor and Sub-Contractor and where applicable that the Subcontractor effect similar insurance relating to the insurances required to be effected by the Contractor under Clause 2 (Contractor effected insurances).

APPENDIX A**CONTRACTORS CLAIMS ADVICE FORM - FOR ACSA INSURED CONTRACTS UNDER THE ANNUAL POLICY**

AIRPORTS COMPANY SOUTH AFRICA SOC LIMITED
REPLACEMENT OF ABLUTION EXTRACTION FANS AND ASSOCIATED EQUIPMENT AT CAPE TOWN INTERNATIONAL
AIRPORT

CONTRACT NO.

Send to: Airports Company South Africa

*
.....
.....
.....
.....

E-Mail The Following People:

Nokulunga.Masiza@airports.co.za

Buhle.Mnguni@airports.co.za

* (Please provide name of contracting company, site address, telephone numbers and e-mail address).

RE: ACSA CONTRACTORS: CAR/PL/PI: CLAIM

Date of loss: _____

Reported to site agent by: _____ Date: _____

Reported to Insurance Broker by: _____ Date: _____

How did the loss occur (cause)? _____

Details and nature of loss or damage to Contract Works _____

Details of other property damaged _____

Names and address of witnesses _____

Estimated cost of repairs (Separate records of all costs must be kept) R _____

Person whom assessor should contact _____

Telephone/Mobile Numbers Of Contact Person _____

Email Address of Contact Person _____

C1.2 Contract Data

Part two - Data provided by the *Contractor*.

Notes to a tendering contractor:

1. Please read both the NEC3 Engineering and Construction Contract (April 2013) and the relevant parts of its Guidance Notes (ECC3-GN) in order to understand the implications of this Data which the tenderer is required to complete. An example of the completed Data is provided on pages 152 to 154 of the ECC3 Guidance Notes.
2. The number of the clause which requires the data is shown in the left-hand column for each statement however other clauses may also use the same data
3. Where a form field like this [] appears, data is required to be inserted relevant to the option selected. Click on the form field **once** and type in the data. Otherwise complete by hand and in ink.

Completion of the data in full, according to Options chosen, is essential to create a complete contract.

Clause	Statement	Data
10.1	The <i>Contractor</i> is (Name): Address Tel No. Fax No.	
11.2(8)	The <i>direct fee percentage</i> is The <i>subcontracted fee percentage</i> is	% %
11.2(18)	The <i>working areas</i> are the Site and	Refer to C4 'Site Information'
24.1	The <i>Contractor's</i> key persons are: 1 Name: Job: Responsibilities: Qualifications: Experience: 2 Name: Job: Responsibilities: Qualifications: Experience: 3 Name: Job: Responsibilities: Qualifications:	Construction Manager/ Site Supervisor Site Foreman Safety Officer

	Experience: 4 Name: Job Responsibilities: Qualifications: Experience:	CV's (and further key persons data including CVs) are appended to Tender Schedule entitled		
11.2(3)	The <i>completion date</i> for the whole of the <i>works</i> is			
11.2(14)	The following matters will be included in the Risk Register			
11.2(19)	The Works Information for the <i>Contractor's</i> design is in:			
31.1	The programme identified in the Contract Data is			
B	Priced contract with bill of quantities			
11.2(21)	The <i>bill of quantities</i> is in	(in figures)		
11.2(31)	The tendered total of the Prices is			
		(in words), excluding VAT		
	Data for Schedules of Cost Components			
B	Priced contract with bill of quantities	Data for the Shorter Schedule of Cost Components		
41 in SSCC	The percentage for people overheads is:	%		
21 in SSCC	The published list of Equipment is the last edition of the list published by			
	The percentage for adjustment for Equipment in the published list is	Minus ____%		
22 in SSCC	The rates of other Equipment are:	Equipment	Size or capacity	Rate

61 in SSCC	The hourly rates for Defined Cost of design outside the Working Areas are Note: Hourly rates are estimated 'cost to company of the employee' and not selling rates. Please insert another schedule if foreign resources may also be used	Category of employee	Hourly rate
62 in SSCC	The percentage for design overheads is	%	
63 in SSCC	The categories of design employees whose travelling expenses to and from the Working Areas are included in Defined Cost are:		

C1.3 Forms of Securities

Pro forma for Bonds & Guarantees

For use with the NEC3 Engineering & Construction Contract (April 2013)

The *conditions of contract* stated in the Contract Data Part 1 include the following Secondary Options:

Option X16: Retention (not used with Option F)

The *Contractor* may provide a Retention Money Guarantee in the form stated here. When the *Employer* receives and accepts a Retention Money Guarantee exactly in the form stated he will instruct the *Project Manager* not to assess any amount be retained in terms of secondary Option X16.

The organisation providing the bond / guarantee does so by copying the pro forma document onto his letterhead without any change to the text or format and completing the required details. The completed document is then given to the *Employer* within the time stated in the contract.

Pro forma Retention Money Guarantee (may be used when Option X16 applies)*(to be reproduced exactly as shown below on the letterhead of the Bank providing the Guarantee)***The Airports Company South Africa SOC Limited**O.R. Tambo International Airport
The Maples, 24 Johnson Road
Bedfordview 2008

Date:

Dear Sirs

Reference No. [●] *[Drafting Note: Bank reference number to be inserted]***Retention Money Guarantee:** *[Drafting Note: Name of Contractor to be inserted]*Project [] : Contract Reference: *[Drafting Note: Contractor contract reference number to be inserted]*

1. In this Guarantee the following words and expressions shall have the following meanings:-

1.1	"Bank" means	[Insert name of Bank], [●] Branch, Registration No. [●]
1.2	"Bank's Address" means	[Insert physical address of Bank]
1.3	"Contract" means	the written agreement relating to providing the <i>works</i> , entered into between the <i>Employer</i> and the <i>Contractor</i> , on or about the [●] day of [●] 20[●] (Contract Reference No. [●]) as amended, varied, restated, novated or substituted from time to time;
1.4	"Contractor" means	[●] a company registered in accordance with the laws of [●] under Registration No [●].
1.5	"Employer" means	[●] a company registered in accordance with the laws of the Republic of South Africa under Registration Number [●]
1.6	"Expiry Date" means	the date on which the Defects Certificate is issued in terms of the Contract.
1.7	"Guaranteed Sum" means	the sum of R[●], ([●] Rand)
1.8	"works" means	[insert details from Contract Data part 1]

2. At the instance of the *Contractor*, we the undersigned _____ and _____, in our respective capacities as _____ and _____ of the Bank, and duly authorized thereto, confirm that we hold the Guaranteed Sum at the disposal of the *Employer* as security for the proper performance by the *Contractor* of all of its obligations in terms of and arising from the Contract and hereby undertake to pay to the *Employer*, on written demand from the *Employer* received prior to the Expiry Date, any sum or sums not exceeding in total the Guaranteed Sum.

3. A demand for payment under this guarantee shall be made in writing at the Bank's address and shall:

- be signed on behalf of the *Employer* by a director of the *Employer*;
- state the amount claimed ("the Demand Amount");
- state that the *Contractor* has failed to carry out his obligation(s) to rectify certain Defect(s) for which he is responsible under the Contract (and the nature of such defect(s)) alternatively that the Demand Amount is payable to the *Employer* in the circumstances contemplated in the Contract.

4. Notwithstanding the reference herein to the Contract the liability of the Bank in terms hereof is as principal and not as surety and the Bank's obligation/s to make payment:

- is and shall be absolute provided demand is made in terms of this bond in all circumstances; and
- is not, and shall not be construed to be, accessory or collateral on any basis whatsoever.

5. The Bank's obligations in terms of this Guarantee:

- shall be restricted to the payment of money only and shall be limited to the maximum of the Guaranteed Sum; and
- shall not be discharged and compliance with any demand for payment received by the Bank in terms hereof shall not be delayed, by the fact that a dispute may exist between the *Employer* and the *Contractor*.

6. The *Employer* shall be entitled to arrange its affairs with the *Contractor* in any manner which it sees fit, without advising us and without affecting our liability under this Guarantee. This includes, without limitation, any extensions, indulgences, release or compromise granted to the *Contractor* or any variation under or to the Contract.7. Should the *Employer* cede its rights against the *Contractor* to a third party where such cession is permitted under the Contract, then the *Employer* shall be entitled to cede to such third party the rights of the *Employer* under this Guarantee on written notification to the Bank of such cession.

8. This Guarantee:

- shall expire on the Expiry Date until which time it is irrevocable;
- is, save as provided for in **Error! Reference source not found.** above, personal to the *Employer* and is neither negotiable nor transferable;
- shall be returned to the Bank upon the earlier of payment of the full Guaranteed Sum or expiry hereof;
- shall be regarded as a liquid document for the purpose of obtaining a court order; and
- shall be governed by and construed in accordance with the law of the Republic of South Africa and shall be subject to the jurisdiction of the Courts of the Republic of South Africa.
- will be invalid and unenforceable if any claim which arises or demand for payment is received after the Expiry Date.

9. The Bank chooses domicilium citandi et executandi for all purposes in connection with this Guarantee at the Bank's Address.

Signed at _____ on this _____ day of _____ 20__

For and on behalf of the Bank

Bank Signatories(s)

Name(s) (printed)

Witness(s)

Bank's seal or stamp

Pro forma ASGI-SA Guarantee*(to be reproduced exactly as shown below on the letterhead of the Bank providing the Guarantee)***The Airports Company South Africa SOC Limited**O.R. Tambo International Airport
The Maples, 24 Johnson Road
Bedfordview 2008

Date:

Dear Sirs

Reference No. [●] *[Drafting Note: Bank reference number to be inserted]***Pro-Forma ASGI-SA Guarantee:** *[Drafting Note: Name of Contractor to be inserted]*Project [] Contract Reference: [●] *[Drafting Note: Contractor contract reference number to be inserted]*

1. In this Guarantee the following words and expressions shall have the following meanings:-

1.1 "Bank" - means [●], [●] Branch, (Registration No. [●]); *[Drafting Note: Name of Bank to be inserted]*1.2 "Bank's Address" - means [●]; *[Drafting Note: Bank's physical address to be inserted]*1.3 "Contract" – means the written agreement relating to the Project, entered into between the *Employer* and the *Contractor*, on or about the [●] day of [●] 200[●] (Contract Reference No. [●] as amended, varied, restated, novated or substituted from time to time; *[Drafting Note: Signature Date and Contract reference number to be inserted]*)1.4 "*Contractor*" – means [●] a company registered in accordance with the laws of [●] under Registration Number [●]. *[Drafting Note: Name and details of Contractor to be inserted]*1.5 "*Contractor's ASGI-SA Obligations*" – means the *Contractor's ASGI-SA Obligations* under and as defined in the Contract.1.6 "*Employer*" - means Eskom Holdings Limited, a company registered in accordance with the laws of the Republic of South Africa under Registration Number 2002/015527/06.1.7 "Expiry Date" - means the [●] day of [●] 200[●]; *[Drafting Note: anticipated date of issue of ASGI-SA Performance Certificate to be inserted.]*

1.8 "Guaranteed Sum" - means the sum of R [●] ([●] Rand);

1.9 "Project" – means the

2. At the instance of the *Contractor*, we the undersigned _____ and _____, in our respective capacities as _____ and _____ of the Bank, and duly authorized thereto, confirm that we hold the Guaranteed Sum at the disposal of the *Employer*, as security for the proper performance by the *Contractor* of the *Contractor's ASGI-SA Obligations* and hereby undertake to pay to the *Employer*, on written demand from the *Employer* received prior to the Expiry Date, any sum or sums not exceeding in total the Guaranteed Sum.

3. A demand for payment under this guarantee shall be made in writing at the Bank's address and shall:

3.1 state the amount claimed ("the Demand Amount");

3.2 state that the Demand Amount is payable to the *Employer* in the circumstances contemplated in the Contract.

4. Notwithstanding the reference herein to the Contract the liability of the Bank in terms hereof is as principal

and not as surety and the Bank's obligation/s to make payment:

4.1 is and shall be absolute provided demand is made in terms of this bond in all circumstances; and

4.2 is not, and shall not be construed to be, accessory or collateral on any basis whatsoever.

5. The Bank's obligations in terms of this Guarantee:

5.1 shall be restricted to the payment of money only and shall be limited to the maximum of the Guaranteed Sum; and

5.2 shall not be discharged and compliance with any demand for payment received by the Bank in terms hereof shall not be delayed, by the fact that a dispute may exist between the *Employer* and the *Contractor*.

6. The *Employer* shall be entitled to arrange its affairs with the *Contractor* in any manner which it sees fit, without advising us and without affecting our liability under this Guarantee. This includes, without limitation, any extensions, indulgences, release or compromise granted to the *Contractor* or any variation under or to the Contract.

7. Should the *Employer* cede its rights against the *Contractor* to a third party where such cession is permitted under the Contract, then the *Employer* shall be entitled to cede to such third party the rights of the *Employer* under this Guarantee on written notification to the Bank of such cession.

8. This Guarantee:

8.1 shall expire on the Expiry Date until which time it is irrevocable;

8.2 is, save as provided for in **Error! Reference source not found.** above, personal to the *Employer* and is neither negotiable nor transferable;

8.3 shall be returned to the Bank upon the earlier of payment of the full Guaranteed Sum or expiry hereof;

8.4 shall be regarded as a liquid document for the purpose of obtaining a court order; and

8.5 shall be governed by and construed in accordance with the law of the Republic of South Africa and shall be subject to the jurisdiction of the courts of the Republic of South Africa.

8.6 Any claim which arises or demand for payment received after expiry date will be invalid and unenforceable.

9. The Bank chooses domicilium citandi et executandi for all purposes in connection with this Guarantee at the Bank's Address.

Signed at _____

Date _____

For and behalf of the Bank

Bank Signatory: _____

Bank Signatory: _____

Witness: _____

Witness: _____

Bank's seal or stamp

Part C2: Pricing Data

Document reference	Title	No of pages
C2.1	Pricing assumptions: Option B	4
C2.2	The <i>Bill of quantities</i> to be obtained from (Annexure 5. 2)	36

C2.1 Pricing assumptions: Option B

1. The conditions of contract

1.1. How work is priced and assessed for payment

Clause 11 in NEC3 Engineering and Construction Contract, April 2013 (ECC3) Option B states:

Identified and defined terms	11 11.2	(21) The Bill of Quantities is the <i>bill of quantities</i> as changed in accordance with this contract to accommodate implemented compensation events and for accepted quotations for acceleration.
		(22) Defined Cost is the cost of the components in the Shorter Schedule of Cost Components whether work is subcontracted or not excluding the cost of preparing quotations for compensation events.
		(28) The Price for Work Done to Date is the total of - the quantity of the work which the <i>Contractor</i> has completed for each item in the Bill of Quantities multiplied by the rate and - a proportion of each lump sum which is the proportion of the work covered by the item which the <i>Contractor</i> has completed. Completed work is work without Defects which would either delay or be covered by immediately following work.
		(31) The Prices are the lump sums and the amounts obtained by multiplying the rates by the quantities for the items in the Bill of Quantities.

This confirms that Option B is a re-measurement contract, and the bill comprises only items measured using quantities and rates or stated as lump sums. The Contractor is paid based on the actual quantities of work performed as opposed to the quantities set out in the Bill of Quantities. Value related items are not used. Time related items are items measured using rates where the rate is a unit of time. With this pricing method, the Contractor bears the risk for his pricing of the bill and the Employer bears the risk for changes in the quantities.

1.2. Function of the Bill of Quantities

Clause 55.1 in Option B states, "Information in the Bill of Quantities is not Works Information or Site Information". This confirms that instructions to do work or how it is to be done are not included in the Bill, but in the Works Information. This is further confirmed by Clause 20.1 which states, "The *Contractor* Provides the Works in accordance with the Works Information". Hence the *Contractor* does not Provide the Works in accordance with the Bill of Quantities. The Bill of Quantities is only a pricing document.

1.3. Guidance before pricing and measuring

1.3.1 Employers preparing tenders or contract documents, and tendering contractors are advised to consult the sections dealing with the bill of quantities in the NEC3 Engineering and Construction Contract (April 2013) the requirements of the tender (if any) and the Guidance Notes before preparing the bill of quantities or before entering rates and lump sums into the bill.

1.3.2 The NEC approach to the P & G bill assumes use will be made of method related charges for Equipment applied to Providing the Works based on durations shown in the Accepted Programme, fixed charges for the use of Equipment that is required throughout the construction phase, time related charges for people working in a supervisory capacity for the period required, and lump sum charges

for other facilities or services not directly related to performing work items typically included in other parts of the bill.

- 1.3.3 The P & G section of the bill is not used for the assessment of compensation events.

2. Measurement and payment

2.1. Symbols

The units of measurement described in the Bill of Quantities are metric units abbreviated as follows:

Abbreviation	Unit
%	percent
h	hour
ha	hectare
kg	kilogram
kl	kilolitre
km	kilometre
km-pass	kilometre-pass
kPa	kilopascal
kW	kilowatt
l	litre
m	metre
mm	millimetre
m ²	square metre
m ² -pass	square metre pass
m ³	cubic metre
m ³ -km	cubic metre-kilometre
MN	meganewton
MN.m	meganewton-metre
MPa	megapascal
No.	number
Prov sum ²	provisional sum
PC-sum	prime cost sum
R/only	Rate only
sum	Lump sum
t	ton (1000kg)
W/day	Work day

2.2. General assumptions

- 2.2.1 Unless otherwise stated, items are measured net in accordance with the drawings, and no allowance has been made in the quantities for waste.
- 2.2.2 The Prices and rates stated for each item in the Bill of Quantities shall be treated as being fully inclusive of all work, risks, liabilities, obligations, overheads, profit and everything necessary as incurred or required by the Contractor in carrying out or providing that item.

² Provisional Sums should not be used unless absolutely unavoidable. Rather include specifications and associated bill items for the most likely scope of work and then change later using the compensation event procedure if necessary.

- 2.2.3 An item against which no Price is entered will be treated as covered by other Prices or rates in the bill of quantities.
- 2.2.4 The quantities contained in the Bill of Quantities may not be final and do not necessarily represent the actual amount of work to be done. The quantities of work assessed and certified for payment by the Project Manager at each assessment date will be used for determining payments due.
- 2.2.5 The short descriptions of the items of payment given in the bill of quantities are only for the purposes of identifying the items. Detail regarding the extent of the work entailed under each item is provided in the Works Information.

2.3. Departures from the method of measurement

2.4. Amplification of or assumptions about measurement items

- 2.4.1 For the avoidance of doubt the following is provided to assist in the interpretation of descriptions given in the method of measurement. In the event of any ambiguity or inconsistency between the statements in the method of measurement and this section, the interpretation given in this section shall be used.

C2.2 The *bill of quantities*

Summary of Bill of Quantities

Item	Description	Unit	Quantity	Rate	Amount
	<u>ACSA</u>				
	<u>GENERAL - ALL BUILDINGS</u>				
	<u>MECHANICAL INSTALLATION</u>				
	<u>AIR-CONDITIONING & VENTILATION INSTALLATION</u>				
	<u>SUMMARY PAGE</u>				
262	Bill 1 - Preliminaries				R -
263	Bill 2 - Central Terminal				R -
264	Bill 3 - Parkade 1&2				R -
265	Bill 4 - Police Station				R -
266	Bill 5 - International Departures Gate A1-A3				R -
267	Bill 6 - Domestic Departures Gate A5-A12				R -
268	Bill 7 - SOB				R -
269	Bill 8 - Mugg & Bean				R -
270	Bill 9 - Check-In - South				R -
271	Bill 10 - KFC				R -
272	Bill 11 - Airline - North and Central				R -
273	Bill 12 - Check-In - North				R -
274	Bill 13 - Domestic Baggage Reclaim				R -
275	Bill 14 - OCC				R -
276	Bill 15 - International Arrivals and Immigration				R -
277	Bill 16 - International Arrivals Concourse				R -
278	Bill 17 - Roof EF-R1 & EF-R2				R -
279	Total for the Air conditioning and Ventilation Installation (excluding VAT)				R -
280	add 15% VAT				R -
281	Total for the Air conditioning and Ventilation Installation (including VAT)				R -

NB: it should be noted the complete Bill of Quantities must be completed and submitted as **Annexure 5. 2** in full as part of the returnable document.

C3.1: EMPLOYER'S WORKS INFORMATION

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1. Description of the works

1.1. Executive overview

The works comprise of the replacement of existing abluion extraction systems with a new system at various abluion facilities at the Cape Town International Airport to meet the latest SANS 10400-part O. The scope of work includes both Mechanical and Electrical services.

1.2. Employer's objectives and purpose of the works

The objective of this contract/project is to appoint a suitably qualified HVAC contractor or service provider to replace the existing abluion extraction systems with new wall-mounted fans and/or ducted extraction systems. The scope of work shall include ducted fans, air terminals, dampers, fittings, flexible ducting, and external weather louvres, all designed and installed in compliance with the latest edition of SANS 10400 Part O.

Where indicated on the drawings and subject to inspection and approval, certain existing components such as ductwork, duct fittings, and air terminals shall be re-utilised.

The mechanical systems serving the abluion areas are generally aged and, in many instances, non-operational, exhibiting significant wear, damage, and corrosion. Numerous areas currently have minimal or no effective ventilation and are non-compliant with the requirements of SANS 10400 Part O. In several instances, systems have been installed with an insufficient number or incorrect type of air terminals, and adequate make-up air provision is lacking.

The scope of work includes both Mechanical and Electrical services:

The scope of works will be guided by the Contractor's schedule of works, to plan the sequencing of work as follows:

- a) Phase 01: The decommissioning of the existing system
 - Decommissioning and removal of existing extract systems and associated equipment.
 - Observation to health and safety, whilst decommissioning HVAC units and electrical units
- b) Phase 02: Installation - Control movement of the contractors to operate in areas permitted
 - The decommissioning will be phased out and will be followed by the installation of the new extract systems in areas indicated in the drawings.
 - Electrical services will be provided to the systems from an existing electrical source.

The drawings will form part of the documentation shared with the contractors as follows,

Drawing No.	Description
1007927-ZUT-DRG-ZZ-ZZ-ME-001-A	C-Gate, Baggage Hall Staff, Domestic Arrivals Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-002-A	Parkade 1 & 2 Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-003-A	Police Station Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-004-A	International Departure Gates A1-A3 Ablutions

1007927-ZUT-DRG-ZZ-ZZ-ME-005-A	Domestic Departure Gates A5-A12 Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-006-A	Mugg and Bean- 3rd Floor North Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-007-A	Southern Office Building (SOB) 1 Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-008-A	Southern Office Building (SOB) Plantroom Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-009-A	Check-in: Second Floor South Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-010-A	KFC- 3rd Floor Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-011-A	Airline offices- First Floor- North and Central Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-012-A	Check-in: Second Floor North Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-013-A	Domestic Baggage Reclaim- Ground Floor- South Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-014-A	OCC- Fourth Floor Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-015-A	International Arrivals & Immigration- Ground Floor North Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-016-A	International Arrivals Concourse Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-017-A	South Toilet Blocks- Roof Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-018-A	North Toilet Blocks- Roof Ablutions

The contractor responsible for the installation

- a) Review of As-built drawings, Condition Assessment Reports
- b) Preparation of Workshop drawings
- c) Submission of equipment brand proposed
- d) Commissioning of equipment
- e) Practical Completion
- f) Snag list
- g) Works Completion

1.3. Interpretation and terminology

The following abbreviations are used in this Works Information:

Abbreviation	Meaning given to the abbreviation
AFC	Approved for construction
ASGI - SA	Accelerated Shared Growth Initiative – South Africa (ASGI-SA)
OBL	Outside battery limits

Abbreviation	Meaning given to the abbreviation
ACSA	Airports Company South Africa
CTIA	Cape Town International Airport
CPG	Contract Participation Goals
OEM	Original Equipment Manufacturer
PPE	Personal Protective Equipment
CCTV	Closed Circuit Television
RCA	Root Cause Analysis
OHSACT	Occupational Health and Safety Act No. 85 of 1993
SANS	South African National Standard
SABS	South African Bureau of Standards
SHE-File	Safety and Healthy File
CTB	Central Terminal Building
SOB	Southern Office Building
HVAC	Heating, Ventilation, and Air Conditioning

2. Management and start up.

2.1. Management meetings

Regular meetings of a general shall be convened and chaired by the designated person as shown in the table below.

Title and Purpose	Approximate Time & Interval	Location	Chairperson	Required Attendance
<u>Kick-off Meeting</u> - To discuss implementation strategy and agree timelines	90 minutes Once off	CTIA Offices (boardroom to be confirmed with the meeting request)	Project Manager	- SCM - The Project Manager - The Contractor - The Engineer
<u>Construction Progress</u> - To track progress as per approved programme - To discuss claims related issues. - To discuss Health & Safety performance	60 minutes Biweekly	CTIA Offices (boardroom to be confirmed with the meeting request)	The Contractor	- The Project Manager - The Contractor - The Engineer
<u>Risk Reduction</u> - To discuss means to mitigate identified risks that can have an impact on project execution.	60 minutes Biweekly	CTIA Offices (boardroom to be confirmed with the meeting request)	Project Manager	- The Project Manager - The Contractor - The Engineer
<u>Compensation Events</u> - To discuss compensation events	As and when required	CTIA Offices (boardroom to be confirmed)	Project Manager	- The Project Manager - The Contractor

that the Contractor has submitted		with the meeting request)		- The Engineer
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Meetings of a specialist nature may be convened as specified elsewhere in this Works Information or if not so specified by persons and at times and locations to suit the Parties, the nature and the progress of the works. Records of these meetings shall be submitted to the Project Manager by the person convening the meeting within five days of the meeting.

All meetings shall be recorded using minutes or a register prepared and circulated by the person who convened the meeting. Such minutes or register shall not be used for the purpose of confirming actions or instructions under the contract as these shall be done separately by the person identified in the *conditions of contract* to carry out such actions or instructions.

2.2. Documentation control

All contractual communications will be in the form of properly compiled letters or forms attached to e-mails and not as a message in the e mail itself.

The contractor will submit claims and progress reports after each milestone in report format agreed between the service manager and the contractor.

A list of material, parts used, by part number shall be furnished when requested by Service Manager and the contractor will be responsible to maintain an up-to-date inventory of material used/kept onsite

2.3. Health and safety risk management

The *Contractor* shall comply with the health and safety requirements contained in Annexure 5.4 to this Works Information.

2.4. Environmental constraints and management

The *Contractor* shall comply with the environmental criteria and constraints stated in Annexure 5.5

The Contractor will keep noise and dust levels to a minimum. At no time shall his/her work result in nuisance, interference or danger to the public or any other person working at the Airport.

At no time shall the Contractor:

- Allow any pollutive or toxic substance to be released into the air or storm water systems
- Interfere with, or put at risk, the functionality of any system or service
- Cause a fire or safety hazard

2.5. Quality assurance requirements

All work must be executed in accordance with prevailing industry norms and standards relating to quality. In this regard, the Contractor will be expected to draft quality plans for the Project Manager.

Within the period stated in the Contact Data, the Contractor submits his complete quality control and assurance system (with all quality control and assurance procedures and manuals) for review and acceptance by the Employer. The manual includes pro-forma checklists for all requirements of the Contractor's quality control and assurance program and those called for in the Scope.

Acceptance by the Employer of the Contractor's quality assurance programme, quality plans and/or inspection and/or test plans, or of those of his Subcontractors will not relieve the Contractor of his obligation to provide services which meet the requirements of the Contract.

2.6. Programming constraints

The Contractor is required to submit a program for approval within 2 (two) weeks of the award of this contract. This program shall be subject to discussion and review by the Project Manager and the Engineer prior to acceptance.

The Contractor's proposed construction program shall be in the form of a bar chart (Gantt chart) or any other time-activity form acceptable to the Engineer. The program shall clearly show:

- (i) The proposed rate of progress in order to complete the Works within the required period as tendered, showing the various activities, their durations and proposed resourcing levels (major plant and labour) for each element of the Works. Sufficient detail shall be provided to enable the Engineer to be able to gauge construction progress. All activities, including establishment on site, trimming and finishing and the completion of all minor ancillary works are to be included in the program.
- (ii) The sequence of activities and any dependencies (time or resource related) between them.
- (iii) The critical path activities.
- (iv) Key dates in respect of work to be carried out, or information, etc., to be provided, by others.
- (v) The anticipated value of work to be done during each month.
- (vi) Other information specifically required by the Engineer.

When drawing up his programme, the Contractor shall, inter alia, take into consideration and make allowance for:

- (i) Expected weather conditions and its effects.
- (ii) Known physical conditions or artificial obstructions.
- (iii) Obtaining permits for all workers and staff, vehicle permits, vehicle operating permits for drivers and operators and radio operators, where applicable
- (iv) The accommodation and safeguarding of public.
- (v) Dealing with, altering and installing services.
- (vi) The reasonable requirements and programmes of the Employer.
- (vii) All other actions required in terms of this contract.

The following details shall be submitted together with the programme.

- (i) The number of working hours per day, working days per week, assumed holiday or shut down periods on which the programme is based.
- (ii) The overall labour and major plant resource levels on which the programme is based.
- (iii) The detailed traffic and construction plant accommodation proposals on which the programme is based.

The Contractor shall base its initial programme of work on the scope of the work as described in the project specification and the schedule of quantities. This programme shall be reviewed on a regular basis by the Contractor in accordance with changing circumstances, delays and amendments to the work ordered by the Engineer as a result of further examinations made by the Engineer.

Minor revisions to the approved program may be introduced from time to time by mutual agreement between the Employer, the Contractor, and the Engineer. Should the Engineer believe that a major revision of the program is required, the Contractor will be notified in writing and a revised program shall be submitted within two weeks of receipt of such notification.

It should be noted that it is in the Contractor's interest to provide a comprehensive program giving as much information as possible about the times allowed for the various activities as well as resources or

other limitations affecting the program, since the approved program may be used to evaluate any claims in terms of the general conditions of contract for extensions of time.

2.7. Contractor's management, supervision and key people

The service provider must provide organogram from showing personal that will be onsite and their lines of authority / communication

The Contractor must have seniority Site Manager who:

- a) Is suitably qualified and experienced with HVAC knowledge, Electronics and Mechanical.
- b) Is suitably qualified and experienced to work on any electrical panels and mechanical components.
- c) Is able to successfully interact with Fire Protection Service Provider and OEM "hotline" personnel.
- d) Is of a level of seniority to successfully direct and manage Contractor staff and possible sub-contractors during construction stage and can successfully interact with airport operational staff and airport management.

2.8. Invoicing and payment

Within two days of receiving a payment certificate from the Project Manager in terms of core clause 51.1, the Contractor provides the Employer with a tax invoice showing the amount due for payment equal to that stated in the Project Manager's payment certificate.

The *Contractor* shall address the tax invoice to invoices.acsa@airports.co.za and include on each invoice the following information:__

- Name and address of the *Contractor*
- The contract number and title;
- *Contractor's* VAT registration number;
- The *Employer's* VAT registration number **4930138393**
- The total Price for Work Done to Date which the *Contractor* has completed.
- Other amounts to be paid to the *Contractor*.
- Less amounts to be paid by or retained from the *Contractor*.
- The change in the amount due since the previous payment being the invoiced amount - excluding VAT, the VAT and including VAT.
- (add other as required)

The Contractor attaches the detail assessment of the amount due to each tax invoice showing the Price for Work Done to Date for each item in the Price List for work which he has completed.

2.9. Insurance provided by the Employer

Refer to ACSA insurance clause Annexures

2.10. Contract change management

Refer to compensation event clauses in section 6 of the core clauses.

2.11. Provision of bonds and guarantees

The form in which a bond or guarantee required by the conditions of contract is to be provided by the Contractor is given in Part 1 Agreements and Contract Data, document C1.3, Securities.

The Employer will withhold payment of amounts due to the Contractor until the bond or guarantee required in terms of this contract has been received and accepted by the person notified to the Contractor by the Project

Manager to receive and accept such bond or guarantee. Such withholding of payment due to the Contractor does not affect the Employer's right to termination stated in this contract.

2.12. Training workshops and technology transfer

The contractor will perform an ongoing on job training workshops on each completion phase of the projects , as well as any obligation for technology transfer being included.

Training of ACSA staff and/or other stakeholders on operation and maintenance of the HVAC system

- Providing of system data and its components
- Recommending improvements on maintenance procedures
- Recommending improvements on operational procedures

3.Engineering and the Contractor's design

3.1. Employer's design

The Employer design is detailed in Annexure 5.2 of the Specifications including the operating philosophy / user requirements specification to which the Contractor is to comply when he is required to design the works. Design and specification are as per tender submission with associated documentation.

3.2. Parts of the works which the *Contractor* is to design

The Contractor shall ensure that the workshop design is fit for the purpose intended. As far as applicable to replacement, the design will be in accordance with the mutually already designed drawings and specification provided by the Employer

The Contractor is still liable if, after having made the equipment to details have been accepted, it fails because it did not comply with the Service Information. Failure to comply gives the Project Manager the right, but not the obligation, to reject the design.

3.3. Procedure for submission and acceptance of *Contractor's* design

The contractor's design as well as Employer specification and installation requirements as per tender submission will be used for this project. The As-built drawings to be prepared by the Contractor and submitted to the Project Manager for acceptance.

3.4. Other requirements of the *Contractor's* design

The contractor to ensure adherence to the specification as per tender documents and built the final product for purpose that is intended for.

3.5. Use of *Contractor's* design

The contractor to ensure adherence to the specification as per tender documents and built the final product for purpose that is intended for.

3.6. Design of Equipment

Contractor's design or proposed design of Equipment are to be shared with the Project Manager, not necessarily for his acceptance but as an assurance that the Equipment will be able to allow the Contractor to provide the Works efficiently and without delay.

3.7. Equipment required to be included in the works

The contractor may use any electrical equipment or tool to ensure the proper completion of works. The list of all tools to be used onsite to be presented as the part of safety file including the safe operating procedures for those tools.

3.8. As-built drawings, operating manuals and maintenance schedules

The contractor to provide As-built drawings, operating manuals and maintenance as stated in the Bill of Quantities as the part of the hand-over documentation.

4. Procurement

The Contractor will respect OEM warranties to the Employer always when procuring products or 3rd party services. It will be the Contractor's sole responsibility to ensure that OEM warranty requirements are adhered to always.

Where Contractors use or quote of a lower quality than recommended by the OEM, or parts not recommended by the OEM, this shall be clearly indicated to the Project Manager on the quotation. This also implies that the Contractor must build relationships with the various key OEM's.

Additional reference can be obtained on Part B of the Works Information/Specification

4.1. People

4.1.1. Minimum requirements of people employed on the Site

Personnel: Minimum requirements of people employed on the Site

- As per the Contractor's requirements to complete the Works.

ACSA Cape Town International Airport (CTIA) site is regarded as a National Key Point of Entry. The following National Key Point Requirements shall be adhered to:

- Criminal clearance check
- Zero alcohol tolerance
- Access to site through valid Permits
- Medical Clearance Certification

Service provider staff are not allowed to operate without valid permits at any time and Project Manager has a right to instruct the individuals contravening permit rules to leave the site and the service provider will be held accountable, and this may lead to contract termination.

The Contractor shall be compensated for costs relating to Employer required permits. The Contractor must ensure that he/she is, at all times, familiar with the Employer's safety and security requirements relating to permits in order for no services to be delayed as a result thereof. This includes the permit application process (available to the Contractor upon request).

The Contractor shall have no claim against the Employer in the event that a permit request is refused for reasons not attributable to the Employer. The following table is not all inclusive, but is provided for illustration purposes:

Permit	Required by/for	Department
AVOP – Airside Vehicle Operator permit	All drivers of vehicles on airside	ACSA Safety
Airside Vehicle Permit	All vehicles that enter airside	ACSA Safety

Permit	Required by/for	Department
Basement Parking permit	All vehicles allowed to enter the delivery basement	ACSA Parking
Personal permit	All persons employed on the airport	ACSA Security
Cell phone permit	All persons taking cell phones to airside	ACSA Security
Lap top permit	All persons taking lap top computers to airside	ACSA Security
Camera permit	All persons taking cameras or camera equipment to airside	ACSA Security
Hot Works Permit	All welding and/metal cutting services	ACSA Safety / Fire & Rescue

Proof of having attended the airside induction training course is required for all personal permit applications. Persons applying for an AVOP must provide proof of having attended an AVOP course. Fees are levied for these courses. Fees are further levied for all permit renewals and refresher courses - where applicable.

Use of cell phones on airside is not permitted unless the user is in possession of an appropriate Airport permit for the device. Cell phone permit issuing authority lies with the ACSA Security department. The Contractor shall not be allowed to use two-way radios at on the Employer's Premises unless these radios are of the type as approved by the ACSA IT department and are intrinsically safe.

Airport Training Courses

- a) AIT (Airside Induction Training)
Initial – R 2100 Excl. VAT
Permits – R271 Excl VAT
- b) AVOP (Airside Vehicle Operator Permit)- Required for driving on Airside.
Initial – R 2100 Excl. VAT
- c) General Security Awareness Training – R 960.00 Excl VAT (Excl. Vat)

4.1.2. BBBEE and preferencing scheme

- 1) In terms of the PPPFA Regulation 4, an organ of state can apply pre- qualifying criteria to advance certain designated groups
- 2) Only tenderers meeting the following criteria may submit proposals:
 - a tenderer having a stipulated minimum B-BBEE status level of contributor 1 or 2; and
 - an EME or QSE; and
 - a tenderer subcontracting a minimum of 30% to-
 - (i) an EME or QSE which is at least 51% owned by black people; or
 - (ii) an EME or QSE which is at least 51% owned by black people who are youth; or
 - (iii) an EME or QSE which is at least 51% owned by black people who are women; or
 - (iv) an EME or QSE which is at least 51% owned by black people with disabilities; or
 - (v) an EME or QSE which is 51% owned by black people living in rural or underdeveloped areas or townships; or
 - (vii) an EME or QSE which is at least 51% owned by black people who are military veterans;
- 3) By submitting a Proposal, the bidder certifies that the information and documents provided are true, correct and devoid of any fraudulent misrepresentations. ACSA reserves its right to seek further legal action in the event that the bidder fails to comply with this paragraph.

- 4) A bidder that fails to meet the above- mentioned pre-qualification criteria, will be disqualified.

4.1.3. Accelerated Shared Growth Initiative – South Africa (ASGI-SA)

The *Contractor* shall comply with the Accelerated Shared Growth Initiative- SA stated in **Annexure 5.9**

4.2. Subcontracting

4.2.1. Preferred subcontractors

No preferred subcontractor or supplier by Employer

4.2.2. Subcontract documentation, and assessment of subcontract tenders

As per Contract Participation Goals - CPG

4.2.3. Limitations on subcontracting

The Contractor may not subcontract more than 20% of the Works where a subcontractor is not an EME.

4.2.4. Attendance on subcontractors

As per the Contractor's requirements to complete the Works.

4.3. Plant and Materials

4.3.1. Plant & Materials provided “free issue” by the Employer

Plant & Materials provided “free issue” by the *Employer*

4.3.2. Contractor's procurement of Plant and Materials

The contractor to clearly state the lead times on Contractor's procurement of Plant and Materials. Contractor to ensure that the material procured are compliant with the specification on the tender document, where possible the procurement preference should be given to Black people suppliers.

4.4. Tests and inspections before delivery

The Contractor shall ensure that the HVAC System supplied equipment will have undergone all applicable factory acceptance and quality tests prior to delivery. Certification to be provided to the Employer accordingly.

4.5. Marking Plant and Materials outside the Working Areas

The Contractor shall ensure that all equipment is clearly marked and to be safely secured at all times when not in use.

4.6. Contractor's Equipment (including temporary works).

The Contractor shall ensure that all equipment is clearly marked and to be safely secured at all times when not in use.

5. Construction

5.1. Temporary works, Site services & construction constraints

5.1.1. Employer's Site entry and security control, permits, and Site regulations

Site Restrictions and Reference to Section 4.1

- The safety file should be completed and approved by the safety department before commencement of work. The safety file is a living document and must be continuously updated with all requirements as specified by law. Also, will be auditable from time to time.
- Personal Protective Equipment should be issued before the commencement of work.

5.1.2. Restrictions to access on Site, roads, walkways and barricades

The Contractor shall protect the site properly and shall so arrange his operations that the minimum danger and inconvenience is caused to airport operations. For this purpose, he shall, inter alia, provide and maintain sufficient signs, lights, barricades, fencing and guarding as may be necessary or required by Airports Company South Africa Limited or by any act, regulation or statutory authorities. add project-specific requirements in this section.

5.1.3. People restrictions on Site; hours of work, conduct and records

It is expected that contractors wear visible company uniform or reflector jackets with contractor name there-on when entering the premises as a form of identification. Permits to be displayed at all times whilst on site.

Proper inspections to be conducted daily on completion of day's work to ensure no Foreign Object Debris (FOD) e.g. screws, nut, wires, papers, insulation taps etc. are left on the tarmac or any manoeuvring area. Any damages or fatalities resulted due to Contractor's negligence on FOD management, the Contractor will be held liable for such action.

5.1.4. Health and safety facilities on Site

The Contractor shall comply with the health and safety requirements contained in **Annexure 5.4** to this Works Information.

5.1.5. Environmental controls, fauna & flora, dealing with objects of historical interest

The *Contractor* shall comply with the environmental criteria and constraints stated in **Annexure 5.5**

The Contractor will keep noise and dust levels to a minimum. At no time shall his/her work result in nuisance, interference or danger to the public or any other person working at the Airport.

At no time shall the Contractor:

- Allow any pollutive or toxic substance to be released into the air or storm water systems
- Interfere with, or put at risk, the functionality of any system or service
- Cause a fire or safety hazard

5.1.6. Title to materials from demolition and excavation

Not Applicable

5.1.7. Contractor's Equipment

Contractor to keep record of equipment onsite, service history etc. and keep a file onsite.

5.1.8. Equipment provided by the *Employer*

Not Applicable

5.1.9. Site services and facilities

The Contractor shall be entitled to use such supplies of electricity and water as may be available on the Site for the purpose of the Works and at his own expense, shall provide any apparatus necessary for such use.

The Contractor shall notify ACSA of any equipment or facility, which will be a consumer of electricity and water. The Contractor shall provide everything else necessary for Providing the Works".

5.1.10. Facilities provided by the *Contractor*

Facilities e.g. storage, site offices, vehicle, equipment provided by the contractor should be safeguarded by the contractor during the construction and be removed off site upon the completion of the contract

5.1.11. Existing premises, inspection of adjoining properties and checking work of Others

All operations required in connection with the Agreement shall, as far as the provisions of the Agreement permit, not unnecessarily or in an improper manner encroach upon the use of airport facilities.

The contractor is to take cognizance that the airport is used by others and other contractors may be on site for unrelated projects/services.

5.1.12. Setting out of the works

- Safety measures to be adhered to according OHS Act. Adhere to ACSA airside safety requirements regarding equipment, vehicles, and personnel operating on the airside.
- Full risk analysis on working on height, next to aircraft and airside and mitigation thereof to be considered as part of safety file requirements.
- Contractor to ensure that other Underground services, other existing services, cable and pipe trenches and covers are identified to prevent any disruption to these services due to contractor's activities.
- Contractor to take necessary steps to control noise, dust, water and waste during his/her activities onsite.

5.1.13. Sequences of construction or installation

Construction and installation must follow a logical and coordinated sequence of events as per the approved Project plan

5.1.14. Hook ups to existing works

The ACSA electrical team will facilitate this tie-in connection with reference to the notification of works to relevant stakeholders and the switching procedures.

5.2. Completion, testing, commissioning and correction of Defects

5.2.1. Work to be done by the Completion Date

All work to be done by the Contractor shall be completed by the Completion Date.

The Project Manager cannot certify Completion until all the has been completed and is also free of Defects which would have, in his opinion, prevented the Employer from using the works and Others from doing their work.

5.2.2. Use of the *works* before Completion has been certified

The Employer may use any part of the works before Completion has been certified but if he does so he takes over the part of the works. Any defect must be attended to as stipulated in the defect clause.

5.2.3. Materials facilities and samples for tests and inspections

Not Applicable

5.2.4. Commissioning

The contractor to submit the commissioning procedures and plan to the Project Manager for approval. The commissioning procedure and plans will be adhered to during commissioning.

5.2.5. Start-up procedures required to put the *works* into operation

The contractor to ensure that he complies with all ACSA security, safety, environmental and operational requirements prior to the commencement of works complete accordingly.

5.2.6. Take over procedures

The works will be handed over partially or fully once commissioned and certified by Project Manager. The commissioning should be witnessed by both ACSA representative and the contractor representative.

5.2.7. Access given by the *Employer* for correction of Defects

The Project Manager arranges for the Employer to allow the Contractor access to and use of a part of the works which has been taken over if needed to correct a Defect. After the works have been put into operation, the Employer may require the Contractor to undertake certain procedures before such access can be granted.

5.2.8. Performance tests after Completion

The works performance will be checked against the design parameters for the duration stipulated in the warranty period. Any deviation to the performance will be rectified by the contractor at their own costs. Furthermore, clause X17 performance levels will be applied

5.2.9. Training and technology transfer

The contractor will perform an ongoing on job training workshops on each completion phase of the projects , as well as any obligation for technology transfer being included.

Training of ACSA staff and/or other stakeholders on operation and maintenance of the HVAC system

- Providing of system data and its components
- Recommending improvements on maintenance procedures
- Recommending improvements on operational procedures

5.2.10. Operational maintenance after Completion

Maintenance manuals, approved As-built drawings by City Council and training will be provided by the contractor on completion of works, including the certification of Completion of the works.

6. Plant and Materials standards and workmanship

6.1. Investigation, survey and Site clearance

Contract to ensure that a thorough inspection and clearance is conducted prior commencement of work of any other services that might be impacted by contractor's activities.

6.2. Building works

Product specification and installation standard to be compliant with National Building Regulations and applicable SANS standards

6.3. Civil engineering and structural works

Applicable SANS standards

6.4. Electrical & mechanical engineering works

Applicable SANS standards

6.5. Process control and IT works

Applicable standards

7. List of drawings

7.1. Drawings issued by the *Employer*

This is the list of drawings issued by the *Employer* at or before the Contract Date and which apply to this contract.

Note: Some drawings may contain both Works Information and Site Information.

Drawing number	Revision	Title
1007927-ZUT-DRG-ZZ-ZZ-ME-001-A	Rev A	C-Gate, Baggage Hall Staff, Domestic Arrivals Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-002-A	Rev A	Parkade 1 & 2 Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-003-A	Rev A	Police Station Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-004-A	Rev A	International Departure Gates A1-A3 Ablutions

1007927-ZUT-DRG-ZZ-ZZ-ME-005-A	Rev A	Domestic Departure Gates A5-A12 Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-006-A	Rev A	Mugg and Bean- 3 rd Floor North Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-007-A	Rev A	Southern Office Building (SOB) 1 Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-008-A	Rev A	Southern Office Building (SOB) Plantroom Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-009-A	Rev A	Check-in: Second Floor South Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-010-A	Rev A	KFC- 3 rd Floor Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-011-A	Rev A	Airline offices- First Floor- North and Central Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-012-A	Rev A	Check-in: Second Floor North Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-013-A	Rev A	Domestic Baggage Reclaim- Ground Floor- South Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-014-A	Rev A	OCC- Fourth Floor Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-015-A	Rev A	International Arrivals & Immigration- Ground Floor North Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-016-A	Rev A	International Arrivals Concourse Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-017-A	Rev A	South Toilet Blocks- Roof Ablutions
1007927-ZUT-DRG-ZZ-ZZ-ME-018-A	Rev A	North Toilet Blocks- Roof Ablutions

PART 4: SITE INFORMATION

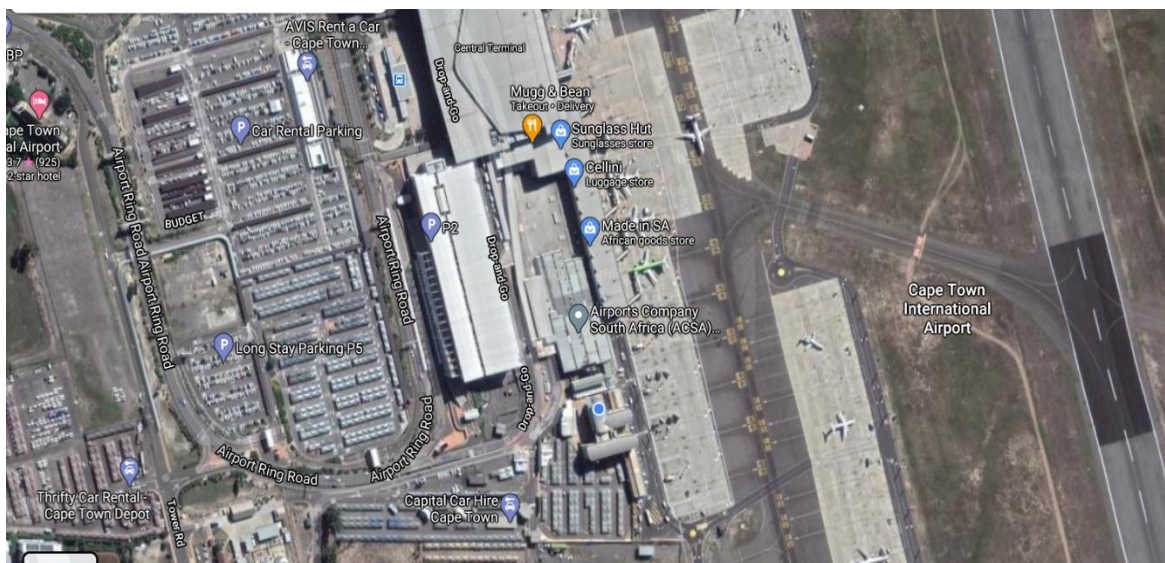
The services are situated on the airside of Cape Town International Airport the services taking place on various and remote areas within the boundary limits of the Cape Town International Airport.

The works will be conducted on airside and landside, requiring hands-on management of the construction work, with consideration of the safety and security.

The airside is a restricted area with stringent access control measures put in place. The Contractor is reminded that this is a National Key Point and as such must adhere to all airport's rules and regulations regarding health safety, environment, security, fire and access control.

General Site Conditions

Temperature (Min - Max)	6°C to 40°C
Relative Humidity	15% to 75%
Wind	Varies daily
Height above Sea Level	46 m
Slope (Existing/Modified)	N/A
Seismic	N/A



PART 5: ANNEXURES

Item #	Reference	Description
1.	Annexure 5.0	Project Standard Specification
2.	Annexure 5.1	Project Technical Specification
3	Annexure 5.2	C2.2 Price Schedule – Bill of Quantities (BOQ)
4.	Annexure 5.3	ACSA Generic Occupational Health and Safety Specification
5.	Annexure 5.4	ACSA Baseline HIRA
6.	Annexure 5.5	Occupational Health and Safety Agreement
7.	Annexure 5.6	Environmental Terms & Conditions
8.	Annexure 5.7	ACSA Construction Environmental Management Plan
9.	Annexure 5.8	Contractor's Installation Conditions & House Rules
10.	Annexure 5.9	POPIA Agreement
11.	Annexure 5.10	Government's Programme for Broad-Based Black Economic Empowerment

ANNEXURE 5.0: STANDARD SPECIFICATION

STANDARD SPECIFICATIONS

1. ABBREVIATIONS

a. South African :

AMEU	Association of Municipal Electricity Undertakings
CSIR	Council for Scientific and Industrial Research
SANS	South African National Standards
SAIEE	South African Institute of Electrical Engineers
SAIME	South African Institute of Mechanical Engineers

b. British :

BS	British Standard
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c. American :

ARI	Airconditioning and Refrigeration Institute
ASA	American Standards Association
ASHRAE	American Society of Heating, Refrigeration and Airconditioning Contractors National Association
UL	Underwriters Laboratories

d. International :

SI	The International System of Units
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e. German :

DIN	Deutsche Industrie Norm
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- f. The Subcontractor shall take delivery of all P.C. items, unpack, check, store, clean, assemble, install connect all services thereto, test, commission and hand over as part of the complete installation entirely in accordance with the Specification. Having taken delivery of P.C. items, and having signed for their receipt in good order, the Subcontractor will be held fully responsible for them.

2. PROVISIONAL SUMS (P.S. ITEMS)

- a. Where a provisional sum is shown in the Tender Form or referred to in the specification, this shall be expended or used at the discretion of the Engineer. The Subcontractor shall make all payments against provisional sums and shall include in his tendered price for all costs incurred and profit required for handling, installation and assuming responsibility.
- b. Tenderers shall allow in their tendered price for taking delivery of all P.S. items, and assuming all responsibilities and providing all attendance as detailed in the preceding clause on Prime Cost Items.

3. CONTINGENCIES AND VARIATIONS

- a. Where an amount for contingencies is included in the Tender Form, expenditure out of this sum shall only be made with the authority of the Engineer. The contingency sum,

whether in part or in whole, shall be deducted from the final account, wherein all variations shall be fully detailed. All variations submitted by the Subcontractor shall be accompanied by estimate sheets detailing itemized material costs, activity times for each component, overheads, profit and other allowances. Copies of quotations shall accompany the estimate sheets if required by the Engineer.

- b. Variations are not intended to create delays. However, should a variation have delay implications, the Subcontractor shall inform the Engineer in writing at the same time as variation costs are submitted, or, where instructions are given before costing takes place, the Subcontractor shall inform the Engineer in writing immediately such instructions are received. Where such written notification is not received at the time determined above, no subsequent claim for a delay will be considered.

4. **SPECIFICATIONS AND DRAWINGS**

- a. The whole of the work specified and indicated on the drawings and such extras as may be authorised, shall be carried out by the Subcontractor. The Specification shall be read in conjunction with the accompanying drawings. Tenders shall include such items as are specified but which may not appear on the drawings and vice versa.
- b. The tenderer will be deemed to have included all items for the proper operation of the work, notwithstanding that such items may not be referred to in the Specification or drawings, unless he specifically states in his tender that such items have been omitted. In such instances he shall submit a quotation at the time of tendering for the items omitted.
- c. Where statements or items in drawings and subsequent sections of the Specification are at variance with corresponding statements in earlier sections of the Specification, then the statements in the drawings and the later sections shall always take precedence.
- d. Annexure 5.1 of the Specification shall apply to the work specified in Annexure 5.2 of the Specification, and vice versa. Annexure 5.2 of the Specification and the accompanying drawings shall govern where they differ from Annexure 5.1.

5. **VERIFICATION OF DRAWINGS AND DIMENSIONS**

- a. Drawings are essentially diagrammatic to the extent that many off-sets, bends, special fittings and exact locations are not indicated. Carefully study drawings and premises in order to determine best methods, exact locations, routes, building obstructions, etc. and install apparatus and equipment in available locations.
- b. Where apparatus and equipment have been indicated on the drawings, dimensions have been taken from typical equipment of class indicated.
- c. Carefully check drawings to see that equipment will fit into spaces provided. Assume full responsibility for the proper and accurate layout of equipment and materials specified and indicated on the drawings.
- d. Install apparatus and equipment in the manner and in the locations indicated on the drawings, avoiding obstructions, preserving headroom, and keeping openings and passageways clear. Make changes in locations of equipment and materials to accomplish this.
- e. Location of piping, ductwork, apparatus and equipment indicated on drawings are approximate only, and shall be changed to meet architectural and structural conditions as required. A complete set of Architect's and Structural Engineer's drawings may be viewed in the offices of the Consulting Engineers.
- f. The Subcontractor shall check with the Principal Contractor, before putting work in hand on any section of the work, that he is in possession of the latest drawings, and should any discrepancy be found between the Subcontractor's drawings as issued by the Engineer those in possession of the Principal Contractor, the matter should be referred to the Engineer.

6. **SHOP DRAWINGS AND SAMPLES**

- a. After receiving tentative approval of the items in the materials and equipment lists, the Subcontractor shall submit to the Engineer through the Principal Contractor complete shop drawings, samples and such other descriptive data as may be required by the Engineer or Principal Contractor to demonstrate compliance with the contract documents.
- b. Shop drawings shall be submitted grouped together as required by the Engineer or Principal Contractor to demonstrate that items covered by such submission have been properly co-ordinated and will function properly with other items forming one assembly of system.
- c. The Subcontractor shall review, stamp with his approval and submit, with reasonable promptness and in orderly sequence so as to cause no delay in the Works, all shop drawings and samples required by the, Engineer and Principal Contractor. Shop drawings and samples shall be properly identified as specified, or as the Engineer and Principal Contractor may require. By approving and submitting shop drawings and samples the Subcontractor thereby represents that he has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data, and that he has checked each shop drawing and sample with the requirements of the Works and Subcontract.
- d. The Engineer will review and approve shop drawings and samples submitted through the Principal Contractor with reasonable promptness so as to cause no delay, but only for conformance with the design concept of the Project, and with the information given in the contract documents. The Engineer's approval of a separate item shall not indicate approval of an assembly in which the item functions.
- e. The Subcontractor shall make any corrections required by the Engineer or Principal Contractor, and shall resubmit the required number of corrected copies of shop drawings, or new samples, until approved. The Subcontractor shall direct specific attention in writing on resubmitted shop drawings to revisions other than the corrections made by the Engineer or Principal Contractor on previous submissions.
- f. No portion of the Subcontract requiring shop drawings or samples submissions shall be commenced until the submission has been approved by the Engineer and Principal Contractor.
- g. Likewise, no portion of the Subcontract requiring coordination of works under different Service Subcontracts shall commence until the co-ordination shop drawings have been approved by the Engineer and Principal Contractor.
- h. All such provisions of the Subcontract shall be in accordance with approved shop drawings and samples.
- i. Approved samples and shop drawings shall be retained and stored at the Subcontractor's expense and shall be available at all times to the Engineer and Principal Contractor for later reference.
- j. The Engineer's approval of shop drawings or samples shall not relieve the Subcontractor of responsibility for erection or installation fit or for any deviation from the requirements of the Subcontract unless the Subcontractor has informed the Principal Contractor in writing of such deviation at the time of submission of shop drawings or samples and the r Engineer has given written approval to the specific deviation, nor shall the Engineer's approval relieve the Subcontractor from responsibility for errors or omissions in the shop drawings or samples.
- k. Approval, comments, amendments or corrections on shop drawings by the Engineer and Principal Contract are not intended to cause any variation int he cost of the work. Should

such approval, comments, amendments, or corrections in the opinion of the Subcontractor, involve additional cost, the Subcontractor shall notify the Principal Contractor in writing within seven days of receipt of such approval, comments, amendments and corrections and shall not proceed with such portion of the work until the Principal Contractor has obtained instructions from the Engineer to do so. In the event of notification of additional costs not reaching the Principal Contractor within the required seven days, no claims for such additional costs of work will be entertained.

7. **AS-BUILT DRAWINGS**

- a. The Subcontractor shall, through the Principal Contractor, furnish the Employer and Engineer with a complete signed set of as-built drawings, **together with an electronic copy of the same drawings**, as a prerequisite to completion. The as-built set shall include all mechanical, electrical and other work where applicable, and shall be prepared jointly by the Subcontractors involved in any section of the Subcontract or part thereof.
- b. If necessary, copies of Engineer's drawings may be used for the purpose. If as-built variations cannot be clearly shown thereon, the Subcontractor shall prepare supplementary drawings that will properly impart the necessary information.
- c. As-built drawings shall be up-dated as work progresses and all deviations in work as actually installed shall be recorded on these drawings.

8. **CO-ORDINATION**

The Subcontractor shall delegate staff sufficient in number and of satisfactory standard to enable him to meet the following requirements.

- a. Detailed engineering including component and equipment engineering in working assembly, in conformance with the concept of the Specification.
- b. Programming and planning of his own work to fit in with the programme of other subcontractors all of which will be incorporated in the Principal Contractor's overall programme.
- c. Issue directions relative to any aspect of construction means, methods, techniques, and sequences or procedures for safety precautions and programmes in connection with the work.
- d. Maintain at the site for the Engineer and Principal Contractor one copy of all drawings, specifications, addenda, approved shop drawings, variation orders and other modifications, in good order and marked to record all changes made during construction.
- e. Prepare and submit materials and equipment lists.
- f. Participate in the preparation of co-ordinated shop drawings where required for the Works.
- g. Submit samples, if called upon to do so, of equipment or individual components for examination or testing.
- h. Prepare as-built drawings.
- i. Produce Spare Parts Information, Operating Instructions and Maintenance Manuals.
- j. The Subcontractor shall prepare and make available to the Engineer and the Principal Contractor at all reasonable times, the following information, or any other information not listed here, which may assist the Engineer and the Principal Contractor to inform themselves about the status of the Subcontractor's activities:
 1. Schedule of material and equipment required for the Subcontract

combined with a time schedule setting out in detail:

2. When required on site to meet the Sub-Contractor's detailed programme.
 3. Delivery time.
 4. Date by which order has to be placed.
 5. Whether or not the item has to be approved by the Engineers.
 6. Date required for submission to the Engineers for their approval.
 7. Whether of local manufacture or imported.
 8. Whether standard item or special manufacture.
- ii. . All orders placed.
 1. Follow-up system to ensure that orders are executed on item combined with forwarding information where applicable.
 - iii. . List of construction equipment required for the execution of the Subcontract.
 1. Anticipated labour force broken down into the various categories of artisans and unskilled personnel.
 - iv. . Anticipated production output in rands per month summarised in a cash flow diagram.
 1. Schedule of shop drawings to be prepared with dates for required submission to and approval by the Engineer and Principal Contractor.
- k. Preparation of detailed information schedules required by the Engineer.
 - l. Prepare, maintain and keep up to date a filing system for shop drawings and samples submitted for approval.
 - m. Supervise work on site in respect of its execution in accordance with the co-ordinated shop drawings, specifications, quality control and progress.
 - n. Co-ordinate the testing, start up and trial operation with other Subcontractors.
 - o. Co-ordinate equipment selection with other Subcontractors to ensure uniformity of equipment wherever possible.
 - p. The Subcontractor shall advise the Principal Contractor immediately of any matters which may adversely or otherwise affect the construction programme and steps that have been or will be taken to remedy the situation.
 - q. Advise the Engineer, or after completion of the work the Employer, on all technical and economic aspects of work under the Subcontract.
 - r. Measure work done and prepare monthly claims for payment.
 - s. Supervise and record results of acceptance tests.

9. **PLANT AREAS**

- a. Tenderers are required to check whether the plant rooms and areas shown on the drawings are large enough to accommodate the equipment offered by them.

- b. Tenderers shall ensure that equipment offered can fit into area shown, allowing for access, maintenance, etc. Passageways and walkways shown must be kept clear.

10. **SIZE LIMITATIONS**

- a. Tenderers shall meet with the Principal Contractor to discuss and agree detailed requirements with regard to access to the site and within the Works to its final location of bulky and/or heavy items of equipment etc.
- b. Wherever such requirements cannot be reasonably accommodated by the Principal Contractor, tenderers shall make due allowance for such equipment etc. to be supplied in broken down form to reduce component sizes and weights to acceptable proportions.
- c. Where no Principal Contractor has been appointed at the time of tendering, tenderers shall study all Architectural, Structural, Engineers and other relevant drawings to ensure that the equipment offered can be readily moved through the site and the Works to its final location. If necessary equipment etc. shall be supplied in broken down form to reduce components sizes and weights to acceptable proportions.
- d. Should any uncertainty exist on any aspect of access, tenderers shall draw this to the attention of the Engineer in writing at the same time as tenders are submitted, failing which, all allowances shall be deemed to have been made by the tenderer.

11. **SELECTION AND ORDERING OF MATERIALS AND EQUIPMENT**

- a. Within 14 days after acceptance of contract, submit to the Engineer for approval a complete list in quadruplicate, of materials and equipment that the Subcontractor proposes to furnish, including manufacturer's catalogue information as to construction, capacity, materials, etc.
- b. Within 30 days after approval of the above list, arrange for purchase and delivery of materials and equipment required, in ample quantities and at proper time. the Employer reserves the right to purchase required materials and equipment and deduct the cost thereof from the contract sum, if the items are not on the job in time to expedite completion.
- c. Materials of similar class or service shall be on one manufacture.
- d. Capacities, sizes and dimensions given are minimum unless otherwise indicated.
- e. Deliver and store manufactured materials in original containers, which shall indicate clearly the manufacturer's name, brand, and identifying number. Clearly mark or stamp with manufacturer's name and rating.
- f. Specified equipment shall be as hereinafter specified.
- g. It is the Subcontractor's responsibility to ensure that all materials and equipment provided are entirely suitable for the application. Materials and equipment which are not suitable for the application, or are not to the satisfaction of the Engineer, shall be replaced by materials and equipment which are suitable and which are to the satisfaction of the Engineer. All such replacement costs shall be for the account of the Subcontractor.

12. **ACCESSIBILITY**

- a. The installation of dampers, thermometers, gauges, cleanouts, control devices or other items requiring reading, adjustment, inspection, repairs, removal or replacement shall be conveniently and accessibly located with reference to the finished building.

13. **CLOSING IN OF UNINSPECTED WORK**

- a. The Subcontractor shall not allow or cause any work to be covered up or enclosed until inspected, tested and approved. Should any work be enclosed or covered up before such inspection and test, he shall, at his own expense, uncover the work and after it has been inspected, tested and approved, make repairs with such materials as necessary to restore his work and that of other sections to original and proper condition.

14. **EQUIPMENT SUPPORTS**

General

- a. Where supports, foundations, stands, suspended platforms for machinery, tanks or other equipment are indicated or specified, perform the following :
 - i. Design and construct supporting structures to safely withstand stresses to which they may be subjected and to distribute loads properly over the building structure. Conform to applicable technical society standards and to codes and regulations of governing authorities.
 - ii. Locate support members so as to avoid equipment strains and interferences with piping connections, tube pulling or other maintenance operations.
 - iii. Where saddles are required, use cast iron or welded steel saddles with curvature to fit the tank shell.
 - iv. Mount power driven equipment on common base with driver.
 - v. Refer to vibration isolation section herein.
- b. **Concrete Foundations** : in general, will be furnished and installed by others.
 - i. Where concrete work is not included in this specification
 - 1. Furnish layout drawings for all foundations
 - 2. Furnish templates and mounting bolts.
 - 3. Grout under all equipment after levelling, filling completely the space between machinery bed plate and foundation surface. Finish exposed surface of grout to make a neat appearance.
 - ii. Where concrete work is included in this specification and additionally to the requirements of Clause 15.2.1.
 - 1. Use concrete mix, reinforcement as required and methods specified in the Principal Contractor's specification.
 - 2. Roughen or cut into floor surface to make good bond or key between foundation and floor.
 - 3. Finish exposed parts with cement mortar, fill voids, trowel smooth, bevel edges and corners to make a neat appearance.
 - 4. Bases shall not be less than 125mm high and shall extend outward 50mm beyond machinery bed-plate. In no case shall foundation be smaller than recommended by the equipment manufacturer.
- c. **Floor Stands** : Where equipment is mounted on stands or legs, constructed of structural steel or steel pipe and fittings, cross brace and fasten with flanges or plates bolted to the floor.

- d. **Ceiling or Wall Supports** : Use suspended platform, strap hangers, bracket or shelf, whichever is most suitable for equipment and location. Construct of structural steel members, steel plates, rods or pipes as required. Cross brace and fasten to building structure or inserts in an approved manner.
- e. **Steel Work** : Shall be neatly fabricated and erected with excess burrs and welding spatter ground off. Paint after fabrication with a rust inhibitive primer, and two coats of approved oil paint or hot dip galvanise, as specified.
- f. Notwithstanding the foregoing, where-ever concrete bases are specified, indicated or necessary, supply, position and fix suitable reinforced galvanised sheet metal formers into which the concrete can be poured.

15. **WATERPROOFING**

- a. **Penetrations** : Wherever work must penetrate waterproofing do so with care. Openings through waterproofing shall be made absolutely watertight in a manner acceptable to the Engineer. All ducts and pipes shall be flashed and same extended in all directions not less than 200mm. Heavily coat all roof penetrations with roofing mastic.
- b. **Equipment** : All equipment installed outdoors shall be designed for this purpose and shall be housed in a weatherproof metal enclosure, ventilated or insulated if required, and provided with suitable hinged access doors and operating hardware.

16. **IDENTIFICATION OF PARTS**

- a. **Valves** : Carefully prepare chart or diagram for each piping system, indicating thereon, by identifying number or letter, each valve in the system, the valve's location and its function.
 - i. Mount one of each chart in aluminium frame with clear glass front and secure on wall as designated by the Engineer.
 - ii. Bind copies of each chart in Operating and Maintenance Manual.
 - iii. Provide each valve with brass, aluminium or plastic disc, not less than 30mm diameter and bearing engraved numbers corresponding to those shown on chart. Fasten discs to valves with 2mm brass wire.
- b. **Instruments and Controls** : Identify all panel mounted instruments and controls with engraved Traffolyte nameplates permanently affixed panelboard. Identify all damper motors and automatic valves, flow switches, pressure switches, etc. with engraved Traffolyte name-plates, indicating the service, and, where applicable, its normal setting. All labels shall be securely fixed mechanically, or with adhesive approved by the engineer.
- c. **Pipe** : Mark each individual pipe with marking bands and arrows to indicate the direction of flow.
 - i. Identify pipes with identification bands of various colours. Colours will be specified by the Engineer.
 - ii. Provide colour code identification chart with aluminium frame and clear glass cover to mount on wall as directed. Provide a copy of chart in Operating and Maintenance Manual.
 - iii. In equipment areas, install bands adjacent to each valve, at each tee and at 2,5 metre intervals on straight runs.
 - iv. In furred spaces, place bands adjacent to each valve at each tee, and 150mm above floor or platforms in shafts.

- v. Where exposed in rooms other than equipment room, place bands at points of entrance and exit into rooms.
- d. **Equipment** : Identify all equipment with engraved Traffolite labels and permanently fix to the equipment with approved screws or adhesive. Names and references shall correspond with the operating and maintenance instructions. Size of lettering shall be to Engineer's approval.

17. **PAINTING, CLEANING EQUIPMENT & PREMISES**

- a. Except where specified to the contrary under items .18.2 and .18.3 of this clause, thoroughly descale, clean and paint all equipment, ducts, pipes, metal parts and insulated and plastered surfaces with a priming coat and two coats of oil paint.
- b. All black metal work, including brackets, hangers, platforms, piping, etc. in shafts, trenches, ceilings and behind cabinets shall be thoroughly cleaned, descaled and painted with two coat zinc chromate followed by one coat oil paint to ensure complete corrosion protection.
- c. Galvanised metal in shafts, trenches and ceilings need not be painted unless elsewhere specified.
- d. Where any item is specified as being painted and such item becomes inaccessible for painting after installation then such item shall be painted prior to installation.
- e. All plant room floors and bases shall be painted with a polyurethane epoxy based paint after the installations are completed and handed over. Unless elsewhere specified, the walls, ceilings and doors will be painted by the Principal Contractor.
- f. Paint shall be of the highest quality and shall be applied strictly in accordance with the manufacturer's recommendations and directions. Paint colours shall be approved by the Engineer.
- g. During the progress of the work, the Subcontractor shall carefully clean up after his men, and shall leave the premises and all portions of the building in which he is working free from his debris.

18. **COMMISSIONING, ADJUSTING AND BALANCING**

- a. Equipment shall be commissioned and adjusted so that it will perform as specified and shown on the drawings. A letter from each supplier of equipment shall be sent to the Engineer stating that the equipment has been installed and commissioned entirely in accordance with the suppliers requirements and recommendations.
- b. The entire control system shall be adjusted and placed in operating by the supplier. Re-adjustments necessary to accomplish the specified results during the first year of operation shall be made without cost to the Employer.
- c. All duct systems shall be adjusted and balanced so that air quantities at outlets are as specified or shown on the drawings so that distribution from air terminals is free from draughts and uniform over the face of each air terminal.
- d. Adjustments shall be made so that splitters and volume adjusters close to air terminals will have the least pressure drop consistent with volume requirements. Additional pressure drop required for balancing of shorter runs shall be obtained by adjustment of the dampers at branch duct take-offs. Adjustable fan drives shall be used for making final adjustments of total air quantities.
- e. Direct reading velocity meters may be used for comparative adjustment of individual air terminals, but air quantities in ducts having velocities of 5,0 m/s or more shall be measured

by means of pitot tubes. Factory fabricated plugged or capped openings for pitot tubes shall be provided as required.

- f. Settings of dampers, splitters and other volume adjusting devices shall be permanently inscribed so that they can be restored to their original positions if disturbed at any time.
- g. Where variable or constant volume regulators or similar devices are installed, the Subcontractor shall remove one device of each size from the installation as directed by the Engineer and shall send such devices to the CSIR or other approved body, for certification of the installation and shall form the basis for performance comparisons of other devices of the same size if required by the Engineer.
- h. A full air volume reading shall be taken on site prior to the device being sent for certification and the Subcontractor shall ensure that all conditions necessary, for the correct operation of the device, prevail prior to the first site volume reading being taken.
- i. In the event of the installation being in operation at the time of such certification being required, the Subcontractor shall install devices of the same size as those on which such certification is taking place, to ensure continuity of operation of the installation.
- j. Fan performances on variable volume systems shall, in addition to any other tests required by the Engineer, be recorded when all variable volume devices are switched to their maximum design volume.
- k. Where balancing dampers are shown in variable or constant volume regulator systems, these shall be used to produce a preliminary air balance to ensure that the regulators are only required to fine balance the installation.

19. **TESTS**

a. **General**

- i. The Engineer will prescribe the methods of testing, the type of data to be recorded and may elect to have such testing or part thereof supervised by an independent body or institution.
- ii. Except where otherwise provided in the Subcontract, the Subcontractor shall provide all labour, materials, fuel, filters and accessories and properly calibrated and certified instruments necessary for carrying out all tests. Power and water for carrying out tests on site will be provided by the Principal Contractor or Employer provided that such tests are not unduly prolonged by the Subcontractor.

b. **Interim Tests and Inspections:**

The Engineer and Principal Contractor or their authorised agents shall be afforded access at all reasonable times to such part of the Subcontract Works at the Subcontractor's premises or the premises of the manufacturer of components parts, as may be necessary for the purpose of inspecting, examining and testing the materials, workmanship and performance of any plant or equipment for the Subcontract Works.

c. **Test Procedures**

- i. Capacities of cooling towers, pumps, heating coils, fans and other equipment shall be determined by operating tests of not less than four hours duration, after stable

conditions have been established. Test procedures shall be in accordance with applicable portions of ASME and other recognised test codes as far as field conditions permit. Capacities shall be based on temperatures and water quantities measured during such tests.

- ii. Temperature differences required for determining capacities shall be measured by thermometers having graduations that permit interpolations having an accuracy of plus or minus 0,1 degrees C.
- iii. Air quantities may be measured by pitot tubes, anemometer or velometer, depending on the velocity and other conditions of flow.
- iv. Sound tests to demonstrate compliance with sound guarantees shall be made at locations selected by the Engineer.
- v. Sound levels shall be measured with a sound meter complying with the latest American Standards Association. The A scale shall be used for overall sound level readings. Where sound levels are specified in octave bands, the above sound level meter shall be supplemented by an Octave Band Analyzer complying with the latest American standards Specifications for an Octave Band Filter Set No. Z2.10, published by the American Standards Association.
- vi. Equipment components of room noise levels (those portions of total room noise levels attributed solely to airconditioning equipment) shall be determined at any point within a room not less than 1,8 metres from an air terminal or room unit.
- vii. As far as possible, sound level readings shall be taken at times when the building is unoccupied or when activity in surrounding areas, and background noise levels in areas tested, are at a minimum and relatively free from sudden changes in noise levels. Readings shall be taken with no equipment operating and with all air-conditioning equipment, capable of transmitting sound to the spaces tested, in operating.
- viii. Test instruments shall be tested for accuracy by an approved laboratory or by the manufacturer, and certificates showing degree of accuracy shall be furnished to the Engineer.
- ix. Whenever any installation or equipment is operated for testing or adjusting as provided for above, the Subcontractor shall operate the entire system for as long a period as may be required to provide satisfactory performance at all times in the occupied spaces served by the system for up to twenty four hours a day continuously until the system is handed over.
- x. The Subcontractor shall provide all labour and supervision required for such operation and the Engineer may assign operating personnel as observers but such observation time shall not be counted as instruction time.

20. OPERATING AND MAINTENANCE MANUALS

- a. Carefully prepare Operating and Maintenance Manual for the installations and submit for approval at least two months before completion of the Subcontract Works. Failure to submit this manual for approval by the time specified will delay final inspection and acceptance of the Subcontract Works by the Engineer.
- b. The form in which the Manual is to be presented is subject to the approval of the Engineer.
- c. The following items together with any other data considered by the Engineer to be pertinent shall be included.

- i. **Front Page**. This page shall detail the service, job name and address, Client, the name and addresses of the Consulting Engineers and the name, address, normal hours and emergency call out telephone of the installing Contractor.
- ii. **Index**. A general index is required to indicate the contents of all sections of the manuals. Each section shall be tagged. In addition, all sections and sub-sections shall be individually indexed in detail at the beginning of each section and sub-section.
- iii. **Abbreviations** used in manual and on drawings.
- iv. **Full description of design and operation of installation**.

This description shall be detailed and comprehensive and shall be related to the mechanical, electrical and controls as-built drawings with references and cross-references being made to these drawings.

Specific functions of systems and equipment shall be detailed and shall include the areas served, and automatic and manual control operations which shall detail sequence starting and interlocking of equipment, safety controls, alarm and fault finding procedures, etc. Set points of the various instruments and controls shall be stated in this description.

- v. **Approved schematic wiring and control diagrams** of the entire system and line diagrams showing the location and function of controls including set points. The diagrams shall relate to the labelling on equipment, controls, switchgear, etc. Drawings shall state, where applicable, the normal and abnormal gauge readings, the control points, scale settings, true settings, differential bands, throttling ranges, time delays, overload settings (actual and scale), and other relevant variable and adjustable items to permit checking and adjustments of each instrument control and motor function.
- vi. **Operating instructions and illustrations** describing operational routing, explaining preventive and checking procedures including a schedule of recommended daily, weekly, monthly and yearly activities, methods of checking the system for normal safe operation, and procedure for safely starting and stopping the system.

The on-site instructions for operation of the plant shall include demonstrations of the correct performance and function of each piece of equipment under both automatic and manual control. If necessary, this service shall be arranged in two parts to adequately demonstrate operation of the plant under summer and winter conditions.

- vii. **Mechanical as-built drawings** on which all systems, plant, equipment, test and measuring points, including valves, balancing valves, diffusers, dampers, orifice plates, controls, sensors, actuators, controllers and other control equipment etc. shall be shown. If, in the opinion of the Engineer, the as-built drawings cannot be used to clearly indicate the locations of and notes relating to smaller items of equipment then additional drawings to the same scale shall be produced, from which notes and information not relevant to the smaller equipment shall be omitted.

All items shall be referenced and cross-referenced with on site labelling etc. and other drawings including air flow, water other fluid piping schematics, valve charts, controls and electrical schematics and diagrams in addition to the commissioning data schedules. Wherever any item of equipment is shown or installed, a consistent reference shall be used throughout.

As-built drawings shall be 1 to 50 scale unless otherwise agreed in writing with the Engineer. All drawings etc. shall be mounted in clear plastic holders, which are pre-punches for filing.

- viii. **Air flow diagrams** which shall indicate all systems and the equipment installed therein, references and design duties etc.
- ix. **Valve charts or diagrams** as determined by the Engineer. Valves shall be numbered and details of location and function shall be scheduled.
- x. **Photographically reduced drawings** shall be reproduced on non-fading paper and coloured where required. These reproductions shall be framed behind glass and mounted in the plant rooms or other locations as instructed by the Engineer.
- xi. **Manufacturer's literature** for all separate items of equipment shall include complete manuals, operating and maintenance instructions and relating tables for each item of equipment for which the manufacturer normally furnishes such information and instructions.
- xii. **Spare parts information** shall include :
 1. A complete list of spare parts and supplies for each item of equipment with source of supply. The list shall include belt sizes, numbers, types and lengths, bearing types, location and numbers;
 2. A list of spare parts and suppliers, for each item of equipment, which is normally furnished at no extra cost with the purchase of the equipment.
 3. A list of additional parts and supplies recommended by the manufacturer to ensure efficient and continuous operation of each item of equipment, for a period of one year or as specified.
- xiii. **Equipment schedules** giving all equipment and motor information including, where applicable, manufacture, serial number, model, type, size, speeds, voltage, capacity, etc.
- xiv. **Equipment location, and suppliers,** suppliers addresses and telephone numbers.
- xv. **Comprehensive commissioning data** for all systems and equipment which shall include all design and measured details for air, water, electrical, controls and other miscellaneous systems. The contractor shall discuss the format for the presentation of this data before commencing commissioning tests. Failure to do this may result in the Subcontractor having to repeat all tests to comply with the Engineer's requirements.

Included in this section shall be performance curves, and tables or schedules with the appropriate operating point indicated for each piece of equipment. complete details of all instruments used for commissioning and testing shall be included in this section including instrument make, serial number, model, type, current calibration curves or tables, etc.

- xvi. **Test certificates and approvals** shall be included where appropriate. Items required are as follows. Pressure vessel test certificates, boiler certificates, insurance company approvals, municipal electrical certificates of acceptance, etc.
- xvii. **The Contractor's name**, address and telephone numbers during normal working hours and emergency numbers for use outside normal working hours.
- d. All information shall be provided in SI units fully in accordance SABS standards.
- e. All information listed above shall be presented in a stiff cover binder as one comprehensive document for all work under the Subcontract.
- f. After approval by the Engineer, the documentation shall be submitted in triplicate in either of the official languages of the Republic of South Africa, as required by the Engineer.
- g. The Engineer shall determine whether the above specified information as furnished by the Subcontractor is adequate and complete and may require such additional submittals by the Subcontractor as necessary to ensure the satisfactory operation of the various items of equipment and to fulfil the intent of the above requirements.

21. **FINAL OPERATION**

- a. The Subcontractor shall provide sufficient qualified staff and operators to operate and maintain the plant from start-up, during testing and balancing and hand-over.
- b. The Subcontractor's operators shall be fully conversant with the plant operation and experienced in running similar installations. The Subcontractor, at his own expense, shall fully train the Employer's operators in all details of operation and maintenance prior to their assuming responsibility for operating the plant. The Employer's operators will be paid by the Employer.
- c. Logging of the plant shall start immediately on start-up.

22. **DEFINITION OF COMPLETION**

The Subcontractor Works or any portion thereof shall be considered complete when:

- a. The Engineer has certified that the following has been carried out in accordance with the Subcontract agreement.
 - i. Physical completion has been reported to the Engineer and all defects made good and the Engineer has given approval for start up. Physical completion shall include all builders work, by other trades, associated with this installation. It is the Subcontractor's responsibility to ensure that all such builders work is completed.

- ii. Start-up has taken place.
 - iii. The Engineer has issued the handing over certificate, accepting the plant and equipment.
 - iv. As-built drawings have been handed over to the Principal Contractor and have been accepted by the Engineer.
 - v. Operating and Maintenance manuals have been accepted by the Engineer.
 - vi. All measurements necessary to prepare the final account have been established.
 - vii. A complete list of claims for any extras, if any, has been submitted to the Engineer through the Principal Contractor complete with supporting documentation and agreed to by the Engineer and Principal Contractor.
- b. When the Principal Contractor has certified that the Sub-Contractor has removed from the site or portion thereof all his plant, equipment and temporary installations and all materials unused.

23.3. The entire installation has been accepted by the Machinery Inspector. It is the Subcontractor's responsibility in terms of this specification to ensure that the installation complies in all respects with the requirements of the Machinery and Occupational Safety Act of 1983, as amended.

23. SPARES AND TOOLS

- a. The Subcontractor shall supply to the Engineer all spares and tools supplied for the equipment, two keys for each switchboard, and two of any other special keys and tools required for the maintenance and operation of the plants.

24. MAINTENANCE

- a. The Subcontractor shall include in his tender price for maintenance of the complete Subcontract Works for a period of twelve months after the issue of the "handling over certificate" or from the date when the Subcontract Works or portions thereof have been handed over for beneficial use. During this period any defective workmanship or materials shall be made good to the satisfaction of the Engineer. The Subcontract Works shall be serviced not less frequently than once per month, unless specified to the contrary elsewhere in this specification, or by written agreement between the Sub-Contractor and the Engineer.
- b. Where materials or equipment require routine maintenance more frequently than the period between service visits herein specified, the Subcontractor shall schedule out all such activities in the Operating and Maintenance Manual and instruct the client accordingly prior to the handing over of the plant for beneficial use.
- c. A major service shall be executed by the Subcontractor in the twelfth month of the contract maintenance period, which shall be to the satisfaction of the Engineer. This major service shall include all annual servicing functions as recommended by the manufacturers of materials and equipment supplied and/or installed under this Subcontract.
- d. Maintenance shall be carried out on an acceptable and agreed day/s to perform full maintenance on the basis of a proper preventative maintenance programme approved by the Engineer.
- e. The Subcontractor will be required to carry out routine tests and to include in his tendered price for such routine testing, and shall also make due allowance for service calls, general attendance and instruction of the Employer's personnel, or persons nominated by the Employer.
- f. The Subcontractor shall report to an official nominated by the Employer on arriving and again at leaving their premises on each visit. Such person, who has been nominated by the Employer, shall sign a Service Report giving details of any defects made good, temperature readings, taken, etc.
- g. The Subcontractor shall undertake to be available within four hours after emergency service call on a 2-hour basis and shall provide and keep up to date the names and home telephone numbers of any persons in his employ who could properly attend to the plant. His tender price shall duly include for this service.
- h. All materials and equipment shall be maintained entirely in accordance with the manufacturer's recommendations and to the satisfaction and approval of the Engineer.
- i. If any defects are not remedied within a reasonable time, the Principal Contractor or Employer shall proceed to do the work at the sole risk of and expense of the Sub-Contractor, but without prejudice to any other rights which the Principal Contractor and Employer may have against the Subcontractor in respect of such defects.
- j. The Subcontractor shall furnish all switchgear and transformer oil, lubricants, refrigerants, special chemicals, replacement air filter media and any other materials necessary during the maintenance period.
- k. The Employer shall furnish free of charge all electric power, and water.

25. **GENERAL - SITE STAFF, OTHER TRADES & EQUIPMENT**

- a. The Subcontractor shall assign a project engineer, assisted by other engineers and qualified draughtsmen experienced in airconditioning and ventilation work, to design and supervise the installations. The curriculum vitae of the staff shall be submitted to the engineer for approval, and if not acceptable, the Subcontractor shall assign other staff who are more competent to the satisfaction of the Engineer. Under no circumstances will incompetent staff be allowed to design, supervise, commission and test the installations.
- b. If through delays, neglect, lack of diligence, or incompetence on the part of the Subcontractor, the Engineer is involved in an extraordinary amount of work, due notice will be given to the Subcontractor of intention to charge for such extra expenses as may be incurred and the appropriate deduction will be made by the Employer from monies due to the Subcontractor.
- c. It is the Subcontractors responsibility to ensure that all work to be carried out by other trades, which either directly or indirectly affects the correct functioning of his installation, is completed in all respects to ensure that the Subcontract works function entirely in accordance with the design intent.
- d. All equipment, valves, etc. shall be suitably protected from Builder's work activities, such as painting of floor slabs in floor voids, shuttering and casting of concrete, plastering etc.
- e. All equipment shall be complete with lifting brackets suitable for future removal of equipment.
- f. The Subcontractor shall provide, hoist and handle all plant, tools, tackle and scaffolding for the Subcontract.
- g. All details of Builder's work must be provided in good time and any extra work resulting from failure to do so will be for the Subcontractor's account.
- h. Neatly and tightly flash off where services penetrate fire baffles in floor and ceiling voids.

26. **MACHINERY DRIVES AND ACCESSORIES**

- a. **Couplings** : Where couplings are specified for direct-drive, non-lubricated types shall be used and the ratings shall be at least 125% of motor kilowatt rating, but in any event shall be sized fully in accordance with manufacturer's recommendations for the application.
- b. **Belt Drives** : Where V-belt drive is required, design for overload per manufacturer's recommendation, but in no case for less than 125% of motor kilowatts. Drive selection shall provide not less than 95% efficiency. All drives larger than 1/2 kW shall be multiple belt drive.
- c. Where size permits, pulleys shall be taper-lock and fitted with high capacity belts. The drives shall be Fenner, Gates, or other approved.
- d. **Lubrication Fittings and Gauges** : Provide oil level gauges, oil pressure gauges, grease gun fittings as required by the equipment. Extended all lubrication fittings to readily accessible locations.
- e. **Guards** : All rotating equipment shall be provided with suitable guards to protect operating personnel as required by regulations.
 - i. Belt guards shall enclose belts, pulleys, and shafts. They shall be constructed of galvanised expanded sheet steel, mounted in an angle frame with angle or channel supports.

- ii. Coupling guards shall completely enclose rotating couplings and shall be constructed of galvanised sheet steel.
- iii. Guards shall be readily removable to provide access to belt drives or couplings.

27. **CONTROLS AND INSTRUMENTS**

a. **Control Systems, Generally** :

- i. Automatic temperature control systems shall include all valves, thermostats, and all other control devices required to maintain the conditions detailed on drawings or specified.
- ii. Control devices shall be connected up complete so as to perform the functions indicated and operate in the required sequence. Thermometers, indicators and all other necessary accessories shall be included.
- iii. Control equipment shall be furnished, installed and commissioned by a Controls Subcontractor who is regularly engaged in the supply and installation of control equipment and who issues complete catalogue information covering a full line of such equipment.
- iv. Control equipment, excluding electric wiring, but including pneumatic tubing and fittings, shall bear the nameplate of the Controls Subcontractor and the entire system, including pneumatic tubing, shall be installed by mechanics regularly employed by or under contract to the Controls Subcontractor. The Controls Subcontractor shall be responsible to the Subcontractor for the quality and satisfactory operation of the controls supplied by him.
- v. Controls shall be mounted in a separate compartment in the relevant airconditioning switchboard constructed specifically for housing the controls. Controllers, relays, switches, etc. shall not be mounted on walls or brackets without the permission of the Engineer.
- vi. Controls and instruments shall be supplied and installed on the drawings and shall operate as described in Part Five.
- vii. Control systems shall be of the electronic, electric or pneumatic type. Control diagrams indicated on the drawings showing one type of system are not necessarily intended to show a preference for that system.
- viii. Pneumatic controls shall not be used where air lines or controller bodies are subject to freezing conditions.
- ix. All control items including, but not limited to, thermostats, humidistats, controllers, sensors, indicators, actuators, etc. shall be of one manufacture.
- x. Indicating instruments shall be flush mounted on a fixed section of the switchboard and shall be 50mm in diameter with an accuracy of 1% of full scale.
- xi. All instruments shall have metric scales.
- xii. Valves, wells, orifice plates and metering devices in piping shall be furnished by the Controls Subcontractor and installed by the Subcontractor.
- xiii. Hygrometers shall be 100mm dial type, Haenni, or other approved.
- xiv. Pressure switches shall be Danfoss, or other approved.
- xv. Failure to mention any specific item or device does not relieve the Subcontractor

of the responsibility for installing such device or item in order to comply with the intent of this specification.

b. **Automatic Dampers** :

- i. Dampers shall be factory fabricated balanced type, with flat or formed galvanised steel or aluminium blades, with factory assembled linkages, mounted in galvanised steel or aluminium frames. Blades mounted vertically shall be supported by thrust bearings. Blades shall have interlocking edges and shall be provided with compressible seals at point of blade contact.

Also provide a metal sealer strip with compressible seals, around the internal perimeter of the damper casing to prevent air leakage between the blades and the casing. Seals shall be selected for temperature ranges of 0 degrees C to 80 degrees C at specified leakage rate. Rectangular dampers 300mm or more in a direction perpendicular to the axis shall be louvred. Blades on louvred dampers must not be over 200mm wide. Round dampers shall be single-blade dampers. Damper blades shall have steel trunnions mounted in bronze sleeve, nylon or ball bearings.

- ii. Dampers shall be not more than 1,2 metres in length between bearings. Opposed blade dampers shall be similar to louvred dampers, except that adjoining blades shall rotate in opposite directions so that the air stream is not deflected to one side. Modulating dampers shall be of the opposed blade type.
- iii. Dampers when closed shall be guaranteed by the manufacturer not to leak in excess of 00mm³/h per square metre at 100mm water gauge static pressure. Dampers shall be installed with operators having sufficient power to limit leakage to the rate specified. Data on damper leakage rates, including operator power criteria, shall be submitted. Dampers for use in high pressure and high velocity systems shall be of special design to minimise noise.
- iv. Dampers shall have bare or channel frames, and rectangular dampers larger than 0,1m sq in area shall have corner bracing.
- v. Dampers operating links shall have brass rods, adjustable in length, that will withstand, without deflection, a load equal to at least twice the maximum operating force of the damper operator. Joints in linkage shall be made with brass pins and clevises or with brass ball and socket joints.
- vi. All parts of steel dampers shall be factory-finished with two coats of rust inhibitive paint or shall be zinc coated.

c. **Damper Operators** :

- i. Operators may be mounted outside of the duct or casing. If outside the duct or casing they must be mounted on support plates that are completely outside the covering. On casings or ducts handling cold air, the support plates shall be installed in a manner that will prevent condensation on damper operator or on supports. When mounted outside covering, the motor mounting shall be supported so that the operator does not deflect from its normal path when operating under load.

d. **Valve and Damper Motors** :

- i. Units shall be quiet in operation. In the event of power failure, operator shall be provided with spring return so that they will "fail safe" in either the normally open or normally closed position as required.

- ii. Operators operating in sequence with other operators shall have positive positioners with adjustable operating ranges and starting points, to permit adjustment of the control sequence as required by the operating characteristics of the system.
- iii. Valve operators shall be of the spring return type with non-ferrous metal bellows or deeply corrugated bellows or diaphragms of reinforced neoprene or approved rubber composition. Bellows or diaphragms shall be of sufficient size so that a change in operating pressure of not more than 2 percent of the total operator operating pressure range will be required to start the valve moving.

e. **Duct Thermostats** :

- i. Thermostats used for temperature control shall be remote sensing element type with controller mounted on a panel. Duct humidity controllers and thermostats used for fire and freeze protection may be rigid stem type. Thermostatic sensing elements used for freeze protection shall be at least 6 metres in length. A freezing condition at any increment of 300mm anywhere along the sensing element shall be sufficient to operate the thermostatic element. Sensing elements (remote bulb averaging type or rigid stem) shall be located where they will respond to a representative temperature within the duct or casing. Operating and adjusting thermostatic mechanisms shall be enclosed in metal or phenolic resin cases and shall be installed outside of ducts and casings. Where ducts or casings are insulated, thermostats shall be mounted flush with outside of insulation in such a manner that moisture will not condense on thermostat or its support.
- ii. Where the distance from a bulb to a sensing element panel exceeds manufacturer's maximum recommended capillary length, a remote transmitter, mounted on the outside of the duct, shall be used between the elements and the operating and adjusting mechanism on the panel. Capillary tubes or wires other than stainless steel elements and operating mechanisms shall be protected by conduit moulding or flexible armour. Excess capillary lengths shall be neatly coiled and fastened out of the way. Capillaries and wiring shall pierce thermal insulation at the smallest practicable number of points and shall be properly sealed wherever they pierce an insulation vapour seal.
- iii. Duct and pipe thermostats shall be of the sensor type with controllers mounted in the associated air-conditioning switchboard. An indicating gauge shall be mounted for each controller, to indicate temperature at sensing point.

f. **Test Pocket and Test Points** :

- i. Test holes sealed with a rubber grommet shall be provided in ducts adjacent to thermostats, thermometers and sensors for testing accuracy of these units.

g. **Static Pressure and Velocity Controllers** :

- i. Static pressure controllers shall be of either the diaphragm rigid element bellows, electronic or liquid type. Each controller shall be provided with a stop cock and tubing connection for attaching a portable draught gauge. Two connections shall be provided where differential pressure is to be controlled.
- ii. Velocity controllers shall be of the diaphragm, bellows, electronic or liquid type. Each diaphragm bellows or liquid type regulator shall have pitot tubes inserted to centre of the duct.
- iii. Sensitivity and speed of response of static pressure and velocity controllers shall be adjustable, and controllers shall be set in the field so that they will maintain steady pressures and velocities without hunting. Adjustable sensitivity shall not

be required for velocity controllers installed on air mixing boxes.

- iv. Static pressure controllers shall be of the remote sensor type with controllers mounted in the associated airconditioning switchboard. An indicating gauge shall be provided for each controller to indicate static pressure at sensing point.

h. **Controllers, Generally** :

- i. Each controller requiring control panel mounting shall be provided with instruments (pressure gauges, voltmeters, pilot lights, etc.) to show at the controller location the condition of the power supply to the controller and the point within its throttling range at which the controller, controlled device, or amplifier is operating. The instruments shall be permanently mounted. For panel mounted controllers, individual permanently mounted instruments may be furnished or a single instrument may be mounted on each panel and provided with switching to permit connecting the instrument to any controller on the panel.

Remote position indication shall be provided by separate transmitters and potentiometers for modulating controls and switches for two-position controls, which shall be mechanically linked to control operators. Air gauges in branch lines shall not be used for remote indication.

- ii. Each heating coil section in a heating coil bank shall be provided with its own control valve and sub-master thermostat, even though control diagrams show only one valve and thermostat for each coil assembly. The thermostat bulb shall be centrally located opposite each coil section. Sub-master controllers shall be reset by a single master controller.

i. **Demonstration** :

- i. After completion of the entire controls installation, the Controls Subcontractor shall demonstrate to the satisfaction of the Engineer, prior to final acceptance, that all control systems and associated equipment which are the responsibility of the Subcontractor, are calibrated, installed and operating in accordance with the Project drawings and Specification and the manufacturer's most recent published data.
- ii. The Controls Subcontractor shall provide the Employer's operating personnel a minimum of two days of 'on the job' training and shall hand over to the Employer, three complete sets of written operating instructions, as-built drawings, specification data sheets and maintenance schedules. On completion of the job, he shall also present for the Employer's consideration, a complete maintenance contract for the installed system.

j. **Control Diagrams** :

Catalogue data on temperature and humidity control equipment, submitted as specified in Part Five, shall include complete schematic control diagrams. Diagrams shall show a large scale outline of each air handling unit, fan, refrigerating system, heating system, heating system, etc. with control devices correctly located thereon and schematic one line piping and wiring shown. Item numbers shall correspond with those shown on the as-built contract drawings. Control tubing shall be numbered to correspond with the drawings. The diagrams shall be included in the operating and maintenance manuals.

k. **Electric and Electronic Control Systems** :

- i. Electronic and electric temperature controls shall be provided with a transformer to supply power for equipment.
- ii. Transformers other than transformers in bridge circuits shall have primaries wound for the correct control circuit voltage. Each transformer shall have capacity to operate simultaneously all apparatus connected to it and shall be capable of

carrying a 25 percent overload for one hour. Each transformer shall be enclosed in a separate compartment in the switchboard and shall have a fused disconnect switch on the primary side, and a fuse cut-out or thermal cut-out on the secondary side if the output exceeds 50 voltamperes.

- iii. Damper operators shall be quiet in operation. When operated at rated voltage, each damper operator shall be capable of delivering the torque required for continuous uniform movement of the damper, and shall withstand, without damage, continuous stalling. Operators shall function properly with a 10 percent plus or minus change in line voltage feeding the equipment. Operators shall be of the hydraulic or geared type. Operator drive pinions and high speed gears may be made of a non-metallic composition to ensure quiet operation. All gears shall be machine cut, with face widths of not less than 3mm. Shafts shall be hardened steel, running in sleeve bearings of bronze, hardened steel, nylon or other suitable material, or ball bearings.
- iv. Operators and gear trains shall be totally enclosed in dust-proof housings of pressed steel or metal castings with rigid conduit connections. Gear trains shall be oil immersed.
- v. Two-position operators shall be of the single direction spring return or reversing type. Proportioning operators shall be capable of stopping at any point in the cycle and starting in either direction from any point. Reversing and proportioning operators shall have limit switches to limit the lever in either direction unless operator is stall type. Every damper operator shall be equipped with a spring yield device so that when in the closed position it will maintain on the damper a pressure equivalent to the pressure rating of the damper.
- vi. Relays shall be of the open contact, mercury type or electronic type and shall be provided with dust-proof enclosures. Capacities shall be suitable for the loads controlled.
- vii. Manual transfer switches shall have operator levers and index plates showing switch positions and names of apparatus controlled or other designations required. Gradual switches shall be of the rotary type with operating knobs, pointers, dials and nameplates and shall provide the same proportioning action as other controllers.
- viii. Complete electric wiring shall be furnished and installed for control apparatus, including wiring to transformer primaries as specified under Electrical Wiring.
- ix. For low voltage D.C. and electronic circuits carrying less than 0,5 amperes, cables of 2 or more conductors, not smaller than 0,75mm² if shielded, or 1,0mm² if not shielded, may be used in lieu of individual wires. Cables carrying A.C. circuits sensitive to external fields shall be shielded. Cables shall terminate in solder or screw type terminal strips. Cables shall not be tapped at intermediate points.
- x. All wires, whether individual or in cables, shall be colour coded or numbered for identification.

28. SWITCHBOARDS AND SWITCHGEAR

a. Switchboard Construction

- i. Switchboards shall be the products of specialist manufacturers of this class of equipment, and shall be purpose-made to carry all specified switchgear, control equipment, etc. and shall be complete with all internal wiring. Tenderers shall refer to the Engineer for the design rupturing capacity for each switchboard, failing which tenderers shall be deemed to have included for all necessary requirements.

- ii. Switchboards shall be of metal construction not less than 2mm thick and adequately braced. Wall-mounting switchboards shall be of the surface type. Floor-standing switchboards shall be mounted on channel iron bases. Where switchboards exceed 1,5 metres in length, or as site conditions and access limitations dictate, switchboards shall be split multi-section type.
- iii. Switchboards shall be complete with inner mounting chassis and overlap type hinged doors, and lift-off, side, top and back covers as required by the Engineer. All equipment shall be flush mounted on steel chassis behind hinged panels with operating toggles projection through close fitting slots cut in the panels. These hinged panels shall have latching, lockable doors. door widths shall not exceed 900mm for wall-mounting and floor-standing switchboards unless approved by the Engineer.
- iv. Switchboards shall be adequately ventilated by means of splash-proof type top ventilating domes which shall be vermin-proofed.
- v. All fixing screws shall enter holes tapped into an adequate thickness of metal or nuts welded to the metal. Self-tapping screws shall not be used in the construction of the switchboards.
- vi. All equipment such as operating handles, catches, switches, instruments, etc. mounted on the front panels are to be either black or chromium plated finish. All bolts, nuts and set screws shall be chromium plated.
- vii. Switchboard manufacturers shall ensure that all necessary provisions are made at switchgear terminals, busbars, etc. for reception of the number and type of cables to be used. Where supply connections to the main switchgear are made by means of multiple cables in parallel or busbar trunking, the incoming cubicle section shall be amply sized to accommodate the cable termination glands or the busbar trunking and extensions. The busbar extensions shall be pre-drilled to receive the cable termination lugs or busbar trunking, details of which shall be provided by the Electrical Subcontractor.
- viii. The Airconditioning Subcontractor shall liaise with the Electrical Subcontractor and make all necessary provision to facilitate the Electrical Subcontractors method of connecting supply cables to the Airconditioning/ Ventilation Switchboards.
- ix. The glands of armoured cables shall be terminated onto the metal housing or framework of the switchboard, or on substantial mild steel gland plates, which shall be bolted to the board framework and positioned to facilitate the termination of the cables. These plates shall be provided in removable sections to manageable lengths, where a number of cable terminations are involved. Gland plates shall be electrically continuous and bonded to the framework or earth conductor. Where single core cables are used, a non-conductive gland plate, Tufnol, or other approved, shall be provided.
- x. Schematic and wiring diagrams and general arrangements of the switchboards shall be submitted for approval before manufacture. The boards shall not be delivered to site until they have been inspected and electrically tested by the Engineer.
- xi. All equipment inside and outside the boards shall be clearly labelled, employing Traffolite strips secured to the panels in an approved manner (fixing with adhesive will not be acceptable).
- xii. Two keys for each lock with Ivorine labels and one master key suitably labelled, shall be handed to the Engineer on completion of the Contract.

- xiii. All switchboards shall be dustproof and hoseproof in accordance with IEC 1 Classification IP65.
- xiv. After completion of the switchboards, they shall be finished inside and outside in baked enamel to the following specifications.
 - 1. Degrease, rinse and de-rust all sheet steel components before applying finishes.
 - 2. Apply Zinc Chromate self-etching primer.
 - 3. One, mist coat epoxy resin-based enamel.
 - 4. Two, full coats epoxy resin-based enamel.

Colours :

Interior	:	white
Exterior	:	as directed

- xv. Switchgear shall comply with the relevant SANS specifications, where these apply, and shall bear the SANS mark where available, or comply with BS specifications where there are no SANS specifications. Switchgear originating in other countries shall comply with recognised equivalent standard specifications.
- xvi. Switchboards shall be complete with sections not exceeding 1,5 metres in length and shall be complete with a main incoming section consisting of a door interlocked, triple pole, main fused switch complete with HRC fuses, a neutral link and copper busbars mounted on bakelite insulators. Where additional cubicle sections are required for equipment as specified in Part Five of this specification, each cubicle section shall be complete with a door interlocked, triple pole, fused switch complete with HRC fuses, a neutral link and copper busbars mounted on bakelite insulators.
- xvii. Switchboards shall also be complete with miniature circuit breakers and/or fuses, starters, contactors, control circuit breakers and/or fuses, and all auxiliary controls and instruments. Switchboards shall be delivered to site fully wired and tested, all internal wiring being neatly run between equipment and clearly labelled terminal blocks. All wires between switchgear and terminals shall be identified with numbered ferrules to correspond with the wiring diagrams.
- xviii. Switchboards shall be carefully designed to ensure ample space for wiring. Wiring shall be provided in all switchboards running horizontally and vertically with sufficient space for all wiring. All control wiring shall be colour coded.
- xix. Where space for future equipment is called for, the cover shall be correctly punched out, approved blanking dummies or covers provided and the chassis and busbars shall be extended and pre-fitted for the reception of the specified future equipment.
- xx. Each switchboard shall be supplied complete with three spare fuses for each different size and type of fuse installed in the switchboard. Spare fuses shall be mounted in Terry clips within the switchboard.
- xxi. Step controllers and interlocking relays shall be provided to obtain sequence starting and operating of plant, within individual switchboards and between all switchboards, and to ensure that equipment is protected against faulty operation. Interlocking control wiring between switchboards and switchboard sections must be isolated and the live side terminals shall be suitably shrouded.

- xxii. Where the method of starting motors is not specified in Part Five of this specification, Tenderers shall allow for starting all motors in compliance with the requirements of the local electrical authority having jurisdiction over this installation.
- xxiii. All controls for motors shall be so arranged, that if the main supply to a motor is disconnected, controls are de-energised.
- xxiv. The airconditioning plants shall have circuits arranged so that fans continue to operate for a pre-set period after switch off via an adjustable timer (0-5 minutes) to allow the heaters to cool down to a safe temperature.
- xxv. High temperature fuses will not be accepted under any circumstances.
- xxvi. Switchboards shall be completely pre-wired to outgoing numbered terminals. All wires between switchboards and equipment and internal wiring shall be identified with numbered ferrules.
- xxvii. With the exception of fans operated by thermostats, all airconditioning plants shall start and stop automatically via time clocks with weekend by pass attachments, installed in each switchboard.
- xxviii. All motors and heater banks shall have pilot lights on their respective switchboards. Green lights shall indicate when motors are running. Yellow lights shall indicate when heaters are switched on. Only one light is required per heater bank. Red lights shall indicate when the heater safety thermostats, motor overloads or low flow circuits trip, or when alarm conditions occur.
- xxix. All low level switches, pressure switches, sail switches, flow switches, safety thermostats and other safety devices shall indicate and alarm on respective switchboards.
- xxx. Chilled water and condenser water low flow circuits shall have separate timers, indicating lamps, manual reset push buttons, and shall prevent the respective chiller/s from operating on low flow.
- xxxi. All safety circuits shall be automatically reset after power is restored without using reset buttons.
- xxxii. Where centrifugal water chillers are installed, the overload relay shall be as recommended by the manufacturer of the chiller motors and shall be approved by the Engineer.

b. Busbars :

- i. Busbars shall be provided in silver coated or tinned copper, loaded to not more than 1,3 amperes per mm sq, and enclosed in a compartment with steel casing separating the busbars from other equipment. Busbars shall be mounted on porcelain or epoxy-resin type busbar insulators and clearance between busbars shall not be less than 0mm between phases and 25mm to earth, and shall be secured by bolts having a diameter of not less than the thickness of the busbars with a minimum diameter of 8mm. busbars shall be taped up after all connections are made. Machined bolts and nuts with washers and spring washers shall be used. Not more than one connection shall be made with one bolt.
- ii. Busbars and busbar connections shall be so supported and proportioned as to be capable of safely withstanding stresses to which they may be subjected, including those due to short circuit and climatic conditions. Provisions shall be made where necessary to allow for expansion and contraction of temperature variation.

c. **Neutral Bars:**

- i. Where heaters or other phase to neutral loads are used, neutral bars are to be not less than half the cross-sectional area of phase busbars, but not less than 25mm x 6mm, and are to be mounted on porcelain or epoxy-resin type insulators.
- ii. Where neutral bars are purely on the control side, 15mm square brass bars with 2 tapped holes per way may be used. The neutral bars shall be mounted on bakelite or equal insulators.

d. **Earthing:**

- i. **Floor Type Panels in Sections:** A copper earthing strip of not less than 25mm x 6mm copper shall run the full length of the complete panel either at the top or bottom of panel. It must be securely bolted to panel framework to ensure good continuity.
- ii. **Wall Mounting Panels:** An earthing brass bolt of not less than 10mm diameter shall be drilled and brazed to the main panel case.

e. **Panel Wiring:**

- i. **Control:** Minimum 1,5mm sq. 250-volt grade PVC covered stranded wire with bare ends soldered.
- ii. **Power:** Minimum 2,5mm sq. PVC covered stranded wire 660-volt grade phase coloured Red, White, Blue and Black for neutral.

f. **Switchgear:**

Where specified in Project Specification, the following equipment shall be included in the switchboards.

Main Fuses Switches: Wallace Town, Watford, MTE, or other approved.

Main Isolator: Watford, MTE, or other approved.

Circuit Breakers: Heinemann, kA rupturing capacity as specified.

Fuses: These shall be in accordance with BS-88-1967 Class Q.1.

Starters: Siemens, Sprecher & Schuh, Telemecanique, or other approved. Method of starting as specified. For starting method other than DOL, suitable interlocking shall be provided to prevent motors from starting direct on line.

Single phase protection must be provided with starter overloads. Inherent type will not be accepted unless approval is obtained from the Engineer.

Contactors: Siemens, Sprecher & Schuh, Telemecanique or other approved, minimum 16 amp contact rating.

Relays: Siemens, Sprecher & Schuh, Telemecanique or other approved, minimum amp contact rating.

Phase Reversal Relay: Cutler-Hammer Igranic, PCI or other approved fitted into panels with contacts so that on failure or phase reversing the plant will stop.

Voltmeters: Unless otherwise specified, moving iron or moving coil type. Minimum 96mm square flush mounting pattern. Voltmeters shall be industrial grade, PCI, Crompton, Fiesta, or other approved.

Ammeters: Unless otherwise specified, moving iron or moving coil type flush mounting pattern. Up to 30 amp may be direct connected. 30 amp and over CT operated 1/5 ratio. Between 30 amp and 0 amp, CT must be primary wound. Above 0 amp ring type CT may be used. Ammeters shall be industrial grade, PCI, Crompton, Fiesta, or other approved.

kWh Meters: Flush mounting type, Sangamo or other approved.

Time Switches: Venner, Horstman, or other approved with half-day and week-end by-pass attachment and minimum of 12 hours spring reserve. Electrically wound with synchronous motor drive.

Push Buttons: Siemens, Sprecher & Schuh, Telemecanique, or other approved, multi-contact build up type.

Damp proof type with shrouds where specified.

Terminal Blocks: All terminal blocks shall be Sprecher & Schuh or other approved.

Transformers: Auto-transformers 3-phase shall be 3-limbed type air-cooled unless otherwise specified. Single phase for control shall be auto wound. Where earth leakage units are used, transformers are to be double wound, Reflex or other approved.

Selector Switches: Kraus & Naimer, or other approved. Minimum 16A contacts.

Pilot Lights: Neon type, Siemens, Sprecher & Schuh, Telemecanique or other approved. Where damp conditions exist, lamps to be incandescent, open type.

Press to test type lamps shall be Siemens, Sprecher & Schuh, Telemecanique, or equal, transformer type.

Maximum Demand Meters: Minimum 96mm square flush mounting pattern with demand pointer setting and indicating drag pointer.

System - Thermal bimetal and ambient compensation.

Overload - Minimum 10 x rated current for one second.

Response - Minimum 15 minutes.

Timers: Sprecher & Schuh, Omron or other approved. Synchronous motor drive type.

Pneumatic type not to be used unless prior permission is given.

Step Controllers: PCI, Honeywell or other approved, shall be suitable for starting a group of equipment in a predetermined sequence and shall have a minimum contact rating of 10A. The step controller shall automatically spring return to the start-up position either on a power failure or after being switched off. (Cascade timers are not acceptable in lieu of step controllers).

g. All switchgear shall be subject to the approval of the Engineer.

29. **ELECTRIC WIRING**

a. All electrical wiring between the switchboards, and inter-connections between switchboards, motors, heaters and controls, etc. shall be carried out in accordance with local regulations to the satisfaction of the Engineer.

b. All conduit and armoured cables shall be supported in neatly constructed cable racks

approved by the Engineer. All corners, take-offs, etc. shall have long radius bends suitable for the cables and conduits. Racks shall be run parallel to or at right angles to walls and equipment. Cables shall be tied at close centres to prevent sagging. All racks shall be installed in positions approved by the Engineer and shall not obstruct passageways or interfere with maintenance work in any way.

- c. All cables shall be marked at both ends by means of non-corroding metal bands with punched or raised numbers. The cable numbers shall appear on the as-built drawings.
- d. Cable trays, where used, shall be approved by the Engineer. They shall be constructed of galvanised steel or aluminium and supported in a neat manner as described above.
- e. All equipment, including dampers, and air terminals etc., shall be fitted with an acceptable means of terminating standard conduit and/or PVC SWA cables. Exposed connections will not be permitted.
- f. Local regulations with regard to isolation of motors shall be strictly adhered to.
- g. All isolators and/or lockout stops shall be dustproof and hoseproof in accordance with I.E.C. 1 Classification IP65.
- h. Lockout stops shall be of the key release, mushroom head type.

i. **Conduit**

- i. **General**: All conduits shall be heavy gauge, welded or solid drawn to SABS specifications. All joints shall be screwed. No conduit less than 20mm diameter shall be used. Conduit fittings and boxes shall be of enamelled malleable iron.
- ii. **Galvanised Conduit**: Any conduit and conduit fittings installed in positions exposed to weather or in moist surroundings shall be galvanised. Where galvanising has been removed by threading cutting, etc. the exposed parts shall be suitably treated or painted to render weatherproof and rust resistant.
- iii. **Conduit Termination**: Conduit shall either be screwed and locknuttet to, or locknuttet on both sides, and bushed on the inside of the box or appliances in which it is terminated. Only solid brass bushes shall be used. Alternatively, and particularly in distribution boards, conduit may be terminated with couplings and brass male bushes.
- iv. **Conduit in Roof Spaces**: Shall be run parallel and at right angles to roof members and shall be secured to these members by means of saddles and screws.
- v. **Conduit in U-form**: Except where specifically prohibited conduit may be run in U-form provided that no V.I.R. conductors are used in conduit so run.
- vi. **Crossing of Expansion Joints**: No conduit is to cross an expansion joint in the structure without an approved arrangement for crossover. Where details of crossover are not given, the Sub-contractor shall refer to the Engineer for instructions.
- vii. **Draw-Wires**: All unwired conduits shall be fitted with galvanised steel draw-wires.
- viii. **Conduit for Future Requirements**: These shall be terminated with boxes and overlapping coverplates and fitted with galvanised steel draw-wires. Where such conduit terminations project from the wall or slab they shall be fitted with couplings and plugs. Such terminations in exposed positions shall be sealed with bitumen and protected with weatherproofing paint.

- ix. **Inspection of Conduit:** The Subcontractor shall notify the Engineer in good time before conduit in concrete is covered so that tubing may be inspected and checked before concrete is cast and shall attend on the Engineer during such inspections.
- x. **Flexible Conduit:** Conduit shall be of the plastic sheathed galvanised steel type and shall be as short as possible as demanded by the circumstances of the installation. The conduit shall be connected to the rest of the installation via a draw box. Connectors for connecting onto the flexible conduit shall be of the screw-in type, manufactured either of brass or cadmium plated mild steel. All flexible conduit connections shall be provided with an earth wire connection as required by the Local Supply Authorities.

j. **Conduit Boxes:**

- i. **Boxes to be Cast in Concrete:** Shall be secured to shuttering (wood or steel) by means of 5mm screws and nuts, unless some other method of fixing is approved by the Engineer.
- ii. **Drawboxes and Blank Boxes:** In reinforced concrete slabs, beams, columns, or in walls, shall be fitted with substantial oversized metal coverplates, fixed with countersunk screws, before surrounding surfaces are painted. Drawbox positions must be approved, and care shall be taken that they do not affect the appearance of the building adversely. Where possible a single coverplate shall be fitted for a number of adjacent drawboxes.
- iii. **Drawboxes in Roof Spaces:** Where only accessible above ceiling, shall not be installed in positions where clearance from ceiling to roof is less than one metre.
- iv. **Switch and Plug Boxes:** Blank switch and plug boxes shall be fitted with blank coverplates and screws to match those specified for switches and switch sockets.
- v. **Mounting Heights of Boxes:** Wherever a mounting height is indicated on the drawing or in the Specification, it shall refer to the distance between the bottom of the outlet box and the finished floor level, unless otherwise specified or indicated. where two similar outlets occur adjacent to each other, these shall line up accurately horizontally unless otherwise indicated.

k. **Chasing:**

- i. **Brickwork:** All chasing of brickwork, etc. shall be carried out by the Subcontractor. Due care is to be taken to prevent damaging of walls during chasing. He must ensure that other trades are not held up owing to delays in such brickwork.
- ii. **Face Brick:** Under no circumstances are face brick or other finished surfaces to be chased without the permission of the Engineer.
- iii. **Concrete:** Where it becomes necessary to chase structural concrete, the permission of the Engineer must first be obtained. Where this is not done and the structure is chased without permission, the Subcontractor will be held responsible for any damage to the structure that may be caused.

l. **Wiring:**

- i. **Standards:** Unless otherwise specified, all wiring shall be carried out with VIR or

PVC insulated cable bearing the SABS mark, delivered on site with seals intact. VIR conductors shall be to SANS 168/1952 and PVC conductors to SANS 150/1957.

- ii. **PVC - S.W.A. Cable:** Plastic insulated cables shall be to SANS 150/1957 and addenda thereto and shall consist of PVC insulated conductors, PVC bedding, galvanised steel wiring armouring and a PVC sheath.
- iii. **PVC - S.W.A. Cable Terminations:** Cable ends shall be made off with approved watertight glands. The glands shall be of the type in which the armouring is clamped between tapered cones compressed by the action of a screw and in which the gland is secured to the outlet casing by means of screwing and/or locknutting. Neoprene shrouds shall be used to cover the junction of the cable and the base of the gland.

m. **Earthing:**

- I. The installation shall be effectively earthed in accordance with the SAIEE wiring regulations and to the requirements of the Supply Authority.

30. **ELECTRIC MOTORS**

- a. In general, motors 1/3 Kw and larger shall be squirrel cage induction type for three phase, 50 Hz power supply.
- b. Motors 1/ Kw and smaller shall be capacitor start, induction run type and split-phase type for single phase, 50 Hz power supply.
- c. Motors shall be GEC, Siemens, Hawker Siddeley, or other approved.
- d. Where the motor is an integral part of equipment, it shall be as recommended by the equipment manufacturer.
- e. Motors that are not directly exposed to weather and are located in non-hazardous spaces, shall have drip-proof enclosures, and shall have continuous duty rating at 0 degrees C.
- f. Motors installed in unguarded outdoor locations shall be totally enclosed, fan cooled, waterproofed with continuous duty rating at 55 degrees C.
- g. Single phase motors shall have built-in overload protection. Overload protectors shall be single pole automatic reset type, except where frequent start-stop may constitute a hazard, then manual reset type shall be used.
- h. Hermetic polyphase motors shall have built-in hermetic thermostat protection devices which shall interrupt the control circuit to protect the motor from overheat.
- i. Where drawings schedule 3-phase motors smaller than 1/3 Kw or single-phase motors larger than 1/ kW, verify with the Engineer before ordering motors.
- j. Motors shall be quiet in operation. If, in the opinion of the Engineer, a motor is unduly noisy, it shall be promptly removed from the job and replaced with an acceptable motor.
- k. Unless otherwise approved, all motors to be supplied by the same manufacturer.
- l. Motor speed shall not exceed 1500 r/min unless approved by the Engineer for specific applications.
- m. Motor starting methods shall comply in all respects with appropriate local authority requirements. Under no circumstances will direct-on-line starting be permitted unless

written permission is granted by the Engineer

31. **FANS**

a. **Fans, generally:**

- i. These requirements apply to fans which are not integral parts of cooling towers, air-handling units and equipment designed as complete units by the manufacturer. All fans shall be guaranteed to deliver the specified air quantities when installed as indicated on the drawings. All fans shall be statically and dynamically balanced and quiet in operation.
- ii. Each fan shall fit into the space provided and shall be installed without damage to the building, building equipment or the fan.
- iii. Fans shall not be operated for any purpose such as temporary ventilation, testing, etc. until the connected ducts have been cleaned and the filters, if any, have been put in regular operation condition.
- iv. All finished parts of fans, such as shafts and bearings, where accessible, shall be protected from rust prior to operation by means of wrappings and protective grease coatings.

b. **Centrifugal Fans**

- i. Performance curves shall be submitted for each centrifugal type fan to be installed. Fan curves shall show absorbed power, static pressure and static efficiency plotted against air volume.
- ii. Unless otherwise specified, centrifugal fans shall have backward curved blades.
- iii. Housings for fans having wheels smaller than 300mm in diameter shall be made of cast-iron, steel, or other structurally suitable material, and housings for fans having wheels 300mm or more in diameter shall be made of steel. Flat portions of housing shall be braced, where necessary, to prevent vibration and provide support for the bearings.
- iv. Housings for fans having wheels larger than 60mm in diameter shall be provided with inspection openings and cover plates having pressure latches on the scroll sheets, located as nearly opposite the outlets as the aprons, etc. will permit. Height of inspection opening shall be 200mm minimum for fans with wheels not over 900mm in diameter and 300mm minimum for all larger fans. Widths of inspection openings shall be not less than 300mm. Inlet rings shall be formed to smooth curves to reduce turbulence.
- v. Large fan housings shall be made in sections to permit installation or removal through openings available in the building. Field joints shall be flanged and bolted. Thickness of steel plate for housing shall not be less than those indicated in the following table.

<u>Wheel Diameter mm</u>	<u>Housing Sides</u>	<u>Thickness mm Scrolls</u>
Not over 600	2,6	2,6
Over 600 and not over 900	2,9	2,9
Over 900 and not over 1500	4,7	4,7
Over 1500	6,3	6,3

- vi. Wheels shall be assembled from fabricated, die formed or moulded parts and shall operate at all speeds up to 1,2 times the maximum speed specified by the manufacturer without noticeable static or dynamic unbalance, eccentricity or wobble. When operating speeds exceed 90% of the maximum catalogued speed for a given fan, the fan selection shall be for the next highest fan class. Wheels shall be designed and braced to resist torsional stresses due to air pressure and rapid acceleration.
- vii. Fans with backward inclined blades and backward curved blades shall be designed to give the fans a continuously rising pressure characteristic and a non-overloading power characteristic. Fans with wheels having double curve blades and equipped with fixed inlet vanes, where required for proper selection, will be accepted in lieu of either the backward inclined blades or backward curved type.
- viii. Bearings shall be self-aligning with oil-retaining dust-excluding seals at each end. Bearings shall be of the ring-oiled, babbitted, sleeve type with large oil reservoirs or of the ball or roller type. Inner races of ball and roller bearings shall be secured to the shafts by press fitting, split taper sleeves, eccentric locking rings or set screws. Taper sleeve mounts shall be carefully adjusted so that the bearings will not be pre-loaded. Eccentric locking rings shall be securely tightened and retained by set screws. Bearings held by set screws only shall have two in each race and screws shall have points designed to provide a locking action on the shaft.
- ix. Where taper sleeve, eccentric locking ring or set screw held bearings are furnished, the actual shaft diameters at the bearings shall not differ from the nominal bearing bores by more than the amounts indicated in the following table of tolerances.

<u>Shaft Diameter mm</u>		<u>Tolerances mm</u>	
		<u>Plus</u>	<u>Minus</u>
Not over 27		0	0,127
27 to 63		0	0,25
63 to 103	0	0,381	
103 and over		0	0,508

- x. Load ratings of ball and roller bearings shall be based on an average bearing life of not less than 100 000 hours when selected at the maximum catalogued speed for the unit, allowance being made for dead load of wheel and shaft and maximum pull of belts. Bearings shall be designed so that fill and drain plugs, pipe connections, etc. will be accessible after installation without dismantling any part. Bearings requiring oil lubrication shall be provided with oil reservoirs and sight glasses accessible in locations outside the ducts or casings and so constructed that their operation will not be affected by change in air pressure and so that oil may be added while the fan is running without danger or over-oiling.
- xi. Bearings requiring grease lubrication shall be provided with grease valves for fans operating at pressure above 100mm w.g.
- xii. Fan selections shall be made as follows:

50 to 100 mm w.g.	-	Air outlet velocity not exceeding 12,5 metres/s
100 to 150 mm w.g.	-	Air outlet velocity not exceeding 15,0 metres/s
Above 150 mm w.g.	-	Air outlet velocity not exceeding 17,5 metres/s sound

- xiii. Fans handling air that is abnormally hot or corrosive, such as exhaust from kitchen range hoods and chemical fume hoods, shall have both bearings opposite the inlet, and overhung wheels and sheaves.
- xiv. Double inlet fans and single inlet fans having wheels larger than 900mm in diameter shall have two bearings, one each side of the wheel, with overhung sheaves.
- xv. Single inlet fans with wheels not over 900mm in diameter may have bearings arranged as specified for larger fans, or bearings may both be located on the side opposite the inlet with overhung wheels. Where belts cannot be changed without dismantling bearings, sheaves shall also be over-hung.

c. **Axial Flow Fans:**

- i. Axial fans shall be Donkin, or other approved, with all accessories as supplied by the manufacturer such as mounting feet, mating flanges, flexible connections, anti-vibration spring, inlet cones, inlet and discharge screens etc. Fans shall be long casing with terminal boxes.
- ii. Fans shall be mounted on anti-vibration mounting which shall eliminate all vibration transmission to the building.
- iii. Fan motors shall be T.E.F.C. squirrel cage design, rod mounted, and airstream rated. The motors shall comply with SABS 98, and the enclosure shall meet the requirements of IP5. All motors shall be of three phase design, with Class F insulation rated for Class B temperature rise.
- iv. Fan motors shall have a minimum of 10% excess power over peak shaft power drawn under site operating conditions.
- v. Fan sizes shall conform with metric sizes contained within the M10 series of preferred numbers.

d. **Propeller Fans**

- i. Propeller fans shall be Donkin or other approved, with accessories as supplied by the manufacturer including mounting plates, wire screen and wall discharge cowl.
- ii. Motors shall be three-phase design unless otherwise specified, with Class E insulation and enclosure meeting the requirements of IP.
- iii. Motor mounting brackets shall include rubber vibration isolators.

32. **DUCTWORK**

- a. All ductworks shall be fabricated from galvanised sheetmetal unless otherwise specified.
- b. Fabricate in accordance with recommended duct construction standards in the ASHRAE Guide, Low Pressure Duct Construction Standards published by Sheetmetal and Airconditioning Contractors' National Association Inc. (SMACNA Duct Manual) 5th edition Dec. 1976.
- c. All high pressure and medium pressure ducting shall be tested for leaks and sealed wherever these occur. The method of testing shall be in accordance with SMACNA standards, and the maximum permissible leakage shall be 1%.
- d. Kitchen exhaust ducting shall be manufactured from 1,6mm thick galvanised steel and all

the longitudinal seams shall be soldered or sealed with an approved duct sealer. Ducts shall be flanged and bolted together with approved gaskets to form watertight joints. Flanges shall be made of 0 x 0 x 6mm steel angles or alternatively MEZZ or TDS flanges can be used, and bolts and nuts shall be 8mm hexagon head spaced at 100mm. Duct supports shall be a minimum of 3mm x 25mm wide located at 1,2 metres centre. All duct supports and bolts and nuts shall be galvanised.

- e. Provide watertight access doors at regular intervals in kitchen exhaust ducting for cleaning purposes. In addition, provide 50mm drain connections with plugged gate valve at the bottom of the duct risers to drain condensate from the ducts when necessary.

f. **Metal Thickness:**

Largest Dimensions mm	Low Pressure Thickness mm	Medium Pressure Thickness mm	High Pressure Thickness mm
Less than 60	0,6	0,8	0,9
80 through 760	0,8	1,00	1,00
780 through 1150	1,00	1,20	1,20
1170 through 1520	1,20	1,60	1,60
1550 through 1850	1,20	1,60	1,60

g. **Duct Construction:**

Longitudinal seams shall be Pittsburgh or Snap-Lock, Transverse joints and reinforcing shall comply with SMACNA Duct Manual or 1975 ASHRAE Guide.

Largest Dimensions mm	Low Pressure Ducting SMANCA Plate No	Medium Pressure Ducting ASHRAE Guide	High Pressure Ducting ASHRAE Guide
Up to 60	6	See 1983 ASHRAE Guide A	See 1983 SHRAE Guide
80 to 760	7 or 7A "	Recommended	"Recommended
780 to 1070	8	Construction for Rectangular	Construction For Rectangular
1090 to 1520	9 or 9A	Medium Pressure	High Pressure
1550 to 1830	10	Ducts"	Ducts"

- h. For metal thicknesses and construction of round ducts, refer to 1983 ASHRAE Guide - Recommended Construction for Round Ducts.
- i. Flanges and reinforcing angles shall be painted after manufacture. All bolts and nuts shall be galvanised. Flanged joints shall be sealed with a ribbon sealer to make the ducting airtight. Use 8mm hexagon head galvanised bolts and nuts spaced at not more than 100mm centres.

j. **Duct Supports:**

Support sheet metal ducts in accordance with the following.

i. **Concealed Horizontal Duct Supports:**

Maximum Diameter mm	Maximum One Side mm	Maximum Other Side mm	Maximum Support Material	Maximum Support Spacing mm
300	300	300	0,7 mm galv iron strap	3000

60	60	900	16mm wide 1,2mm galv iron strap	1800
600	600	1200	16mm wide 1,6mm galv iron strap	1200
900	900	1500	25mm wide 2,0 galv 1200 iron strap 25mm wide	

ii. **Vertical Duct Supports:**

Maximum Diameter For Round Duct or Maximum Side of Rectangular Duct	Rectangular Duct-Angle Iron Size	Round Duct-Circular Band Size
300mm	25 x 25 x 3mm	1,2mm galvanised iron 50mm wide
900mm	25 x 25 x 3mm	1,6mm galvanised iron 50mm wide
1200mm	0 x 0 x 3mm	3,0mm galvanised iron strap 0mm wide
1500mm	0 x 0 x 6mm	3,0mm galvanised iron strap 50mm wide

- iii. Install supports on two opposite sides of each duct and rivet, bolt or metal screw to each side of duct at not more than 150mm intervals. Circular bands or angle iron supports shall project beyond opening in floor.
- iv. Hangers shall be attached to the structure. Attachment to concrete beams or floors shall be by iron or steel concrete inserts, power driven fasteners or expansion bolts, or hangers with ends bent at least 180 degrees cast into a slab. Attachment to structural steel may be by welded studs or beams clamps. Power driven fasteners shall not be used to support ducts over one metre maximum dimension. The minimum size of bolts or studs shall be 6mm for ducts below one metre in size. Ducts over one metre shall be supported by 10mm bolts or studs. All bolts and studs shall be galvanised. All fixing methods shall be subject to the approval of the Structural Engineer and/or the Architect, and it shall be the responsibility of the Subcontractor to obtain such approval.
- k. **Transitions:** in the size of duct shall be made gradually with slope of not more than one metre in five where possible, but not more than one metre in three metres in any case.
- l. **Elbows:** shall have an inside radius equal to width of duct.
- m. **Square Elbows:** shall have double thickness turning vanes. (SMACNA Plate No. 22, figures C and D). In lined ductwork and where indicated, turning vanes shall be Sonoturn acoustical vanes.
- n. **Access Plate:** Use SMACNA Plate No. 32, figure A or B in ducts for access to fire dampers where necessary.
- o. **Flexible Connections:** Flexible connections shall be made of an impervious material tightly secured to angle iron flanges by flat iron bands bolted to the angle iron frames with galvanised or plated set screws. The flexible connections shall provide a clear space of 75mm between flanges. The material shall have a flame spread number not exceeding 10 and a smoke development number not exceeding 25.
- p. Tape all transverse flat strip joints in the medium and high-pressure duct system with four

inch wide strips of oz. canvas duck saturated with 3M No. EC-800 adhesive, smoothed to a neat and airtight finish. Edges of canvas shall be machine finished and free of loose threads.

- q. Low pressure ducting may be sealed with 3M No EC-800 adhesive or alternatively with the following tape.
 - i. Minnesota Mining & Manufacturing plastic film tape No. 7 at least 75mm wide.
 - ii. Minnesota Mining & Manufacturing aluminium foil tape No. 25 at least 75mm wide.
- r. All ducts' sizes are sheetmetal sizes. Allowance has been made for duct liner.
- s. Counterflashing for all openings through roof for ducts or fans shall be the responsibility of the Subcontractor.
- t. **Insulated Flexible Ductwork:** shall be PPG Glass-Flex Thermaflex II type M-KF, or Wiremold type K, pre-insulated flexible duct, or other approved.
- u. Insulated flexible air ducts for air connection between air terminals, ductwork, air mixing boxes, etc. shall be factory pre-insulated flexible metal type or spiral reinforced fabric type. The flexible metal type shall be of interlocked spiral construction or zinc-coated steel. The spiral reinforced fabric type shall consist of a steel wire helix, or a corrosion resistant flat steel spiral supporting and permanently connected to a coated fabric having a mineral base. The spiral reinforcement shall be zinc-coated unless completely enclosed by plastic or sealed by the fabric.
- v. Flexible duct insulation shall be 25mm nominal thickness of 2 kg/m³ density. The insulation shall encase the flexible duct and shall be sheathed with a moisture barrier having a permeability of not over 0,02 perm. The duct and insulation components shall have a flame spread of not over 10 with a smoke development of not over 25.
- w. Pressure requirements for external sheathing and vapour barrier will not apply where flexible duct inside of insulation meets all pressure and velocity requirements.
- x. All insulated ducts, exclusive of vapour barrier material, shall have a flame spread of not over 10 with a smoke development of not over 25.
- y. Where insulated flexible ducts join ductwork, air mixing boxes and air terminals, the flexible duct liner shall be secured with a pressure-sensitive vapour seal adhesive tape or duct sealer and with sheet metal screws. To prevent compressing insulation, a 50mm lone, flexible foamed closed cell plastic spacer the same thickness as the insulation shall be inserted over the liner and under the vapour barrier cover on the end fitting and secured with a stainless steel or zinc coated metal clamp applied over the vapour tight joint.
- z. All ends of duct sections to be joined in the field shall be coated, before assembly, with a cementing material that will prevent delamination, air leakage or erosion. Finished flexible ductwork installation shall not erode, delaminate or impart loose fibres or odours to the air stream in any manner when the system is operating.
- aa. Flexible ducting shall be supported at regular intervals and shall not be supported on the ceilings. Supporting brackets and hangers shall not damage the insulation or insulation covering and shall not distort the ducting in any way.
- bb. Balancing Dampers: shall be installed in all branch ducts and in branch-main ducts and main ducts as indicated on the drawings and as required to completely balance the system with particular regard to noise generation.
- cc. Where neither duct dimensions exceed 60mm and where not otherwise noted volume dampers may be job-fabricated "Butterfly" type, consisting of a blade constructed of

1,2mm galvanised steel secured to a square operating rod.

- dd. Where either duct dimension exceeds 60mm volume dampers shall be multi-louvre type, opposed acting, with interlocking blades, having maximum width of 150mm. Dampers shall be factory fabricated balanced type, with flat or formed galvanised steel or aluminium blades, with factory assembled linkages, mounted in galvanised steel or aluminium frames. Blades shall have interlocking edges, which seal over the entire length of the blades. Damper blades shall have steel trunnions mounted in bronze sleeve bearings, nylon or ball bearings. Dampers shall not be more than 1200mm between bearings.
- ee. Dampers shall have bar or channel frames and rectangular dampers larger than 0, square meters in area shall have corner bracing.
- ff. Dampers operating links shall have steel, brass or stainless-steel rods, adjustable in length, that will withstand, without deflection, a load equal to at least twice the maximum operating force of the damper operator. Joints in the linkages shall be made with brass pins and clevises or with brass ball and socket joints.
- gg. All parts of steel dampers shall be factory finished with two coats of rust inhibitive paint.
- hh. Each damper shall be fitted with a locking type adjusting device, Vent-lock 61 or equal. Where duct pressure exceeds 50mm S.P. use Vent-lock 60 Hivel locking device and 609 Hivel end bearings.
- ii. Where dampers are concealed above plaster ceilings the adjusting devices shall be made accessible by means of a Vent-lock 677 concealed regulator with flush plate.

33. **AIR TERMINALS AND LOUVRES** :

- a. **Sizes** : shall be generally as noted on the drawings, but Subcontractor shall verify that size shown is proper for indicated quantity, throw and noise level in accordance with the manufacturer's performance data.
- b. **Types** : shall be Trox, or other approved with concealed fasteners. Air terminals indicated on the drawings have been selected from the above catalogue.
 - i. **Square or Rectangular Ceiling Diffusers** : Trox type ADLQ-CK anodised aluminium diffusers with opposed blade dampers or similar and approved. Air quantities and diffuser sizes are given on the drawings unless otherwise indicated, sizes given are neck dimensions.
 - ii. **Supply Air Registers** : Trox type AT-DG double deflection anodised aluminium grilles or similar and approved fitted with opposed blade dampers and supplied with steel sub-frames and concealed fasteners.
 - iii. **Return/Exhaust Air Grilles** : Trox type ASS-CK single deflection anodised aluminium grilles or similar and approved fitted with opposed blade dampers and supplied with steel sub-frames and concealed fasteners.
 - iv. **Floor Grilles** : Tate, or other approved, perforated panels with slide damper action to match the raised floors in the computer rooms. The make and type of flow grilles must be confirmed prior to ordering.
 - v. **Door Louvres** : Trox type AGS-T anodised aluminium door louvres or similar and approved with flanges and rear matching flanges. They shall be of the V-type assembled from extruded aluminium sections in an extruded aluminium

section frame.

- vi. **Wire Mesh Screens** : Trox type GW expanded metal grilles or similar and approved with opposed blade dampers where required for balancing air quantities. Expanded metal to be aluminium or steel with openings to be determined by the Engineer. In any event the nett free area shall be not less than 60%. Wire mesh screens through which air passes to the transformer room shall have 6mm square mesh.
- vii. **Transfer Grilles** : Trox type ASS or similar and approved single deflection anodised aluminium grilles fitted to both sides of the wall and supplied with steel sub-frames and concealed fasteners.
- viii. **Outside Air Intake/Exhaust Louvres** : Trox type AWG or similar and approved anodised aluminium louvres with 20mm x 1,8mm galvanised wire mesh screen.
- c. **Finish** : All grilles, diffusers, louvres and dampers accessories shall be factory finish.
 - i. Unless otherwise specified, tender prices shall be based on natural anodised finish for grilles, diffusers register and louvres.
 - ii. Prior to the ordering of such equipment, the Subcontractor shall obtain written confirmation with regard to the actual finish and colours selected by the Architect.
 - iii. Dampers, pattern adjusters, brackets, screws and similar devices visible through the fact of the grille or diffuser shall be painted flat black.

34. **VOLUME FLOW RATE REGULATORS**

- a. Volume flow rate regulators shall be system operated with mechanical volume control mechanism, unaffected by gravitational forces and suitable for mounting in any position.
- b. Regulators shall be factory calibrated by the manufacturer for the specified air volumes and shall deliver the required volume of air, regardless of system pressure variations, to within ☐ 5% of design values, whilst operating within the pressure differential range specified by the manufacturer.
- c. Air volume flow rates shall be capable of being adjusted on site.
- d. Regulators shall have a flow range of not less than 2 : 1 referred to the maximum flow rate specified by the manufacturer.
- e. Regulator casings, damper blades and linkages shall be constructed of galvanised steel with damper blade spindles mounted in ball bearings.
- f. Regulators shall be installed in accordance with the manufacturer's recommendations and shall be entirely suitable for the system application.
- g. Electric or pneumatic actuators and any micro-switches, on variable volume regulators, shall be factory fitted by the manufacturer.
- h. Regulators shall be complete with terminal box suitable for glanding off and terminating cables.

35. **SOUND ATTENUATORS** :

a. **General**

- i. The Sound levels specified in Part Five shall not be exceeded on account of operation of the airconditioning and ventilation plant due to either noise

transmission through airways, breakout through duct or plantroom walls or to transmission through the building structure.

- ii. Except where otherwise indicated on the drawings or in Part Five, sound attenuators and splitters shall be of the product of a manufacturer regularly engaged in the production thereof such as Donkin, Trox, or other approved.
- iii. Published catalogue data or a certified laboratory test report showing sound attenuation characteristics of each sound absorber shall be submitted for approval.
- iv. All attenuator and splitter lining which is damaged in shipment, exposure or any other manner shall not be installed. Material in place which has been damaged shall be replaced as directed by the Engineer.
- v. In hospital installations the sound absorbing material shall be completely covered with Melinex plastic, or other approved material.
- vi. Sound attenuators in the airflow of kitchen extraction systems shall have a sound absorbing lining which shall not absorb any grease or fat.
- vii. In the case of corrosive airflow applications, the sound attenuator materials shall be suitable for the application.
- viii. Sound attenuators shall be flanged and provided complete with matching counter flanges.
- ix. Casings shall be constructed of galvanised mild steel sheet, flanged for connection to ductwork, complete with matching counter flanges. The gauge of sheet steel shall be not less than the thickness specified for ductwork of the same dimensions.
- x. Sound attenuators shall be installed generally in accordance with good practice, and particularly in accordance with the manufacturer's recommendations.

b. **Sound Absorbent Material**

- i. The sound absorbing material shall not impart any odour to the discharge air, delaminate or be loosened by the air stream under regular operating conditions at passage velocities up to 20 m/s. The material shall be vermin-proof, fire retardant and rot resistant. Above velocities of 20 m/s, construction shall be subject to approval of the Engineer.
- ii. Sound absorbing lining material shall have a density of not less than 2 kg/m³, a thickness of not less than 25mm and sound absorption coefficient efficiency at each frequency of not less than the following. Material shall be faced with a woven fibreglass fabric with a surface fire index not exceeding 0,1 in accordance with SABS 963.

Frequency - Hz	125	250	500	1000	2000	000
Percent - Absorption	-05	-032	-063	-096	1,02	0,95

- iii. Sound absorbing duct lining for medium and high pressure duct systems shall be similar in all respects to the material described above except that it shall not be less than 50mm thick with a minimum density of 8 kg/m³.
- iv. Material for cell type sound absorbers shall be of the rigid type and materials

facing the air stream on both sides shall have both sides treated to prevent detachment of loose material.

c. **Factory-Fabricated Attenuators** :

- i. The units shall be complete with sound absorbing material, protective facing and outer zinc-coated steel casing which shall be internally baffled and supported, so that, under an internal pressure of 250mm water gauge, the casing will not leak or deflect more than 12mm. Lining materials shall be held in place with compression to prevent settling.
- ii. Protective facing over lining shall be zinc-coated expanded/perforated steel sheet or metal mesh with glass cloth facing, or formed rigid lining material with bonded woven glass cloth facing. Perforations shall be small enough to prevent erosion of the absorbing material or shall be backed by a second material that will prevent such erosion.
- iii. Cylindrical sound attenuators shall have a galvanised perforated sheet steel inner casing. The space between the casing and the inner lining shall be filled with sound absorbing material with protective facing over as previously described.
- iv. A centrally mounted pod may be used in cylindrical sound attenuators to obtain the required attenuation. The pod shall be made of perforated galvanised mild steel sheet with end caps and filled with sound absorbing material with protective facing over as previously described.

d. **Sound Attenuating Splitters**

- i. Where it is impossible to install conventional factory fabricated attenuators, written application may be made to the engineer for the installation of splitters.
- ii. Splitters shall comply with the relevant parts of preceding paragraphs. They shall be the product of manufacturer regularly engaged in the production of attenuators, and shall be installed in accordance with his recommendations.

e. **Sound Attenuating Bends**

- i. Attenuating Bends shall incorporate suitably faced fibreglass of minimum density 2 kg/m³, covered with zinc plated perforated metal. The detail design shall be to the approval of the Engineer.

f. **Lined Plenums**

- i. The internal surfaces of masonry plenums shall be lined with 50mm grade 80/10 rockwool. This shall be secured to masonry surfaces with a suitable non-combustible adhesive and held into position with galvanised expanded mesh. The latter shall be secured to the concrete structure onto wooden battens at 500 centres, rockwool to the plenum walls. The lining shall be with protective facing over as previously described.

36. FIRE DAMPERS

- a. Fire Dampers shall be furnished and installed where indicated on the drawings and/or where required by local codes and ordinances. All fire dampers shall be provided with access openings with metal screwed coverplates thereto. All fire dampers shall be permanently identified. Identification shall be clearly visible from the damper maintenance access point.
- b. No fire dampers shall be built into structure. In all cases where fire dampers are indicated in fire rated structures, a flanged sheet metal sleeve of the same size, construction, gauge and fire rating as the fire damper, shall be manufactured and positioned in the fire rated structure so that the sleeves can be built in by the Principal Contractor. The fire damper shall then be bolted on to the sleeve by the Subcontractor.
- c. Where indicated on the drawings, fire dampers shall be fitted with 220 volt or 2 volt motor or solenoid/thermally operated mechanisms, which shall operate the fire dampers on an alarm signal from the fire detection system. The fire services detection system will be provided by others.
- d. All fire dampers shall be Europair, Blendair or Trox and shall have visual indicators for open and closed positions. The dampers shall be fitted with heavy duty micro-switches mounted outside the fire dampers to indicate when dampers are operated, on the fire detection panel provided by the Fire Protection Subcontractor.
- e. All motor and solenoid/thermally operated fire dampers shall have fusible links.
- f. Motor operated fire dampers shall motor in both directions.
- g. All fire dampers shall be supported from the structure and shall not be supported on fire baffles or ducts.
- h. All fire dampers shall be of the multi-blade very low leakage rate type. The tenderer shall state in his offer the leakage of the fire damper allowed for, which shall not exceed $0,1\text{m}^3/\text{s.m}^2$ after 1 hour at 538 degrees C.
- i. Fire dampers shall be SABS approved and shall meet the requirements of the relevant local Fire Authority.
- j. Fire dampers shall be installed strictly in accordance with the manufacturer's recommendations.
- k. Fire dampers shall be operated by a fusible link, thermal bulb or bimetallic link set to operated at 7 degrees C. The linkage shall incorporate a simple method of regularly testing the release action of the fire damper and resetting thereafter to the normal operational position without disassembly of components or linkage nor with destruction of the installed link.
- l. Fire dampers shall close tightly by either spring tension, knee-lock or latching action upon release, and shall remain so up to the maximum rated temperature.

37. STEEL PLATFORMS

- a. Platforms shall be Mentis or other approved, constructed of 0mm x 5mm flat steel sections arranged in a 0mm square grid pattern and shall be supported and fixed to channel or angle iron framework.
- b. Where platforms occur in air shafts, supporting steel framework shall be designed to provide minimum obstruction to air flow and details shall be submitted to the Engineer for approval before manufacture.

- c. All components shall be hot-dipped galvanised after manufacture.

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1 GENERAL

This specification covers the manufacture, supply, delivery, erection, wiring, commissioning, testing and handing over of toilet extraction systems that includes but not limited to extractor fans, extract air terminals, ductwork, and associated electrical work in complete working order and ready for immediate use. Annexure 5.1 and Annexure 5.2 cover the standard and technical specification for the subsequent installation for ten (10) months of all plant and equipment necessary for the installations described herein and as indicated on the accompanying drawings, of which:

- The words “handing over in complete working order” in the clause above shall mean not only the major items of plant and equipment covered by this Specification but also the incidental sundry component’s necessary for the complete execution of the work and for the proper operation of the installation.
- The words “subsequent installation for a period of ten months” in the clause above, shall mean that such period shall commence from the date the installation are accepted and after “practical completion” has been confirmed in writing by the ENGINEER.
- The words “described herein” in the clause above, shall mean all sections or parts of this Specification, bill of quantities and drawings.
- The words “accompanying drawings” in the above clause shall mean all drawings as mentioned under the Drawing Schedule of this Specification.

The Cape Town International Airport (CTIA) require a replacement of the extraction systems in various ablution facilities within the airport. The ablution areas denoted as are:

1. C-Gate, Baggage Hall Staff, Domestic Arrivals
2. Parkade 1 & 2
3. Police Station
4. International Departure Gates A1-A3
5. Domestic Departure Gates A5-A12
6. Mugg and Bean- 3rd Floor North
7. Southern Office Building (SOB) 1
8. Southern Office Building (SOB) Plantroom
9. Check-in: Second Floor South
10. KFC- 3rd Floor
11. Airline offices- First Floor- North And Central
12. Check-in: Second Floor North
13. Domestic Baggage Reclaim- Ground Floor- South
14. OCC- Fourth Floor
15. International Arrivals & Immigration- Ground Floor North
16. International Arrivals Concourse
17. South Toilet Blocks- Roof
18. North Toilet Blocks- Roof

This specification has been written in such a manner as to be as generic as possible. Tenderers are to ensure that all ductwork, accessories and ancillaries are included to ensure the final installation performs as described below and on the drawings. Tenderers must have a fully equipped repair and maintenance workshop with manufacturer approved staff within the major town (Cape Town) and to support the installation for a minimum duration of the defects liability period.

Time is of essence in this contract and the HVAC Contractor will be required to observe strictly all rules of security imposed by the Client. In this regard identification documents of all workmen may be requested for security purposes by the Clients Security Department.

All work related to this contract will be required to be executed timeously necessary to meet the targeted completion dates. Penalties will be imposed for delays instituted by the HVAC Contractor. These penalties maybe over and above cost of consequential delays resulting from timeous non-performance by the HVAC Contractor.

The work shall entail the following:

- Decommissioning and safe removal of the existing wall mounted split air-conditioning units, which shall be handed over to the client.
- Installation of toilet extract systems, inclusive of ducting, grilles, air terminals, electrical wiring and components etc. to serve the ablution facilities mentioned above.
- Associated builders work including but not limited to supports, holes through walls, coring, plastering, painting etc.

All personnel engaged under this Contract shall remain within the designated work areas associated with the installation. Access to, and presence within, other parts of the building where no installation activities are scheduled shall be strictly prohibited.

Equipment that is to be supplied/offered by the Contractor is to be approved by the Engineer prior to commencing with any purchase action.

Tenderers, however, are free to offer alternative equipment that in their opinion would be equal to or an improvement upon that specified.

Where such alternatives are offered, price variations compared with the main offer shall be clearly stated, as also the advantages claimed for such a substitution. Such price variations shall be shown in a covering letter, separate from the Schedule of Prices.

NOTE: The Contractor must refer to the drawings for the pricing of the Materials. All equipment schedules are clearly incorporated within the drawings forming part of the tender documents.

The successful tenderer shall endeavour to ensure timeous delivery of all equipment and products.

1.2 STANDARDS

1.2.1 The entire new installation shall be carried out in accordance with:-

- 1.2.1.1 The Application of the National Building Regulations SANS 10400 (including all SANS addenda).
- 1.2.1.2 The South African National Standards Code of practice for the Wiring of Premises SABS 0142 (including all SABS addenda).
- 1.2.1.3 The Occupational Health and Safety Act No.85 of 1993.
- 1.2.1.4 The Standard Specification for the Airconditioning and Ventilation Services for the Province of KwaZulu Natal : Department of Works Issue : August 1997 issued by the Head : Works of the KwaZulu Natal Provincial Administration. (Available from Department of Works)
- 1.2.1.4.1 Refrigeration Systems including Plants associated with Airconditioning Systems as SANS 10147.
- 1.2.1.4.2 The Installation, Testing and Balancing of Airconditioning Duct Work as SANS 10173.
- 1.2.1.4.3 Airconditioning Duct Work as SANS 1238.
- 1.2.1.4.4 Filters for use in Airconditioning and General Ventilation as SANS 1424.
- 1.2.1.4.5 Room Air Conditioners as SANS 1125.
- 1.2.1.4.6 Lighting and Ventilation as SANS 10400-O
- 1.2.1.5 The Municipal By-Laws and any special requirements of the Supply Authorities of the area or district concerned.
- 1.2.1.6 The Municipal Fire Regulations.
- 1.2.1.7 The Contractor shall provide all guards and protective devices etc. and arrange for all inspections, tests, certificates, etc, necessary to comply with the said Acts, Regulations and By-Laws, whether specified herein or not.

2 DESIGN CONDITIONS

The design condition below is based on the following:

Pressure relationship to adjacent areas: Negative (-5 to -10 Pa)

Occupancy type	Fresh air rate (L/s.m ²)	Fresh air rate (L/s.person)	Default Occupancy Density	Air category classification	Minimum exhaust air rate (L/s.m ²)	Maximum CO ₂ above outdoor (PPM)
Rooms containing baths, showers, toilet pans or urinals	1.4	7	10	3	12.5	750

Site location:

The Cape Town International Airport is in Matroosfontein, Western Cape, approximately 20km from the city centre. It is the primary airport serving the city of Cape Town and the second busiest airport in South Africa. The airport has domestic and international terminals, linked by a central terminal.



Figure 1: Aerial View of Cape Town International Airport

3 SCOPE OF THE WORKS AND SYSTEM DESIGN

3.1 System Description

The mechanical systems serving the ablution areas are overall aged and, in many instances, non-operational, showing significant signs of wear, damage, and corrosion. There are many systems with minimal or no ventilation. Many of the areas are non-compliant with SANS 10400 Part O. Many of the systems have been installed with an insufficient number or incorrect type of air terminal, and make-up air is not prevalent in some instances.

The scope of the HVAC contract includes the installation of mechanical systems with new extraction fans or ducted systems including ducted fan, air terminals, dampers, fittings, flexible ducting and weather louvres, where applicable to meet the latest SANS 10400 part O

Other components to be integrated into the system shall include, but not be limited to, electrical connections, volume control dampers, electric controls, control panels, builder's work, and all activities associated with testing and commissioning.

4 CREDIT FOR THE REMOVAL OF OLD EQUIPMENT FROM THE BUILDING

- 4.1 The removal of existing toilet extract fans, ductwork, grilles, dampers, cabling, and associated components from the airport ablution areas will yield reusable and scrap materials, including metals.
- 4.2 The Contractor shall allow for the recovery, removal, and lawful disposal of all such materials. Any recoverable value arising from scrap materials shall be credited to the Employer and shall be included in the tender price.
- 4.3 All removals shall be carried out without disruption to airport operations and in accordance with the Airport Authority's safety, security, and environmental requirements.

5 SEQUENCE OF WORK

- 5.1 HVAC contractor is expected to be appointed around April 2026.
- 5.2 The HVAC contractor shall prepare a detailed programme of the works to run concurrently with the maintenance programme to ensure that the completion date is met. Should there be a possibility for any adjustments in future to minimise the installation period, this must be brought to the immediate attention of the Engineer.
- 5.3 All installation work which can be undertaken prior to equipment deliveries must proceed.
- 5.4 The phasing of the ablution extract systems is of utmost importance in this contract so as to ensure that there is no disruption in the existing ventilation system and normal operations of the airport. In this regard, the successful contractor shall formulate a practical sequence of the installation.

6 SPECIFICATIONS AND DRAWINGS

- 6.1 The Detailed Technical Specification and the accompanying drawings shall have precedence over the Standard Technical Specification.

Drawing reference:

- 1007927-ZUT-DRG-ZZ-ZZ-ME-001-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-002-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-003-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-004-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-005-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-006-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-007-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-008-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-009-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-010-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-011-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-012-A

- 1007927-ZUT-DRG-ZZ-ZZ-ME-013-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-014-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-015-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-016-A
- 1007927-ZUT-DRG-ZZ-ZZ-ME-017-A

7 TENDERER SITE INSPECTION

- 7.1 All Tenderers shall make their own arrangements with the Department to accurately assess, without disrupting hospital operations, the scope of work in relation to the removal of existing equipment at the facilities and the available plantroom spaces for new equipment. No official dates will be scheduled for viewing of these facilities.

8 VERIFICATION OF DRAWINGS AND DIMENSIONS

- 8.1 Where apparatus and equipment have been indicated on the Engineer's drawings, dimensions have been taken from previous drawings from the client and approximations on site.
- 8.2 Carefully check drawings to see that equipment will fit into spaces provided. Assume full responsibility for proper and accurate layout of equipment and materials specified and indicated on the drawings.
- 8.3 Install apparatus and equipment in the manner and in the locations indicated on the drawings, avoiding obstructions, preserving headroom, and keeping openings and passageways clear. Make changes in locations of equipment and materials to accomplish this.
- 8.4 Location of ductwork, apparatus and equipment indicated on drawings are approximate only and shall be changed to meet architectural and structural conditions as required. The HVAC contractor shall undertake to measure the existing airconditioned areas to ensure proper fitting of ducting, piping, equipment, etc.

The HVAC contractor shall check with the Head: Works before putting work in hand on any section of the work, that he is fully satisfied that the shop drawings reflect true site measurements.

9 SHOP DRAWINGS

The HVAC contractor shall prepare shop drawings detailing the entire installation. Approval of shop drawings shall be obtained from the Head: Works prior to manufacture.

10 AS-BUILT DRAWINGS

The HVAC contractor shall, furnish the Client with a complete signed plastic transparent set of as-built CAD drawings as a prerequisite to completion. The as-built set shall include all mechanical, electrical and other work where applicable.

As-built drawings shall be up-dated as work progresses and all deviations in work as actually installed shall be recorded on these drawings.

11 REMOVAL AND REINSTALLATION OF DUCTWORK INSULATION

Not Applicable to this Phase

12 EXCLUSIONS

The following work is excluded from this Contract and will be carried out by others.

- 12.1 BMS connection from the extraction system to the central BMS network.

13 SECURITY AND CLEANLINESS

- 13.1 The HVAC contractor shall ensure that personal hygiene of personnel and cleanliness is maintained in every aspect of installation work. The HVAC contractor shall not allow the accumulation of dirt on the various floors during the construction phase. In this regard he shall ensure that all removal of equipment is disposed of as quickly as possible without impeding the progress of other trades.
- 13.2.1 As regards security, the HVAC contractor and his workforce will have to comply with all security requirements instituted by the Project Manager and his representatives. These may include periodic searches of worker's toolboxes, toolbags etc.; together with body searches as and when deemed necessary.

14 CONTRACTUAL RELATIONSHIPS

This contract must be executed in conjunction with the Electrical sub-contractor and any other sub-contractor. The HVAC contractor shall co-ordinate his work with the installation of other trades so as to ensure a smooth execution of the works.

15 CREDIT FOR OLD MATERIALS

The HVAC Contractor shall be responsible for the handling, storage, rigging, and removal of all redundant materials from site.

16 DUCTWORK

- 16.1 Ducting and plenums shall be constructed and installed to SMACNA HVAC Duct construction Standards 1985 Tenth Printing - April 1992 3M and SMACNA HVAC Duct Leakage Test Manual first Edition 1985 Fourth Printing - September 1990. All sheetmetal ducting shown on the drawings shall be constructed for low pressure classification.
- 16.2 All duct sizes shown on the drawings are sheetmetal sizes.
- 16.3 All ductwork inside plantrooms and roof spaces or where visible shall be flanged using cadmium plated bolts and nuts. Air balancing dampers shall be fitted in all branch ducts immediately after the take-off from the main duct.
- 16.4 All ductwork inside plantrooms basement garage and roof plant areas or where otherwise visible shall be supported on hot dipped galvanised brackets complete with adjustable hanger rods.
- 16.5 All flexible ducts to exhaust air terminals shall be Kopex thermobrite.
- 16.6 Branch duct collars and spigot outlets shall be secured to main ducts by means of the clinch lock method. Where collars and spigots are fitted to internally insulated ducts, care shall be taken that the insulation is properly cut away and remaining edges firmly adhered to collar or spigot to ensure that no insulation ends are exposed to the air stream.
- 16.7 During the construction all duct systems shall be protected from ingress of dust, dirt and foreign matter. Open ends shall be provided with temporary covers. Strict compliance of this requirement will be enforced. Failure on the part of the Selected Contractor to observe this requirement will not be tolerated and the Head : Works may instruct the Selected Contractor to replace such soiled ducts at no additional cost to the Employer.

- 16.8 Duct systems shall be thoroughly blown out before any air terminals or the specified air filters are fitted. Prior arrangements shall be made with the Principal Contractor so that ducts are not blown out whilst painting inside areas served by such duct system is in progress or still wet. Any damage which may arise due to failure by the Selected Contractor shall be rectified and the cost thereof shall be for his account.

17 ADJUSTMENT OF AIR DISTRIBUTION SYSTEMS

- 17.1.1 Balance completed air distribution systems by adjustment of dampers and apparatus so that the actual air delivery or exhaust of each diffuser, grille or resister shall not vary more than 5% from air quantities indicated.
- 17.1.2 Adjust all registers, grilles, diffusers, so that there are no unacceptable draughts.
- 17.1.3 Air balancing shall be in accordance with the procedures outlined in 'Testing and Balancing Manual for Ventilating and Airconditioning Systems' published by Ventilating and Contractors Association, Chicago, USA.
- 17.1.4 After systems have been adjusted, submit complete test report indicating the following information: -
- 17.1.4.1 Method of balancing and details of instruments used.
- 17.1.4.2 Copies of all air velocity and pressure readings and duct layout showing where readings were taken.
- 17.1.4.3 Location, type dimension size of each air inlet or outlet, stating the measured and adjusted air quantity.
- 17.1.4.4 Total air quantity measured for each fan system.
- 17.1.4.5 Fan speeds for adjusted and balanced fan systems.
- 17.1.4.6 Current drawn by motor for adjusted and balanced fan systems with clean air filters, coils, etc.
- 17.2 Each stair pressurisation fan system shall be adjusted to pressurise such stairway to not less than 25Pa with any three doors open and not more than 50Pa with all doors closed.
- 17.3 If, in the opinion of the Head: Works, there is sufficient reason to doubt that fan systems have not been properly balanced, the Selected Contractor shall re-balance such fan systems at no additional cost to the Employer.
- 17.4 The Head: Works may from time to time request the Selected Contractor to confirm test results by spot checks and all test instruments, etc, shall be provided by the Selected Contractor.
- 17.5 All test instruments which measure air velocities, air pressures, etc. shall be calibrated before any final tests are carried out, by a reputable bureau, who can provide acceptable certification that test instruments are calibrated. Any such calibration certificate shall at any time not be more than two months old.

18 SOUND ATTENUATORS

- 18.1 Provide sound attenuators in positions indicated on the drawings.
- 18.2 The sound attenuators shall be those manufactured and recommended by Sound Attenuators (Pty) Limited, Trox or other approved, and selected by such firm to provide the following maximum sound levels in the airconditioned and ventilated spaces when the air supply systems to which they are connected are operational:

Areas Complex	Noise Criteria Curve
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Administration Areas/Offices	: NC 35 - 40
Ventilated Spaces Connected To Ducted Air Input/Extract/Exhaust Systems	: NC 35 - 45
At 1,5 Metres Distance From Ducted Air Intake/Exhaust Air Louvres	: NC 45 - 50
All Other Airconditioned Areas	: NC 35 - 40

18.3 Where sound attenuators, installed in airconditioning plant supply and return air ducts, have no internal linings they shall be externally insulated with 25mm thick 40 kg/m density thermal insulation and sheet metal clad to prevent sweating due to condensation. The insulation shall not affect the performance of the sound attenuators.

18.4 All sound attenuators shall have mild steel angle iron flanged ends. Bolts and nuts shall be cadmium plated.

18.5 Sound attenuators with damaged linings shall be replaced at no additional cost to the Employer.

18.6 Sound attenuators which due to incorrect construction, installation, etc. fail to reduce the maximum allowable sound levels in the conditioned space to the levels as specified when the systems to which they are connected are operational, shall be modified to produce the required attenuation without any cost to the Employer.

18.7 Sound attenuators in exhaust air ducting from kitchen canopies shall also have their sound absorbing infill material covered with Melinex or Hostaphan membrane to prevent grease and fat being absorbed by the infill material. The membrane material shall be suitable for steam cleaning.

18.8 All sound attenuators shall be labelled on the outside of the casing with aluminium identification tags fastened to the casing with pop rivets. Identification shall state type of sound absorber, size, airway, spacing, etc.

19 MACHINERY DRIVES AND ACCESSORIES.

19.1 Couplings

19.1.1 Where couplings are specified for direct-drive, non lubricated types shall be used and the rating shall be at least 125% of motor kW rating.

19.2 Belt Drives

19.2.1 Where V-belt drive is required, design for overload per manufacturer's recommendation, but in no case for less than 125% of motor kW. Drive selection shall provide not less than 95% efficiency. All belt drives for motors 0,5 kW and larger shall have a minimum of two belts.

19.3 Where size permits, pulleys shall be taper-lock and fitted with high capacity belts. The drives shall be Fenner, Gates, or other approved.

19.4 Lubrication Fittings and Gauges

19.4.1 Provide oil level gauges, oil pressure gauges, grease gun fittings as required by the equipment. Extend all lubrication fittings to readily accessible locations.

19.5 Guards

19.5.1 All rotating equipment shall be provided with suitable guards to protect operating personnel as required by regulations. Final coat of paint shall be signal red.

19.5.2 The guards shall enclose belts, pulleys and shafts. They shall be constructed of galvanised expanded sheet metal, mounted in an angle frame with angle or channel supports. Guards shall include allowance for motor adjustment.

19.5.3 Coupling guards shall completely enclose rotating coupling and shall be constructed of galvanised sheet steel.

- 19.5.4 Guards shall be readily removable to provide access to belt drives or couplings.
- 19.6 Fan guards shall be perforated galvanised steel with test openings for r.p.s. readings of motor and fan shaft without removal of guards.
- 19.7 All guards for rotating machinery shall be strictly in accordance with the requirements of the Machinery and Occupational Safety Act (Act no. 10 of 1985 as amended).

20 ELECTRIC MOTORS

- 20.1 In general, motors 1/3 kW and larger shall be squirrel cage induction type for three phase, 50 cycle power supply.
- 20.2 Motors 1/4 and smaller shall be capacitor start, induction run type or split-phase type for single phase, 50 cycle power supply.
- 20.3 Motors shall be AEG, GEC, Hawker Siddeley, or other approved.
- 20.4 Where the motor is an integral part of equipment, it shall be as recommended by the equipment manufacturer, or as specified.
- 20.5 Motors that are not directly exposed to weather and are located in non-hazardous spaces, shall have drip-proof enclosures, and shall have continuous duty rating at 40 °C.
- 20.6 Motors installed in unguarded outdoor locations shall be totally enclosed, fan-cooled, weatherproofed with ventilated cowl with continuous duty rating at 55 °C.
- 20.7 Single phase motors shall have built-in overload protection. Overload protectors shall be single pole automatic reset type, except where frequent start-stop may constitute a hazard, then manual reset type shall be used.
- 20.8 Hermetic polyphase motors shall have built-in hermetic thermostat protection devices which shall interrupt the control circuit to protect the motor from overheat.
- 20.9 Where drawings or Equipment Schedules schedule 3-phase motors smaller than 1/3 kW or single phase motors larger than 1/4 kW, verify with the Head : Works before ordering motors.
- 20.10 Motors shall be quiet in operation. If, in the opinion of the Head : Works, a motor is unduly noisy, it shall be promptly removed from the job and replaced with an acceptable motor.
- 20.11 Unless otherwise approved, all motors to be supplied by the same manufacturer.
- 20.12 Motor speed shall not exceed 1500 r p m unless approved by the Head : Works, or where specified for specific applications.
- 20.13 During the construction period, motors shall be sealed in plastic or other suitable material to provide adequate protection from damage and ingress of dust and moisture.
- 20.14 Before commissioning any motor, thoroughly clean the motor and inspect to ensure that it will not be damaged due to dirt and moisture which may have entered the motor.

21 VIBRATION ISOLATION

21.1 General

- 21.1.1 Selected Contractor shall be responsible for the rectification of any mechanical plant noise and or vibration which can be heard and/or felt in the occupied spaces of the building due to the operation of Air Conditioning and Ventilation systems, which form part of this Specification and Contract.
- 21.1.2 Selected Contractor's attention is drawn to the following principal precautions which shall be taken in order to ensure that minimum noise emanates from the plants installed:
- 21.1.2.1 All rotating machinery shall be accurately balanced, statically and dynamically.
- 21.1.2.2 Centrifugal fans, axial flow fans, propeller fans, mixed flow fans, pumps, or any other rotating equipment shall be mounted on or from vibration absorbing mountings.
- 21.1.2.3 All rotating machinery connections or assemblies shall be made flexible by means of items such as flexible pipe, flexible connections in ductwork connections to fans, etc.
- 21.1.2.4 All ducts shall be free of internal sharp edges, screws, etc. projecting into the airstream.
- 21.1.2.5 All fans and pumps shall have speeds not greater than those specified.
- 21.1.3 All equipment, piping, etc, shall be mounted on or suspended from approved foundations and supports, all as specified or as shown on the drawings, or as required.
- 21.1.4 Concrete foundations will be provided by the Principal Contractor. The Selected Contractor shall furnish all required sheet metal formers, templates and detailed drawings indicating positions for

anchor bolts, etc, for all inertia concrete bases, and or sub-bases. The Selected Contractor shall position the sheet metal formers to enable the Principal Contractor to cast the concrete into them.

21.1.5 Spring mounts shall be as specified

21.2 Piping Penetrations

21.2.1 Under no circumstances shall there be direct contact between piping and pipe sleeves where piping penetrates walls, floors, shafts, etc.

21.2.2 Provide 25mm thick mineral wool with a density of 40 kg/M3 for the full depth of the penetration around all insulated and uninsulated piping. The insulation shall be contained in a metal sleeve. Ends of the insulation shall be finished with a non-hardsetting type putty.

22 FANS

22.1 Fans shall be installed in positions indicated on the drawings and shall be of sizes and capacities given in the schedules.

22.2 Centrifugal Fans.

22.2.1 All centrifugal fans which do not form an integral part of airhandling units, room fan-coil units, fan coil units shall be Donkin, or equal, complete with steel bases and mounted on vibration absorbing mountings.

22.2.2 Belt drives shall be matched multiple V-belt type, with minimum of two belts per drive, having a capacity of 1,4 times motor kW rating. Drives for direct-on-line start motors shall be selected accordingly and all drives for the fans shall be selected to provide the required fan speeds.

22.2.3 Each fan shall be provided with a nameplate to indicate size, module, serial number, class and maximum allowable speed for fan.

22.2.4 Belt guards shall include hinged section to facilitate checking of belt tension without having to remove the belt guards.

22.2.5 Fan motors shall be suitable for 380V/3/50 Hz supply and shall be of the type and class as specified in the schedules. Motors shall be mounted on factory made slide rails with adjusting bolts and locknuts.

22.2.6 All kitchen canopies exhaust air fans (KEF-1 & EF-30) shall be suitable for continuous operation at a temperature of 315oC.

22.2.7 Fan wheels and housing shall be sand blasted and painted with paint system comprising universal epoxy primer, M10 Epoxy intermediate coat and a polyacrythane top coat.

22.2.8 All kitchen exhaust fans shall include the following :

22.2.8.1 Split casing for removal and cleaning of fan wheel.

22.2.8.2 Access plate in fan scroll complete with pressure latches for inspection of fan wheel.

22.2.8.3 Drain socket of 50 mm with female thread and plug for washing down inside of fan scroll.

22.3 Axial Flow Fans

22.3.1 All axial flow fans shall be complete with accessories indicated on the drawings.

22.3.2 Fan casings shall include terminal boxes and lubricating nipples and shall be hot dipped galvanised after manufacture.

22.3.3 Fan casings shall be provided with name plate to indicate size, model, serial number, pitch angle range, selected pitch angle motor size, speed, etc, in accessible position.

22.3.4 Fan motor shall be suitable for 380 V/3/50Hz supply.

22.4 Propeller Fans.

22.4.1 Propeller fans shall be complete with accessories indicated on the drawings, or schedules.

22.4.2 Fan motors shall be suitable for 380V/3/50Hz supply.

22.4.3 The following propeller fan shall be complete with accessories as given in the schedules of equipment.

22.5 In-Line Constant Speed Mixed Flow Fans

22.5.1 All in-line constant speed mixed flow fans shall be as specified, complete with accessories and with air flow and fan static pressure as given on the drawings or schedules.

22.5.2 Fan motors shall be suitable for 380Volt/3/50Hz supply. Motors shall be IP54 protected.

22.5.3 Fan impellers shall be aluminium with integral inlet fairings spun to close tolerances for optimum performance.

22.5.4 Fan casings shall be manufactured for corrosion resistant pre-galvanised sheet steel or aluminium complete with drilled flanged connections.

22.5.5 Exhaust air fans and exposed ducting on the roof shall be factory painted as for kitchen exhaust fans.

22.6 Bell Entry Plate Mounted Axial Flow Fans

22.6.1 All bell entry plate mounted axial flow fans shall be as specified, or other approved, complete with accessories and with air flow and fan static pressure as given on the drawings or schedules.

22.6.2 Fan motors shall be suitable for 380Volt/3/50Hz supply and shall be IP55 protected.

23 AIR TERMINALS, DAMPERS & LOUVRES

23.1 Refer to detailed drawings and schedules on which air terminals, dampers, louvres, etc., are indicated giving type, capacity, size and make.

23.2 Selections are based on Trox equipment, except for certain slot type diffusers. The Selected Contractor shall verify that sizes for alternative air terminals, dampers, louvres, etc., are equal in performance, noise level, etc., based on Head : Working catalogue data.

23.3 Grilles

23.3.1 Side Wall Supply Air Grilles

23.3.2 Shall be aluminium double deflection grilles with opposed blade volume control dampers and subframes for concealed fixing as per specification.

23.4 Side Wall Supply Air Grilles

23.4.1 Shall be aluminium double deflection grilles and subframes for concealed fixing as per specification

23.5 Side Wall Return/Exhaust/Transfer Grilles

23.6 Shall be single deflection grilles and subframes for concealed fixing as per specification.

23.7 Ceiling Diffusers

23.7.1 Shall be as per specification for 1, 2, 3 or 4-way diffusion pattern, with or without volume control dampers as scheduled on the drawings.

23.8 Egg Grate Grilles

23.8.1 Shall be aluminium core only complete with concealed fasteners to hold core in position inside ceiling Tee opening.

23.9 Disc Valves

23.9.1 Shall be complete with subframe and clip fixing.

23.10 Louvres

23.10.1 Shall be aluminium louvres with plastic coated wire mesh screen and masonry subframe as indicated on the drawings.

23.11 Manual Dampers

23.11.1 Shall be galvanised mild steel construction with nylon bearings where anyone transverse duct dimension exceeds 460mm.

23.11.2 Where either dimension is less than 460mm dampers may be of the butterfly type.

23.12 Motorised Dampers

23.12.1 Shall be galvanised mild steel construction with nylon bearings and shall be complete with electrically operated 'on-off' spring return Belimo FM220 damper motor(s) suitable for 220 volt, single phase, 50Hz operation.

23.13 Door Grilles and Undercuts

23.13.1 Shall be fitted by the Principal Contractor. The Selected Contractor shall however check that the door grilles indicated on the drawings and or door schedules are installed.

23.13.2 Door grilles shall be as per specification.

23.13.3 Certain of the doors require undercuts in lieu of door grilles. The Selected Contractor shall however check that the door undercuts required are provided.

23.14 Finishes

23.14.1 Aluminium diffusers and grilles shall be natural anodised aluminium. All rear assemblies and external and internal finishes of plenum boxes shall be stove matt black.

23.14.2 All ductwork which is visible through air terminals shall be painted matt black

24 CONTROL

24.1 Wired remote type computerized controllers shall be provided for the control and monitoring of ablation extraction fans to maintain required air change rates and negative pressure conditions. The position of the main control panel shall be advised.

24.2 Each extraction fan system shall be equipped with self-diagnostic and fault logging capability to allow rapid identification of failures and facilitate maintenance and service.

24.3 Remote LCD (Liquid Crystal Display) controllers, where provided, shall retain the most recent fault and alarm codes for ease of troubleshooting and maintenance.

24.4 Extraction fan operation shall be automatically controlled to maintain adequate ventilation rates in ablation areas in accordance with applicable airport, health, and building regulations. Manual override shall be provided for maintenance and emergency operation.

24.5 The installation shall be connected to a central intelligent control system (BMS) capable of managing the extraction systems and integrating with other building services, including the following functions:

- Local and remote monitoring of all extraction fans
- Local and remote control of fan operation
- Status indication (run, stop, fault, trip)
- Alarm and fault reporting
- Run hour accumulation and history recording
- Time scheduling (day, night, peak occupancy modes)
- Override operation for extended hours
- Setting of minimum and maximum operating parameters
- Emergency shutdown in the event of fire
- Password-protected access levels
- Graphical User Interface (GUI)
- Ethernet communication port
- Digital input/output contacts

The programmable logic controller or BMS controller shall be capable of accepting, processing, and actuating all relevant control and safety signals, including but not limited to:

- Fan run and fault status
- Motor overload and thermal protection
- Airflow or duct static pressure
- Differential pressure across filters (where applicable)
- Run hours and maintenance alarms
- Occupancy or demand signals
- Interlocks with fire alarm and smoke control systems
- Time-based scheduling (hour, day, and week settings)
- History and alarm logging

24.6 The Mechanical Contractor shall supply and install all interface equipment, control cabling, and terminations between extraction fans, local controllers, and the central control system.

24.7 Extraction fan speed shall be controlled by means of VVVF (Variable Voltage Variable Frequency) drives where specified. Fan control shall be based on duct static pressure, airflow measurement, or demand-based signals, with control feedback provided to the programmable logic controller or BMS.

24.8 All electronic field sensors (including differential pressure sensors, airflow switches, pressure transducers, and run status contacts) and mechanical indicators (pressure gauges where applicable) shall be provided to ensure safe, reliable, and energy-efficient operation, and to enable clear visual monitoring of system performance.

24.9 A fire alarm signal shall be provided to automatically shut down or operate extraction fans in accordance with the approved fire engineering and smoke control strategy for the airport.

24.10 Control panels, variable speed drives, and electronic components shall be fully integrated with the main control system to ensure coordinated operation, fault reporting, and optimum system performance.

24.11 All extraction fans shall be interlocked with airflow safety switches to prevent operation under no-flow or unsafe conditions. Interlocks shall be provided via both electronic and hard-wired safety circuits.

24.12 Differential pressure switches or airflow proving devices shall be installed to provide airflow failure alarms and dirty filter indications where filters are fitted.

24.13 Control logic for extraction fan operation shall include:

- Automatic start/stop based on occupancy schedules or demand signals

- Continuous or intermittent operation modes selectable via the central control system
- Fail-safe operation to prevent loss of ventilation in occupied ablution areas
- Alarm generation and reporting upon fan failure or abnormal operating conditions

25 SWITCHBOARD CONSTRUCTION

- 25.1 A new floor-mounted HVAC switchboard shall be supplied, installed, tested, and commissioned in the designated plant room or services area for the ablution extraction systems.
- 25.2 The switchboard shall be of front-access construction, bottom cable entry, and be water- and dust-proof to a minimum rating of IP54.
- 25.3 The tenderer shall allow for a prospective fault level of 25kA. The final fault level shall be verified prior to manufacture of the switchboard.
- 25.4 The switchboard shall be of cubicle-type construction and shall include, as a minimum, the following sections.

Incomer Cubicle

- Incoming circuit breaker sized to suit the connected load
- Incoming voltmeter
- Three phase ammeters
- Anti-single phase and phase reversal protection relay

Ablution Extraction Fan Cubicles

- 25.5 Separate cubicles shall be provided for each ablution extraction fan or fan group, as applicable.

- 25.6 Each cubicle shall include:

- Incoming circuit breaker with door-interlocked, padlockable rotary handle
- Ammeter for fan motor current indication
- Motor starter appropriate to motor size (DOL, star-delta, or VVVF drive as specified)
- Control circuit breaker
- Manual–Off–Auto selector switch (keyswitch where required)
- Anti-recycle timer to prevent excessive motor starts
- Power-on pilot lamp
- Run pilot lamp
- Fault/trip pilot lamp
- Airflow fail pilot lamp
- Dirty filter pilot lamp (where filters are installed)

- 25.7 The following BMS signals shall be provided for each extraction fan:

- Fan start command
- Fan run status
- Fan fault indication
- Airflow failure alarm
- Filter dirty alarm

Cables and Wiring

- 25.8 All power and control cables shall be multicore PVC insulated armoured cables in accordance with SABS 1507, except for control, pressure, and airflow sensors which shall be wired in overall Mylar screened (OAM) cable installed in Bosal-type conduit.
- 25.9 Surfix-type cables will not be accepted.

25.10 All cables shall be installed on galvanised cable tray or ladder and painted orange.

25.11 All field-mounted isolators shall be rated to IP65 minimum and provided with padlockable rotary handles.

25.12 The new switchboard shall be designed to accept the existing incoming busbars where applicable. The mechanical contractor shall be responsible for the safe disconnection and reconnection of these busbars.

Building Management System (BMS)

25.13 Each switchboard shall be provided with a stand-alone controller networked to the BMS front end.

25.14 In the event of network failure, the controller shall continue operating autonomously using the last valid parameters received.

25.15 Each switchboard and associated control panel shall be provided with at least one controller incorporating a digital display indicating the status of all inputs and outputs related to the switchboard.

25.16 All extraction fans and associated equipment shall be connected to the BMS system via the network. The tenderer shall allow for all hardware, software, programming, and commissioning required for full control and monitoring.

25.17 The BMS front end shall, as a minimum, comprise:

- PC with minimum 2.8GHz processor
- Minimum 512MB RAM
- Minimum 120GB hard drive
- DVD-RW/CD-RW drive
- Optical mouse
- 17-inch monitor
- Colour laser printer
- Windows operating system

25.18 The BMS display shall include graphical representations of the extraction systems and floor layouts. Individual extraction fans shall be selectable via the graphical interface, allowing all operating data, alarms, and adjustable parameters to be viewed.

25.19 Multiple password access levels shall be implemented as follows:

- Level 1 – Viewing only
- Level 2 – Operator level with limited parameter adjustment and scheduling
- Level 3 – Commissioning level with full parameter access
- Level 4 – Programming level with unrestricted access

25.20 Each operator shall log in individually, and all parameter changes shall be logged with time, date, and operator identification.

Switchboard Construction Requirements

25.21 Switchboards shall be manufactured from galvanised or Zintex sheet steel with a minimum thickness of 2mm.

25.22 After completion of all door cut-outs, enclosures shall be epoxy wash primed and electrostatically powder coated.

25.23 The switchboard colour shall be orange.

25.24 Any doors modified after painting shall be professionally repainted or touched up.

- 25.25 Floor-mounted switchboards shall be mounted on a substantial channel iron base, hot-dip galvanised.
- 25.26 All switchgear shall be mounted on a backing plate drilled and tapped to accept fasteners. Plastic slotted trunking, terminal rails, and DIN rails may be pop-riveted. Self-tapping screws shall not be used.
- 25.27 Backing plates shall be finished white.
- 25.28 Fasteners on copper or brass conductors shall be machine screws. Fasteners up to 5mm shall be brass; fasteners 6mm and larger shall be cadmium-plated steel. Galvanised fasteners shall not be used on copper or brass. All fasteners shall be fitted with flat and spring washers.
- 25.29 Structural fasteners shall be cadmium-plated steel or galvanised steel. Galvanised fasteners shall not be used on copper or brass components.
- 25.30 Completed switchboards shall achieve a minimum ingress protection rating of IP54.
- 25.31 Switchboard doors shall be bonded to earth using 4mm² copper braid.
- 25.32 Doors shall be hinged and secured using standard 6.35mm catches.
- 25.33 Large access panels shall be dowelled at the bottom and secured with standard 6.35mm catches.
- 25.34 Small access panels, busbar extension panels, and gland plates shall be secured with chrome-plated setscrews or studs and chrome-plated dome nuts.
- 25.35 All internal wiring shall be installed in slotted PVC trunking with a minimum of 20% spare capacity.
- 25.36 In switchboards with fault levels of 10kA or greater, wiring between busbars and components shall not be smaller than 16mm².
- 25.37 Power and control wiring shall be sized strictly in accordance with SABS 0147 Method 1, taking into account overload protection, short-circuit ratings, grouping, and ambient temperature.
- 25.38 Door wiring shall be mechanically secured and protected with spiral binding. Adhesive fixing methods shall not be used.
- 25.39 Outgoing terminals and incoming isolators shall be arranged to suit top or bottom cable entry as applicable.
- 25.40 Adequate space shall be provided between terminals and the enclosure to allow ease of site termination.
- 25.41 All site-made gland holes shall be formed using chassis punches. Hole saws shall not be used.
- 25.42 Exposed isolator terminals shall be shrouded.
- 25.43 All live busbars shall be covered with insulating material and labelled "DANGER – LIVE BUSBARS BEHIND THIS COVER".
- 25.44 All equipment, including circuit breakers and fuses, shall be permanently labelled using engraved plastic labels. Labels shall be white lettering on black background, except danger labels which shall be white lettering on red background. Fuse labels shall include fuse ratings.
- 25.45 All terminals shall be numbered on both sides. No more than two conductors shall be terminated in any terminal.
- 25.46 All wires shall be numbered in accordance with the wiring diagrams using Haley Partex PA-type markers.
- 25.47 Wire colours shall comply with the specified power and control colour coding.
- 25.48 Wire colours:

Power		
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Live		Phase colours
Neutral		Black
Control		
220vac	Live	Red
	Neutral	Black
24vac	Live	Brown
	Neutral	Grey
DC	Positive	Orange
	Negative	White
Other		Pink

25.49 All conductors shall be terminated with correctly crimped lugs or bootlace ferrules as appropriate. Ratchet crimping tools shall be used. No exposed conductors shall be visible.

25.50 Earth and neutral bars shall be copper, secured with nuts, bolts, washers, and spring washers. Systems where screws bear directly onto conductors shall not be accepted.

25.51 All switchboards shall be inspected and tested prior to dispatch to site.

25.52 Wall-mounted boards shall be supplied with brackets to space the enclosure a minimum of 20mm off the wall.

25.53 All installations and wiring shall comply with:

- The latest revision of SABS 0142
- The latest revision of SABS 1765
- Occupational Health and Safety Regulations
- Local authority regulations
- The specification issued by the Consulting Engineer

25.54 The switchboard manufacturer shall provide a release certificate for each switchboard in accordance with SABS 1765.

25.55 No alterations to wiring diagrams, switchgear selection, cable sizes, cable types, or equipment layout shall be made without written approval.

26 SITE WIRING

26.1 Cable Tray and Cable Ladder

26.2 All references to cable trays in this document also refer to cable ladders.

26.3 All cables are to be on cable tray or cable ladder. The type of cable tray or cable ladder used must be approved in advance.

26.4 Cable trays are to be hot-dip galvanised and are to be painted as follows:

- 26.4.1.1 Clean with Spick & Span galvanised iron cleaner
- 26.4.1.2 Cold galvanise any cut edges
- 26.4.1.3 Prime with calcium plumbate paint
- 26.4.1.4 Paint orange

26.4.2 Cable tray brackets are to be hot dip galvanised, and painted in the same way as cable tray, except that they are to be black.

26.4.3 As an alternative galvanised cable trays and brackets may be plastic coated.

26.4.4 Cable trays are not to be cut to form bends. Elbows and tees are to be factory-made items. Ascenders and descenders are to be beaten round a former.

26.4.5 Cable trays may be horizontal or vertical unless the drawing is marked to the contrary.

26.4.6 All take-offs from cable tray runs must be done using tees or bends

26.4.7 Cables must not be bunched on cable tray.

- 26.4.8 Only one layer of cables is permitted on cable trays.
- 26.4.9 Cables may not cross over on cable tray
- 26.4.10 Where changes of size occur on a cable tray run, this must be done using bends and tees. Abrupt changes of size are not allowed.
- 26.4.11 Cable trays must be spaced off the surface that they are fastened to. Unistrut must be used for cable tray over 100mm.
- 26.4.12 Do not short-circuit vibration isolators on machinery with cable tray.
- 26.4.13 Cable tray brackets and supports must be of sufficient strength to prevent sagging, twisting etc. particularly in the case of large cables.
- 26.4.14 Cable trays and conduits are to be properly earthed to the switchboard earth bar.

26.5 Earthing

- 26.5.1 All equipment is to be earthed.
- 26.5.2 All earths are to be made off to the switchboard earth bar.
- 26.5.3 The earthing strands in ECC cable, surfix, etc. are to be made off to the proper earthing points at both ends of the cable.

26.6 Making Off and Terminating Wires and Cables

- 26.6.1 All site made holes in switchboards for glands etc. must be done with a chassis punch. Hole saws are not to be used. In the case of switchboards mounted outside, or in damp conditions, the cut edges of these holes must be treated with cold galvanising, and touched up with the correct colour paint.
- 26.6.2 Where cables are made off into boards, this must be done carefully, offsetting the cables neatly and evenly, without cross-overs.
- 26.6.3 All cable tails must have sufficient slack to allow tong testers to be used.
- 26.6.4 Allow sufficient slack when making cables off to allow for adjustment of pulleys, removal of actuators etc.
- 26.6.5 No more than two lugs or two conductors without lugs are permitted in any terminal.
- 26.6.6 Wires connected to numbered terminals are to bear the same number. Wire numbers are to be Haley Partex type PA.
- 26.6.7 All cables are to be numbered on both ends, directly above the gland shroud, with copper, brass or stainless steel bands or strips with the number embossed or punched on the strip or band.
- 26.6.8 All wires except as noted below are to have lugs crimped to the ends. Lugs on wires 6mm and under are to be insulated. Insulated bootlace ferrules are acceptable when the terminal is designed to accept them. The correct type of crimper is to be used. Ratchet crimpers only are to be used on insulated terminals. No exposed conductors are to be visible on wires which have insulated lugs.
- 26.6.9 Single core conductors are not to have crimped lugs, but are to have insulated bootlace ferrules. Wires 10mm and over which are secured into saddle or screw terminals are to be twisted and bound.

26.7 Conduits

- 26.7.1 All conduit is to bear the relevant SABS mark.
- 26.7.2 Conduits are to be run neatly and parallel to each other.
- 26.7.3 Conduits are to be bent and offset with the correct tool. Wrinkling of the inside of bends will not be accepted.
- 26.7.4 Through boxes, end boxes and fittings are to be made of the same material as the conduit, except that galvanised boxes and fittings may be used with black conduit.
- 26.7.5 Inspection bends, tees or couplings may not be used.
- 26.7.6 All unwired conduits are to have draw-wires installed.
- 26.7.7 Open conduit ends and boxes are to be sealed to prevent the ingress of debris.
- 26.7.8 Cut conduit ends are to be properly reamed.
- 26.7.9 Conduits must be made off to switchboards, boxes, trunking etc using a coupling and male bush.
- 26.7.10 Solid brass bushes must be used on iron conduit, plastic bushes on aluminium conduit, and brass or plastic bushes on plastic conduit.
- 26.7.11 Where the enameling or galvanising of conduit has been removed by threading or tools, then the bare metal is to be painted with cold galvanising paint.
- 26.7.12 Conduit fixings are to be manufacturers items designed for the fixing of conduit. The method of fixing is to be approved before construction commences.

- 26.7.13 Metal conduit is to be fixed at minimum 2.0m, and plastic conduit 0.75m. In addition conduit is to be fixed 150mm before and after each bend, offset and box. Sagging between fixings will not be accepted.
- 26.7.14 Draw boxes are to be installed after two right-angle bends, or after 10.0m of straight conduit.
- 26.7.15 All plastic conduit joints and fittings are to be glued.

26.8 Trunking

- 26.8.1 Trunking may not to be cut to form bends. Distribution outlets, elbows, tees, ascenders and descenders are to be factory-made items and must be radiused.
- 26.8.2 Internal splices are to be used for joints.
- 26.8.3 Sharp fastenings are not to protrude into trunking.
- 26.8.4 All cable trays, ladders, conduits, surface mounted cables, trunking etc. is to be run parallel to or at right angles to walls and other surfaces, and may not be solid over expansion joints.
- 26.8.5 All cut edges are to be smoothed, and no sharp edges are to be left inside trunking.
- 26.8.6 All brackets are to be galvanised

26.9 General

- 26.9.1 All conductors are to be stranded.
- 26.9.2 All cables are to be PVC SWA PVC.
- 26.9.3 Screened cable for low voltage controls may be 0.5mm² OAM in conduit
- 26.9.4 No surfix or similar cable may be used.
- 26.9.5 Wall mounted switchboards are to be spaced away from the wall 20mm.
- 26.9.6 All cut ends of galvanised material are to be painted with cold galvanising paint.
- 26.9.7 All iron or steel material and fastenings exposed to damp conditions must be hot dip galvanised. Electro-galvanised or cadmium plated material will not be accepted unless suitably painted.
- 26.9.8 All switchboards, isolators, terminal boxes etc. located outside, or in any area subject to dampness, must be bottom entry only.
- 26.9.9 All installations and wiring are to conform to the following:
- 26.9.10 The latest revision of SABS 0142 code of practice for the wiring of premises
- 26.9.11 Machinery and occupational safety regulations
- 26.9.12 Local authority regulations
- 26.9.13 Electrical Compliance Certificates as required by the latest revision of SABS 0142 are to be produced before power is applied to the installation.
- 26.9.14 All cable and cable tray routes, wiring methods etc. must be approved in advance.
- 26.9.15 DO NOT alter wiring diagrams, switchgear selections, cable sizes, cable types, equipment positions etc. without permission.

27 VIBRATION ISOLATION

- 27.1 Support of Piping in Plantrooms.
- 27.1.1 In plantrooms, all new chilled water and condenser water piping shall be individually supported from resilient hanger and rod isolators providing a minimum static deflection of 25mm in position indicated on the drawings where necessary.
- 27.1.2 These hangers shall be a combination of steel spring and neoprene-in-shear mountings and shall be one of the following, or other approved, capable of carrying the applied load:
- | | | | |
|--------|------------|---|--|
| 27.1.3 | Type PC30N | - | Mason Industried Inc. New York |
| 27.1.4 | Type RSH | - | Vibration Mountings and Controls Inc, Butler, New Jersey |
- 27.2 All piping isolation hanger supports shall be capable of supporting piping during erection at a fixed elevation, regardless of load changes. The isolation hanger units shall incorporate an adjusting feature to transfer the load to the spring element within the hanger mounts after the piping system has been filled with water.
- 27.3 Isolation hangers shall be selected by the manufacturer in accordance with their recommendations. Submit details to the Head : Works for approval, before ordering the isolation hangers.