

ANNEXURE 1

SCOPE OF WORK/TECHNICAL SPECIFICATION



CONSTRUCTION UPGRADES TO UNISA EUCLID MECHANICAL AND INDUSTRIAL LABS IN FLORIDA CAMPUS SCOPE OF WORK

The scope of work includes the followings:

UNISA intends to appoint a Principal Contractor to implement the construction upgrades to the Euclid Mechanical and Industrial Labs at the Florida Campus adjacent to the Christiaan de Wet Road entrance.

UNISA EULCID MECHANICAL & INDUSTRIAL LABS building is located at the Florida Campus on 28 Pioneer Avenue. The Employer, UNISA, intends to undertake, on behalf of End User Department herein referred to as UNISA FLORIDA, the refurbishment and upgrade of its existing Mechanical and Industrial Lab buildings with the intention to extend the current mezzanine floor in order to cater for more enclosed labs as per the requirements of the UNISA FLORIDA professors.

Mechanical Labs - Euclid Mechanical Labs is located adjacent to the Civil Engineering Labs, this lab is approximately 983m² in size. The ground floor predominantly comprises of an open workshop area of approximately 307m², and enclosed labs for Strength of Machine labs, Thermo Dynamics, Fluid Mechanics and Mechanics of machines. Roller shutter doors located on the northern part of the building facilitates the movement of machinery into the lab, there is also an operational crane for the movement of large equipment. The mezzanine level is 376m² in size and has access to an external passage that leads to a fire escape and lift core.

Industrial Labs - Euclid Industrial Labs is located adjacent to the Mechanical Labs, this lab is approximately 983m² in size. The ground floor predominantly comprises of an open workshop area for sheet and metal fabrication as well as manufacturing technology. Roller shutter doors located on the northern part of the building facilitates the movement of machinery into the lab, there is also an operational crane for the movement of large equipment. The mezzanine level is 376m² in size and has access to an external passage that leads to a fire escape and lift core.

The principal works are General Building works, which comprise of concrete, masonry, drywalling and structural steel works.

Refer to the list of attached drawings at the end of the document and BOQ for detailed scope definition:

Summary:

1. Carefully cut into existing slabs paving and build foundation to Structural Engineer's details
2. Carefully re-route any existing services where applicable under existing paving
3. Erect new structure, drywalling and install finishes as per drawings
4. Install electrical and plumbing reticulation as per drawings
5. Install electrical and plumbing fittings as per drawings
6. Make good all existing slab paving on completion of construction around the new structure
7. Clean and make good all snags and handover to client
8. Make good and ensure protection of all immovable machinery during the works



1. INTERNAL FINISHES

1.1 FLOORS

1.1.1 Codes of Practice

SANS 10155: 1980	Accuracy in buildings
SANS 10107: 2011	Code of Practice for the Design & Installation for Ceramic Tiling
SANS 10043: 2009	The installation of wood and laminate flooring
SANS 10109-2: 2004	Concrete floors. Part 2: Finishes to concrete floors
SANS 10070: 2012	The installation of resilient thermoplastic and similar flexible floor covering materials
SANS 2001:CC1:2009	Construction works Part CC1: Concrete works (structural)

1.1.2 Construction

Permissible deviations appropriate to the degree of accuracy specified in the scope of work shall be applied to linear dimensions, position, verticality, levelness, squareness and bow. If no degree of accuracy is specified, degree of accuracy II shall apply.

Any deviation from flatness of plane surface or any abrupt change in continuous surface shall be measured as the maximum deviation of the surface from any straight line of length 3m joining two points on the surface, determined by means of a straight edge, the ends of which are supported on identical blocks of suitable thickness placed over each of the joints.

Where a wood-floated or steel-floated or power-floated finish or a screed topping or granolithic finish is required in terms of the scope of work, the concrete shall, unless otherwise specified in the specification data, be finished to a degree of accuracy II.

All new surface beds and suspended concrete floors to comply with the structural engineers' details, specifications, and shall, unless specified otherwise, comply with the Class 2 floor classification.

Class	Description	Max Deviation (mm)
1	For floors requiring minimum irregularity, such as large format specialized warehouses and stores with an epoxy or vinyl floor finish. May necessitate the use of special methods and will require close supervision.	3
2	Reasonable degree of accuracy required and suitable for the major proportion of construction work.	5
3	Suitable for floors where both a reasonable degree of accuracy and regularity is not important.	10

Table 1 – Classification of floor



1	2	3	4
Item	Permissible deviation (pd)		
	mm		
	Degree of accuracy		
	III	II	I
Reinforcement			
1) Spacing between two adjacent bars	± 25	± 20	± 15
2) Longitudinal location of bends and ends of bars	± 40	± 30	± 20
3) Cover to reinforcement	0, +20	0, +20	0, +20
Foundations: mass and reinforced concrete			
1) Position on plan of any edge or surface measured from the nearest grid line or agreed centre line	± 50	± 35	± 20
2) Linear dimensions on plan cast against excavation sides	± 60	± 40	± 20
3) Linear dimensions on plan cast against formwork	± 30	± 20	± 1
4) Level of underside of concrete	+20, -40	+15, -30	+10, -20
5) Surface level (i.e. top of foundation) (excluding floor slabs)	+15, -30	+10, -20	+5, -10
Elements or components above foundations			
1) Position on plan of any edge or surface measured from the nearest grid line or agreed centre line	± 25	± 15	± 5
2) Linear (other than cross-sectional) dimensions	± 30	± 20	± 10
3) Cross-sectional dimensions	+20, -10	+15, -5	+5, -5
4) Level (deviation from designated level with reference to the nearest transferred datum (TD) of the upper or lower surface, as might be specified, of any slab or other element or component)	+10, -20	+5, -15	0, -10
5) Verticality, per metre of height, subject to a maximum of	5 70	5 50	2 30
6) Out-of-squareness of a corner or opening or element such as a column for short side of length			
a) ≤ 0,5 m	± 10	± 5	± 3
b) > 0,5 m; ≤ 2 m	± 20	± 15	± 10
c) > 2 m; ≤ 4 m	± 25	± 20	± 15
7) Exposed concrete surfaces:			
a) flatness of plane surface	10	5	3
b) abrupt changes in a continuous surface	10	5	2
8) Exposed concrete surface to be plastered:			
a) flatness of plane surface	15	10	a
b) abrupt changes in a continuous surface	10	5	a
Location of holding-down bolts			
1) The centre line of a holding-down bolt from its designated location on plan	a	± 3	a
2) The top of the bolt from its designated elevation	a	+5, -3	a
^a Tolerances not stated. Those for bow, camber and twist, and for slipform concrete and precast concrete shall be specified in the scope of work.			

Table 2 – Accuracy in concrete work (source: SANS 2001-CC1:2007 p55)



1.1.3 Screeds

Existing Concrete Surface Beds and Suspended Slabs

All existing concrete surface beds and suspended slabs to receive a self-levelling structural screed and shall, unless specified otherwise, result in a floor that complies with the Class 2 floor classification.

Bonded Screeds to New Concrete Surface Beds and Suspended Slabs

All new concrete surface beds shall, unless specified otherwise and only once they are in a hardened state, receive a wood floated screed finish, 25mm and maximum 50mm thick.

Where the screed is anticipated to exceed or exceeds 50mm thickness, reinforcing mesh as per the structural engineer’s specification shall be required.

All screeds shall be applied in one single operation, unless practically impossible to do so at which point the manufacturers written guidance, if applicable, as well as the structural engineers written specifications and permission shall be obtained prior to applying the screed in more than one operation.

Bonded Screeds to New Concrete Surface Beds and Suspended Slabs

All screeds shall ensure that the specified floor classification as per Table 1 is achieved.

1.1.4 Joints

All screeds and floor coverings shall be installed without any interference whatsoever with any of the structural joints in the concrete surface bed and suspended floors.

All screeds and floor coverings shall be installed without any interference whatsoever with any of the structural joints in the concrete surface bed and suspended floors.

The installation of all floor coverings shall allow for movement joints, other than structural joints, in strict compliance with the manufacturer’s specifications.

All structural and movement joints that are expressed in floor coverings shall, except in the case of an epoxy finish or if specified otherwise, receive a flat transition strip as per the architect’s details and specifications.

1.2 FLOORS

Type	Colour	Supplier	Supplier code
Anti-static vinyl flooring	Whisper Grey	Floorworx or Similar	MS123
Anti-static vinyl flooring	Ash Grey	Floorworx or Similar	MS122

Static dissipative vinyl floor sheets laid in long direction with welded joints with Floorworx approved adhesive or similar.



2.0 WALLS

2.1.1 Codes of Practice

SANS 10155: 1980	Accuracy in buildings
SANS 1090: 2009	Aggregates from natural sources – fine aggregates for plaster and mortar
SANS 2001-EM1:2007	Construction works – Part EM1: Cement plaster
SANS 50197-1: 2013	Cement Part 1: Composition, specifications, and conformity criteria for cement
SANS 10400-K: 2011	The application of the National Building Regulations Part K: Walls

2.1.2 Construction

All new masonry walls to comply with the SANS 10155: 1980 – Accuracy in buildings permissible deviations in walls (Table 3).

All new drywall partitions to be constructed using Gyproc Sound Resistant Wall System with 15mm thick Gyproc SoundBloc, or similarly approved and to comply with Table 4.

Supply and install 162mm 2hr Fire rated Drywall between labs, supply and install 162mm 2 hr Fire rated drywall between Engine testing lab, supply and install 132mm 1hr Fire rated drywall within Male and Female bathrooms. Supply and install moisture resistance drywall between shower and cubicles.

1 Description	2 3	
	PD mm	
	Grade	
	II	I
Position on plan		
PD of fair-faced specified side of wall from the designed position	± 15	± 10
Length		
Up to and including 5 m	± 15	± 10
Over 5 m, up to and including 10 m	± 20	± 15
Over 10 m	± 25	± 20
Height		
Up to and including 3 m: brickwork	± 10	± 5
Up to and including 3 m: blockwork	± 15	± 10
Over 3 m, up to and including 6 m	± 20	± 15
Over 6 m	± 25	± 20
Wall thickness	± 15	± 10
Level of bed joints		
Length up to but not exceeding 5 m	± 10	± 5
Over 5 m but not exceeding 10 m	± 15	± 10
Over 10 m but not exceeding 20 m	± 20	± 15
Add for every 5 m in excess of 20 m	± 5	± 5
Straightness, max.		
In any 5 m (not cumulative): brickwork	15	10
In any 5 m (not cumulative): blockwork	10	5
Verticality		
In any 8 course: brickwork	± 10	± 5
In any 3 m	± 15	± 10
Finished surfaces		
PD of any point from a 2 m straight-edge placed in any direction on the wall, max.	6	3

Table 3 – Permissible deviations in masonry work (SANS 10155: 1980 Accuracy in Buildingsp29)



DESCRIPTION	PD, mm	
	Grade	
	II	I
<u>Position on plan</u> PD of fair-faced specified side of wall from the designed position	±15	±10
<u>Length</u> Up to and including 5m	±15	±10
Over 5m, up to and including 10m	±20	±15
Over 10m	±25	±20
<u>Height</u> Up to and including 3m	±10	± 5
Over 3m, up to and including 6m	±20	±15
Over 6m	±25	±20
<u>Straightness, max.</u> In any 5m (not cumulative)	15	10
<u>Verticality</u> In any 2m	±10	± 5
In any 5m	±15	±10
<u>Finished surfaces</u> PD of any point from a 2m straight-edge placed in any direction of the wall, max.	6	3

Table 4 – Permissible deviations in drywall partitions and lightweight internal walls (General specification for drywall partitions and lightweight internal walls South African Building Interior Systems Association 2nd Ed, June 2004)

2.1.3 Plaster To Masonry Walls

Existing and New Masonry and Concrete Walls

All loose and damaged plaster to existing masonry shall be stripped off and made good, with new plaster to match thickness of existing plaster.

All plaster to new masonry and concrete walls, shall, unless specified otherwise, be a min 10mm and max 20mm thick, with a steel troweled finish.

Where the plaster is anticipated to exceed or exceeds 20mm in thickness, reinforcing mesh as per the structural engineer’s specification shall be required.

Each plaster coat shall be applied in one single operation, unless practically impossible to do so at which point the manufacturers written guidance, if applicable, as well as the structural engineers written specifications and permission shall be obtained prior to applying any single coat of plaster in more than one operation.

The chasing of plaster is expressly prohibited, however where the chasing of plaster is unavoidable, the minimum cover thickness of the plaster over chased services and reinforcing mesh as per the structural engineer’s specification shall be required.



Permissible Deviations from datum level

All plaster shall ensure that Grade II accuracy as per SANS 10155:1980 – Accuracy in buildings as per Table 3 is achieved.

2.1.4 Rhinolite To Drywall Partitions

All drywall partitions to be skimmed with 1 x coat 2.5mm thick *Rhinolite* or similar approved.

2.1.4 Joints

All plaster and wall coverings shall be installed without any interference whatsoever with any of the structural joints in the walls.

The installation of all plasters, skim coat and wall coverings shall allow for the movement joints, other than structural joints, in strict compliance with the manufacturer’s specifications.

All structural and movement joints that are expressed in the plaster and the wall coverings shall, except in the case of an epoxy or resin finish or if specified otherwise, receive a flexible “*Polymer Paintable joint sealant*” as per the structural engineers details and specification.

2. WALL COVERINGS

Type	Colour	Supplier	Supplier code
Paint	Black Ebony	Plascon	GR-N04
Paint	Orchid Bay	Plascon	GR-Y06
Paint	Deep Blue	Plascon	G 25
Paint	Medium Yellow	Plascon	G 6
Paint	Paradiso	Plascon	G7-A1-1
Paint	Golden Brown	Plascon	G 17
Paint	Mayor Green	Plascon	G5-A1-1

All Plastered walls and drywall partitions to receive 1 x coat “Plascon 1 step prep Water Based Primer , sealer and undercoat”, or similar approved, minimum 16 hours overcoating time, to be followed by 2 x coats Plascon washable and tough PVA” or similar approved. Minimum 48 hours drying time between successive.

Type	Colour	Supplier	Supplier code
Wall Tile	Kerry Grey	CTM	
Floor Tile	Kerry Grey	CTM	

All Walls to ablutions and kitchens to receive full height, 600 x 600mm Rectified Ceramic wall tiles

Colour: Kerry Grey

TAL “Goldstar 6” tile adhesive or similar approved.

TAL “High Traffic Grout”. Colour: Dove Grey

TAL “Superflex” liquid waterproofing system and membrane, full height to all shower walls.



3. CONCRETE SOFFITS

3.1 GENERAL

3.1.1 Codes of Practice

SANS 10155: 1980	Accuracy in buildings
SANS 1090: 2009	Aggregates from natural sources – fine aggregates for plaster and mortar
SANS 2001-EM1:2007	Construction works – Part EM1: Cement plaster
SANS 50197-1: 2013	Cement Part 1: Composition, specifications, and conformity criteria for cement
SANS 10400-K: 2011	The application of the National Building Regulations Part K: Walls

3.1.2 CONSTRUCTION

Soffits to existing and new concrete suspended slabs

All loose plaster to existing concrete soffits, shall be removed.

All damaged plaster in exposed areas shall be made good and unless specified otherwise, the thickness and finish shall match the existing plaster finish.

All exposed plaster to existing and new concrete suspended slabs, shall, unless specified otherwise, be a min 10mm and max 20mm thick, with a steel troweled finish.

Where the plaster is anticipated to exceed or exceeds 20mm in thickness, reinforcing mesh as per structural engineer's specifications shall be required.

Each plaster coat shall be applied in one single operation, unless practically impossible to do so at which point the manufacturers written guidance, if applicable, as well as the structural engineers written specifications and permission shall be obtained prior to applying any single coat of plaster in more than one operation.

3.1.3 Joints

All plaster shall be installed without any interference whatsoever with any of the structural joints in the concrete.

All visible structural and movement joints that are expressed in the painted soffit, shall except in the case of a painted finish, or if specified otherwise, receive a flexible "Polymer Paintable Joint Sealant" as per the structural engineers' details and specifications.



4. BULKHEADS AND CEILINGS

4.1 GENERAL

Refer to the C-Series set of Drawings

4.1.1 Codes of Practice

SANS 10155: 1980 Accuracy in buildings

General specifications for drywall partitions and lightweight internal walls South African Building Interior Systems Association 2nd Ed, June 2004

4.1.2 Construction

All new bulkheads and ceilings shall comply with to comply with the SANS 10155: 1980 – Accuracy in buildings permissible deviations in floors and ceilings. Please refer to drawing C001 – Ceiling & Electrical Plan

Supply and installation ISOVER CINEPLEX 40MM X 1200X600 WITH BLACK CEILING GRID, Supply and installation GYPROC SKIMMED CEILING WITH MOISTURE RESISTANCE BOARD, Supply and installation MALE AND FEMALE GYPROC GYPREX WHITE 9MM 600MMX600MM, Supply and installation BULKHEAD CEILINGS

1 Description	2	3	4
	PD mm		
	Grade		
	III	II	I
Floors: level of finished surface			
PD from the designed level of any point on a floor surface	± 20	± 15	± 10
PD in level between any two points 6 m apart, max.	15	10	5
PD at any point above a 3 m straight-edge placed level in any direction (avoid abrupt changes of the level), max.	10	6	3
Ceilings: level of finished surface			
PD in level of any point on a ceiling from the designed level	± 20	± 15	± 10
PD in level between any two points 6 m apart, max.	15	10	5
PD at any point above a 3 m straight-edge placed level in any direction, max.	10	6	3

Table 5 – Permissible deviations in floors and ceilings work (SANS 10155: 1980 Accuracy in Buildings p)

4.1.3 Drywall Bulkhead

All drywall bulkheads shall be constructed with 6.4mm thick “Gyproc Rhinoboard” or similar approved, on Gyproc Donn Steel Brandering” and with aluminum shadow line plaster trims all around.

All drywall bulkheads to be skimmed with 1 x coat 2.5mm hick Rhinolite or similar approved.

Permissible Deviations from datum level

All plaster shall ensure that Grade II accuracy as per SANS 10155:1980 – Accuracy in buildings as per Table 5.



4.1.4 Ceiling Structure/Nail Up Ceilings

Allow for 38mm X 235mm Timber joist ceiling grid structure at 1200mm x 600mm

Allow for Fibreglass thermal insulation

Allow for 25mm x 25mm Donn Galvanised steel angle grid

Allow for Rhino Fire board ceiling @120 minutes fire rating

Allow for Rhino Fire board ceiling bulkhead @120 minutes fire rating

Permissible Deviations from datum level

All plaster shall ensure that Grade II accuracy as per SANS 10155:1980 – Accuracy in buildings as per Table 5.

4.1.5 Suspended Lay-in Ceilings

All lay-in ceilings shall be constructed with “Gyproc Donn T38V/T37V Ceiling Grid” or similar approved suspended from the building structural members, with aluminum shadow line plaster trims and transitions strips all around

Permissible Deviations from datum level

All plaster shall ensure that Grade II accuracy as per SANS 10155:1980 – Accuracy in buildings as per Table 3.

4.1.6 Joints

All suspended bulkheads and lay-in ceilings shall be installed without any interference whatsoever with any of the structural joints in the floor and walls.

The installation of the suspended bulkheads and lay-in ceilings shall allow for movement joints, other than structural joints, in strict compliance with the manufacturer’s specifications.

All structural and movement joints that are expressed in the suspended bulkheads shall, unless specified otherwise, receive a flexible “Polymer Paintable Joint Sealant” as per the structural engineers’ details and specification.

4.2 CEILING COVERINGS

Please revert to ceiling drawings - C001 – Ceiling & Electrical Plan

Type	Colour	Supplier	Supplier code
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All suspended bulkheads to receive 1 x coat “Plascon 1 step prep Water Based Primer, Sealer and Undercoat”, or similar approved, minimum 16hrs overcoating time, to be followed by 2 x coats Plascon washable and PVA with minimum 48hrs between successive coats.



5. JOINERY

5.1 GENERAL

5.1.1 Codes of Practice

SANS 10155: 1980 Accuracy in buildings

5.1.2 Construction

All timber carcasses to be constructed from 16mm thick white melamine boards and 3mm Masonite Backing Boards, with 16mm thick supawood doors and drawer fronts as per approved shop drawings

Please refer to joinery drawings – G Series drawings as per attached drawings

5.1.3 Paint to Supawood Elements

All timer supawood doors and drawers fronts to receive 1 x coat Plascon

6. WINDOWS AND DOORS

6.1 GENERAL

Refer to Drawing 5000 – UNISA Labs – Doors, Gate & Window Schedules – Rev B

6.1.1 Codes of Practice

SANS 10155: 1980	Accuracy in buildings
SANS 1090: 2009	Aggregates from natural sources – fine aggregates for plaster and mortar
SANS 2001-EM1:2007	Construction works – Part EM1: Cement plaster
SANS 50197-1: 2013	Cement Part 1: Composition, specifications, and conformity criteria for cement
SANS 10400-K: 2011	The application of the National Building Regulations Part K: Walls

6.1.2 Construction

All doors and windows openings in new masonry walls to comply with the SANS 10155: 1980 – Accuracy in buildings permissible deviations in walls (Table 3).

Supply and install doors & windows as per windows and door schedules.



1.1 GENERAL

Drawings to be read in conjunction with all relevant architects, consultants and specialists drawings and specification

All details and dimensions subject to the confirmation on site, any discrepancies must be brought to the engineer's attention prior to construction.

Drawings must not be scaled.

All construction workmanship and materials to be in accordance with the relevant provisions of the application of the national building regulations SANS 10400 and relevant parts of SABS 1200.

The works will be inspected from time to time by the engineer to ascertain that the contractor is carrying out work in the general conformity with the engineering drawings and documents. Such inspections are not for the contractors benefit and do not relieve him of the responsibility of constructing the works in accordance with engineering drawings, documents and good building practice.

1.1.1 Concrete (Structural)

All concrete shall conform to the requirements the SANS 1200G.

All reinforced concrete to conform to the requirements of SANS 1200GB.

Concrete specifications:

- Foundations 30mpa,
- Strip footings 25mpa,
- Walls 30mpa,
- Columns 30mpa,
- Beams 30mpa,
- Slabs 30mpa.

All concrete shall be continuously cured for a minimum of 7 days by an approved method – to be submitted to engineer prior to construction start.

Minimum cover to rebar:

- All slab soffit 30mm,
- All foundations 50mm
- Columns & beams 30mm.

The degree of accuracy shall be grade III FOR foundations and Grade II for all other concrete works, as per SABS 1200G.

Removal of form work to be as follows:

- Beam sides, walls,
- Unloaded columns 1 day,
- Beam props 14days, slabs props 10 days

All reinforcement must be inspected by the engineer or his nominated representative before concrete is cast.



1.1.2 Masonry

All loadbearing brick work shall be laid to the requirements and tolerance of SANS 10164 and SANS 10145.

Class II mortar shall be used throughout as per SANS 10164

All Load Bearing Bricks or blocks shall have a nominal compressive strength of 14mpa

Water absorption of clay bricks not to exceed 12%.

Galvanized butterfly ties complying with SANS 28 or approved polypropylene ties shall be built into the cavity walls at a rate of 5 ties per square meter minimum. Adjacent to columns, ties to be built into every second layer of brickwork.

Brick reinforcements – approved galvanized brick force (2.88mm diameter longitudinal wires) is required:

- In every fourth course of loading bearing brickwork, unless otherwise specified;
- In every layer of foundation walls up to the DPC;
- In the first four layers above suspended slabs and;
- In the first four layers above and below window and above door openings extending at least 600mm past such openings.

Slip joints – except over masonry brick columns, the top of all loadbearing brickwork to be plastered smooth with 3:1 mortar. Two layers of 500 micron gunplas placed on walls prior to casting of concrete.

All 10mm soft joint (Jointex) between beam / slab soffit and the top of all loadbearing brickwork to be plastered smooth with 3:1 cement mortar.

Soft joints on all external walls to be sealed with polysulphide sealant on outside.

1.1.3 Steelwork

All steelwork to be Grade S355JR according to SANS 1431 or 10025-2.

Steel surfaces shall not be more heavily pitted or rusted than Grade C of ISO 8501-1

All steelwork to be hot-dip galvanized to SANS 121/ISO 1461-fabrication to SANS 14713/ISO 14713

All bolts to be hot-dip galvanized to SANS 121/ISO 1461, bolts to be Grade 8,8 to SANS 1700-5-1, diameter and number as indicated on the drawings. Nuts to be hot-dip galvanized Grade 8,8 to SANS 121/ISO 1461.

All welding to be metal-arc process in accordance with ANSI/AWS D1, 1/D1, 1M, consumables shall be chosen to ensure that the mechanical properties of the weld metal in not less than that of the parent material, the required weld length, type and thickness is indicated on the drawings

The permissible deviation of fabricated rolled sections after fabrication shall be in accordance with Table 3 of SANS 2001-CS1:2005

The permissible deviation for foundation, wall and anchor bolts shall be in accordance with Table 4 of SANS 2001-CS1:2005

The permissible deviation for foundation, wall and anchor bolts shall be in accordance with Table 7 of SANS 2001-CS1:2005



The permissible deviation of erected components shall be in accordance with Table 8 of SANS 2001-CS1:2005

All holding down (HD) bolts to be fabricated from round bar meeting the requirements SANS 1431 Grade 300 WA. HD Bolts to be used with Grade 8,8 nuts all hot-dip galvanized to SANS 121/ISO 1461

Fabrication of components may only proceed when the engineer has approved the fabrication drawings

Erection of components may only proceed when the engineer inspected and approved the fabricated, galvanized components

Cladding may only proceed when the engineer has inspected and approved the erected structure

All queries relating to this drawing to be directed to the engineer



**UNISA – EUCLID BUILDING
MEZZANINE LABS**

FLORIDA CAMPUS

ELECTRICAL INSTALLATION

SECTION 1: GENERAL SPECIFICATION

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**UNISA – EUCLID BUILDING
MEZZANINE LABS**

FLORIDA CAMPUS

ELECTRICAL INSTALLATION

SECTION 1: GENERAL SPECIFICATION

1.1 REGULATIONS, FACTORIES ACT AND BY-LAWS

The work shall be carried out strictly in accordance with:

- (a) the latest issue of "SANS 0142: Code of Practice for the Wiring of Premises" hereafter called the "Wiring Code".
- (b) the "Occupational Health and Safety Act" of 1993 as amended to date and hereafter called the "Act".
- (c) the Municipal By-Laws and any special requirements of the local Supply Authority.
- (d) the local Fire Office Regulations.

In addition, the work is to be of high standard and to the satisfaction of the Engineer.

1.2 NOTICES AND FEES

The Contractor shall give all notices required by and pay all necessary fees, including any inspection fees, which may be due to the local Supply Authority.

At submittal of the official account, only the nett amount of the fee charged by the Supply Authority for connection of the installation to the supply mains, will be refunded to the Contractor by the Department.

1.3 SCHEDULE OF FITTINGS

In all instances where schedules of light, socket outlet and power points are attached or included on the drawings, these schedules are to be regarded as forming part of the specifications.

1.4 QUALITY OF MATERIALS

Only materials of first-class quality shall be used, and all materials shall be subject to the approval of the Engineer.

Wherever applicable the material is to comply with the relevant South African Bureau of Standards specifications, or to British Standard Specifications, where



no SABS specifications exist.

Materials wherever possible, must be of South African Manufacture.

1.5 CONDUIT AND ACCESSORIES

Unless otherwise stated under Section two of this Specification and except where other methods of installation are specified for certain circuits, the installation shall be in screwed conduit throughout. Open wiring will not be allowed in roof spaces.

For light and normal socket outlet circuits, the conduit used shall have an external diameter of 20 mm. In all other instances the size of conduit shall be in accordance with the "Wiring Code" for the specified number and size of conductors, unless otherwise directed in the schedules or indicated on the drawings.

Except where agreed to, or otherwise specified or indicated on the drawings, all conduit to points shall be run via the ceiling slab or roof space.

Whether conduit shall be galvanized or black enamelled is specified under Section 2 of this Specification. However, in damp situations and where exposed to weather, the conduit, accessories, and fittings shall be galvanized in all cases.

Mechanical and electrical continuity must be maintained throughout the installation, but conduit shall not be relied upon alone for earth continuity.

Conduit and conduit fittings must be thoroughly inspected for defects before installation, and all sharp edges and burrs removed.

Running joints are to be avoided as far as possible and conduit is to be set to the required angles; normal bends will not be acceptable except as may be permitted in larger diameters.

All conduit fittings except couplings shall be of the inspection type. Where cast metal conduit accessories are used, these shall be of malleable iron. Zinc base fittings will not be allowed.

Bushes shall be of brass only.

Bushes and locknuts are to be used where conduit enters switch boxes. Draw boxes are to be provided in accordance with the "Wiring Code: and wherever necessary to facilitate easy wiring.

As an alternative to the screwed conduit type of installation, as specified above, unscrewed conduit with Cheney type conduit fittings will also be acceptable to the Engineer. The use of this alternative system is, however, subject to the following conditions :-

- (a) The unscrewed conduit shall be manufactured of mild steel having a minimum thickness of 0,9 mm (20 gauge) and shall be in accordance with SABS 1007 of 1973. Conduit manufactured of lighter gauge material, i.e., 0,7 mm (22 gauge) will not be permitted.



- (b) Bending and setting of unscrewed conduits must be done with special benders and apparatus manufactured for this purpose and which are obtainable from the suppliers of the Cheney system. Damage to the conduit resulting from the use of incorrect bending apparatus or methods, must on indication by the Department's inspectorate staff, be completely removed and rectified and any wiring already drawn into such damaged conduits must also be completely renewed at the Contractor's expense.
- (c) Tenderers must ensure that general approval of the proposed conduit system to be used is obtained from the local electricity supply authority prior to the submission of their tender. Under no circumstances will consideration be given by the Engineer to any claim submitted by the Contractor which may result from a lack of knowledge in regard to the supply authority's requirements.
- (d) Conduit and accessories used for flame-proof installations and for suspension of lightning fittings as well as all load bearing conduit shall in all instances be of the screwed type.

1.6 CONDUIT IN ROOF SPACES

Conduit in roof spaces shall be installed parallel or at right angles to the roof members and shall be secured at intervals not exceeding 1,5 m by means of saddles screwed to the roof timbers.

Nails or crampets will not be allowed.

Under flat roofs, in false ceilings or where there is less than 0,9m of clearance, or should the ceilings be insulated with glass wool or other insulating material, the conduit shall be installed in such a manner as to allow for all wiring to be executed from below the ceilings.

Conduit runs from distribution boards shall, where possible, terminate in fabricated sheet steel draw boxes installed directly above or in close proximity to the boards.



1.7 SURFACE MOUNTED CONDUIT

Wherever possible, the conduit installation is to be concealed in the building work; however, where unavoidable or otherwise specified under Section 2 of this Specification, conduits installed on the surface must be plumbed or levelled and only straight lengths shall be used.

The use of inspection bends is to be avoided and instead the conduit shall be set uniformly, and inspection couplings used where necessary.

No threads will be permitted to show when the conduit installation is complete, except where running couplings have been employed.

Running couplings are only to be used where unavoidable and shall be fitted with a sliced coupling as a locknut.

Conduit is to be run on approved spacer saddles rigidly secured to the walls.

Alternatively, fittings, tees, boxes, couplings etc. are to be cut into the surface to allow the conduit to fit flush against the surface. Conduit is to be bedded into any wall irregularities to avoid gaps between the surface and conduit.

Crossing of conduits is to be avoided, however, should it be necessary, purpose-made boxes are to be provided at the junction. The finish of the boxes and positioning shall be in keeping with the general layout.

Where several conduits are installed side by side, they shall be evenly spaced and grouped under one purpose-made saddle.

Distribution boards, draw boxes, industrial switches and socket outlets etc., shall be neatly recessed into the surface to avoid double sets.

In situations where there are no ceilings the conduits are to be run along the wall plates and tie beams.

Only approved plugging materials such as aluminium inserts, fibre plugs, plastic plugs, etc., and round-head screws shall be used for fixing saddles, switches, socket outlets etc., to walls. Wood plugs and plugging in joints in brick walls are not acceptable.

1.8 CONDUIT IN CONCRETE SLABS

In order not to delay building operations the Contractor must ensure that all conduits and other electrical equipment which are to be cast in the concrete columns and slabs are installed in good time.

The Contractor shall have a representative in attendance at all times when the casting of concrete takes place.

Draw boxes, expansion joint boxes and round conduit boxes are to be provided where necessary. Sharp bends of any nature will not be allowed in concrete slabs.

Ceiling boxes shall consist of the standard type box with extension ring (50 mm

deep).

Draw and/or inspection boxes shall be grouped under one common cover plate, and must preferably be installed in passages or male lavatories.

All boxes, etc., are to be securely fixed to the shuttering to prevent displacement when concrete is cast. The conduit shall be supported and secured at regular intervals and installed as close as possible and to the neutral axis of concrete slabs and/or beams.

Before any concrete slab is cast, all conduit droppers to switchboards shall be neatly spaced and rigidly fixed.

1.9 **FLEXIBLE CONNECTIONS FOR CONNECTIONS TO STOVES, MACHINES ETC.**

Flexible tubing connections shall be of the plastic sheathed galvanized steel type.

Other types may only be used subject to the prior approval of the Employer's site Electrical Representative.

Connectors for coupling onto the flexible tubing shall be of the gland or screw-in types, manufactured of either brass or cadmium or zinc plated mild steel, and the connectors after having been fixed onto the tubing, shall be durable and mechanically sound.

NOTE: Aluminium and zinc alloy connectors will not be acceptable.

1.10 **WIRING**

Except where otherwise specified in Section 2 of the Specification, wiring shall be carried out in conduit throughout. Only one circuit per conduit shall be permitted.

No wiring shall be drawn into conduit until the conduit installation has been completed and all conduit ends provided with bushes. All conduit to be clear of moisture and debris before wiring is commenced.

Unless otherwise directed in Section 2 of the Specification or indicated on the drawings, all wiring for lighting circuits is to be carried out with 2,5mm² conductors and for the socket outlet circuits the wiring shall consist of 4mm² conductors with a 2,5mm² earth conductors. In all other instances the number and size of cables drawn into any conduit shall be as specified or shown on the drawings. Sizes and numbers of cables not specified must be determined in accordance with the "Wiring Code".

The loop-in system shall be followed throughout, and no joints of any description will be permitted.

The wiring shall be done in PVC insulated 600/1000 V grade cable to SABS 150 (tables C & H).

Where cable ends connect onto switches, fittings, etc., the end strands must be neatly and tightly twisted together and firmly secured. Cutting away of wire strands of any cable will not be allowed.



1.11 SWITCHES AND SOCKET OUTLETS

All switches and switch-socket outlet combination units shall conform to the Employer's Quality Specifications.

None other than 16 A 3-pin sockets are to be used unless other special purpose types are distinctly specified or shown on the drawings.

All light switches shall be installed at 1350mm above finished floor level and all socket outlets as directed in the Schedule of socket outlet points and special power points, which forms part of this Specification, or alternatively the height of socket outlets may be indicated on the drawings.

1.12 SWITCHGEAR

Switchgear, which includes circuit breakers, iron-clad switches, interlocked switch-socket outlet units, contactors, time switches, etc., is to be in accordance with the Employer's Quality Specifications and shall be equal and similar in quality to such brands as may be specified.

For uniform appearance of switchboards, only one approved make of each of the different classes of switchgear shall be used throughout the installations.

1.13 SWITCHBOARDS

All boards shall be in accordance with the types as specified, be constructed according to the detail or type drawings and must be approved before installation.

In all instances where provision is to be made on boards for supply authority's main switch and/or metering equipment the Contractor must ensure that all requirements of the authorities concerned in this respect are met.

Any construction, or standard type board proposed as an alternative to that specified, must have the prior approval of the department.

All busbars, wiring, terminals, etc, are to be adequately insulated and all wiring is to enter the switchgear from the back of the board. The switchgear shall be mounted within the boards to give flush to the panel. Cable end boxes and other ancillary equipment must be provided where required.

Clearly engraved labels are to be mounted on or below every switch. The wording of the labels in English is to be according the lay-out drawings or as directed by the Employer's Representative and must be confirmed on site. Flush mounted boards to be installed with the top of board 1800mm above the finished floor level.

1.14 WORKMANSHIP AND STAFF

All artisans employed on the service must be in possession of a Wireman's Certificate of Registration. Apprentices and Improvers, not in possession of this Certificate cannot be employed on the service without the prior approval of the Employer.



The workmanship shall be of the highest grade and to the satisfaction of the Employer and the Engineer

All inferior work shall, on indication by the Employer's Inspecting Officers, immediately be removed and rectified by and at the expense of the Electrical Contractor.

1.15 **EARTHING OF INSTALLATION**

The type of main earthing must be as required by the supply authority, if other than the Employer, and in any event as directed by the Employer's Representative, who may require additional earthing to meet test standards.

Installations shall be effectively earthed in accordance with the "Wiring Code" and to the requirements of the supply authority.

All hot and cold water and waste pipes are to be effectively bonded by means of 12,5mm x 1,60mm solid or perforated copper tape (not wire), clamped by means of brass bolts and nuts. The tape is to be fixed to walls by means of rounded brass screws at intervals not exceeding 150mm.

1.16 **MOUNTING AND POSITIONING OF LIGHT FITTINGS**

The Electrical Contractor is to note that in the case of board and acoustic tile ceilings, i.e. as opposed to concrete slabs, close co-operation with the Building Contractor is necessary to ensure that as far as possible the light fittings are symmetrically positioned with regard to the ceiling pattern.

The layout of the fittings as indicated on the drawings must be adhered to as far as possible, but the exact positions must be confirmed with the Employer's Representative.

Fluorescent fittings installed against concrete ceilings shall be screwed to the outlet boxes and in addition 2 x 6 mm expansion or other approved type fixing bolts are to be provided. The bolts are to be 3/4 of the length of the fittings apart.

Fluorescent fittings to be mounted on board ceilings shall be secured by means of two 40 mm x No. 10 round head screws and washers. The fittings shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed 3/4 of the length of the fitting apart.

In addition to the above, an earth conductor is to be taken from the earthing terminal on all fluorescent fittings and solidly bonded onto the conduit installation.

Incandescent fittings are to be screwed directly to outlet boxes in concrete slabs. Against board ceilings the fittings shall be secured to the branding or joints by means of two 40 mm x No. 8 round head screws.

Before any light luminaires are ordered by the Contractor, **the makes and types of these luminaires must be approved by the Engineer.**



1.17 **VARIATIONS IN EXTENT OF CONTRACT**

The Employer reserves the right to instruct the Contractor to carry out variations to the contract or in accordance with the prices quoted by the Contractor in the Price Schedule for Variations or Bill of Quantities, which ever is applicable.

For variations not provided for in the Price Schedule, or Bill of Quantities, the Employer may call on the Contractor to submit a separate written quotation.

Labour and material shall be based on items in the price schedule of the Contract, and no payment will be made for the transport of labour and material to and from the service.

The Employer, however, reserves the right to execute any alterations or additions that may be necessary with its own staff.

1.18 **EMPLOYER'S MATERIAL**

The Employer reserves the right to omit the supply of light luminaires, cooking appliances and water heaters from the contract in whole or in part, and to deliver such material to the Contractor from its own stores.

When certain materials are supplied by the Employer to the Contractor for installation, the Contractor must arrange for taking delivery and providing safe storage for these materials.

The Contractor will be held responsible for all damage to or loss of such material while it is in his custody.



**UNISA – EUCLID BUILDING
MEZZANINE LABS
FLORIDA CAMPUS**

ELECTRICAL INSTALLATION

SECTION 2 : SUPPLEMENTARY SPECIFICATION

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**UNISA – EUCLID BUILDING
MEZZANINE LABS**

FLORIDA CAMPUS

ELECTRICAL INSTALLATION

PART 2 : SUPPLEMENTARY SPECIFICATION

1. GENERAL

This Project Specification must be read as an addendum to the Technical Specification for electrical works.

This Project Specification together with the drawings describe the scope of works to be executed in terms of this documentation.

2. SCOPE OF CONTRACT

The scope of the electrical works described in detail in this document and drawings covers the supply, delivery, off-loading, storage, installation, commissioning, testing, handing over and free maintenance for the period stated in the tender document of all specified equipment and materials for the electrical installation required for the upgrading of the Mechanical and Industrial Labs within the Euclid Building at Florida Campus.

The installation shall be suitable for operation in Gauteng at an altitude of approximately 1913 metres above sea level with a maximum atmospheric temperature of 40°C and a minimum temperature of 5°C.

The onus is on the tenderer to ascertain any local conditions or peculiarities which might affect the contract, and which are not shown on the drawings.

The scope of work comprises the following:

- a) Addition of electrical circuits and switched socket outlets to existing electrical installation.
- b) Supply, deliver and installation of new supply cables to the Mechanical and Industrial labs.
- c) Supply, deliver and install new distribution boards.
- d) General electrical installations in the buildings of lighting and socket installation.
- e) Wiring routes for the data installation in the buildings.
- f) Issuing Electrical Certificate of Compliance upon completion of testing and commissioning.



3. ELECTRICITY SUPPLY

The building will be supplied through an existing 400V 3phase electrical connection obtained from the existing substation situated on the south-eastern side of both the labs.

Access to the substation shall be requested formally in writing by the contractor to UNISAs Electrical Department. All required documentation shall be provided prior to access being granted.

4. LOW VOLTAGE DISTRIBUTION AND CABLES

The details of the low voltage distribution system are provided on the plans and in the schedules.

All new low voltage cables shall be supplied with annealed copper conductors, PVC insulated, steel wire armoured and PVC sheathed.

All low voltage cables terminating in distribution boards shall be terminated with "Pratley" glands and holes for glands shall be cut with hole saws of the correct size to allow for proper tightening of the gland on the switchboard frames.

Although cables have been specified and lengths included in the Bills of Quantities, it should be noted that all cable sizes are subject to change and no cables shall be ordered without the approval of the Engineer.

5. CONDUIT

SABS approved PVC conduit will be used throughout the contract.

All conduit runs must be planned properly and must be co-ordinated with other services. Specific service routes where conduit for various services are grouped, must be used.

Unsightly and unplanned conduit installations will not be accepted and will be replaced by the contractor at his own expense.

6. LOW VOLTAGE DISTRIBUTION BOARDS

The scope of this portion of the works will be the supply, delivery, off-loading, possible storage, placing into position, erecting, testing and commissioning of all low voltage boards required for the project. As there are no 'As Built' documentation of the existing distribution boards, the electrical contractor shall provide a new circuit diagram for the proposed new electrical distribution boards in conjunction with the electrical drawings provided and ensure that all circuits are accounted for. Before any board is manufactured, the Sub-contractor shall obtain approval from the Engineer to proceed with the manufacture of that particular board.

Supply and install the distribution boards in the positions as shown on the drawings.



Five spare 25mm dia. And Seven spare 20mm dia. Conduits must be supplied from all distribution boards to roof spaces.

Three sets of factory drawings on all distribution boards must be submitted for inspection before manufacture of the distribution boards commence.

All distribution boards must be flush mounted architrave and must have doors, which must be padlockable.

The current capacity of busbars may not exceed 1,6 A/mm².

Openings into distribution boards must tie up with the installation.

The distribution boards must be placed in such a way that the Builder can build them into the walls where applicable. Special provision must be made that the distribution board tray is not damaged while being built in.

The distribution boards must be placed in the position shown on the drawings. All distribution boards must be installed level.

Apparatus and requirements by the Supply Authority are not indicated on the distribution board diagrams and schedules. It is expected of the Electrical Contractor to install all such apparatus, accessories and systems as may be required by the Supply Authority, as part of the electrical contract price.

A neutral bar associated with each bank of MCB's must be positioned below each bank of MCB's and must be wired in the same sequence as the MCB's. Not more than one conductor per connector will be accepted.

Only hydraulic-magnetic operated MCB's must be used if the new micro ranges are not used.

5 kA circuit breakers will be accepted in distribution boards.

Busbar stubs must be provided where more than one conductor terminates on equipment.

Earth conductors must be fastened with two screws and shoes to earth bars.

In all cases, boards must be large enough or supplied with suitable ventilation louvres to ensure that the temperature within the board under full load conditions, does not exceed the maximum temperature allowed so as to ensure correct tripping of all breakers and correct operation of all equipment in the board.

7. EARTHING

Earthing of the installation shall be in accordance with the Act and the earthing standard.

On the main earth bars, all equipment is to be properly earthed and bonded and the diameters of the required earth conductors are shown on the drawings. In all cases it should be noted that distribution boards are not earthed via cable armouring, but by means of separate earth conductors.

During installation of the cables and associated earth conductors, the contractor shall take note of copper theft, which is at present prevalent in the building industry, and as such he shall take all precautions to ensure that theft is minimised.

8. SLEEVES AND CONDUITS FOR OTHER SERVICES

Other services such as telephone and data systems, etc. will be supplied and installed by others. It is however a requirement of the electrical contract that all sleeves, conduits, outlet boxes, draw boxes, draw wires, cable trays, etc. required to house and distribute these other services, should be supplied and installed by the electrical contractor. The drawings show the conduits, sleeves, boxes and trays, which are required for these purposes, but it should be noted that these layouts are provisional only and will alter as the information becomes available. However, quantities based on these layouts have been included in the Bill of Quantities for the general electrical installation.

The contractor should note that he remains responsible to ensure that all conduits and sleeves are open and accessible to the other contractors. Where these are blocked, he shall be responsible to repair them.

In all cases, conduits for these other services shall terminate in 65mm dia. Round boxes in the ceiling voids.

9. PROJECT PROGRAM AND PHASING OF THE DELIVERY OF MATERIALS

In terms of the contract conditions, the electrical sub-contractor shall liaise with the principal contractor and arrange his own program in accordance with the program for the building, in order that the electrical installation of the different sections is completed when required.

It is a special requirement of this contract that the delivery of materials for which payment is required by the electrical contractor, shall be affected in an orderly manner so as to place the smallest burden on the client, with regard to payment for materials. In order to comply with this requirement, careful preplanning of material deliveries by the electrical contractor will be required and supplier's delivery times will be crucial, not only to ensure that this requirement is met, but also to ensure that the construction activities are not delayed.

In an effort to avoid disputes regarding the electrical contractor's claims for payment for material on site, it is a requirement that on a monthly basis, the material orders for that month shall be approved by the Engineer, prior to the orders being placed. It should however be noted that in no ways will this approval (or the lack thereof) be regarded as sufficient grounds for claims by the contractor for delays encountered, as a result of late delivery of materials.

10. CABLE TRAYS

Notwithstanding the requirements of Clause 20 of the Standard Specification, cable trays for electrical cables and for other services may be welded wire mesh heavy-duty cable trays used in conjunction with the unistrut metal framing system. It should be noted that the wiremesh trays shall have a pitch of 50 x 50mm with longitudinal sidewall wires at 25mm centres. Wire diameter shall be 4mm with heavy sidewall longitudinal 6mm wires. The wiremesh trays shall be hot-dipped galvanised after fabrication and the correct joiner clips, hold down saddles and screws must be used in conjunction with these trays. Prior to the ordering of the trays, as sample shall be approved by the Engineer



and in all cases, the supports shall be close enough to ensure that under no circumstances does deformation of the cable tray under the weight of the cables or other services exceed 6mm in a longitudinal direction.

It should be noted that on-site fabrication of bends reducers, etc. will only be allowed under exceptional circumstances where the standard accessories cannot be used. In all other cases, the standard accessories as supplied by the manufacturer shall be utilised.

11. LUMINAIRES

Tenderers shall allow for all luminaires listed in the Schedules and shown on the drawings.

When the term "similar and equivalent" is not used in the specification. The tenderers shall have no choice but to install the specific Luminaires as specified.

All luminaires shall be complete with lamps, indicator lamps, ballasts, chokes, control gear and all other accessories required to make the luminaires fully operative.

All luminaires shall be equipped with an earth terminal and shall be properly earthed.

The Contractor shall be responsible for the purchasing, taking delivery, storing, installation, aiming, adjustment, testing and commissioning of all luminaires specified including all necessary mounting accessories, bracket, poles, stirrups, base plates, etc. and including any necessary excavation and backfilling.

The internal wiring shall consist of flexible stranded copper conductors of not less than 0.5 mm² with suitable heat-resisting insulation to SABS 529. A terminal block shall be fitted to each luminaire.

Luminaires shall not cause radio or television interference in accordance with Posts and Telecommunications requirements.

Luminaires shall be designed to prevent excessive temperatures and components and materials shall be selected so that they are not adversely affected by the operating temperature.

The voltage rating and lamp wattage shall be clearly and indelibly marked on control gear. Ballasts shall be power factor corrected to at least 0,85 lagging and shall have a minimum circuit efficiency of 0,85. Capacitors shall comply with SABS 1250 : 1979.

Ballasts shall be silent in operation. Noise level reports, prepared by an accredited laboratory, shall be submitted for approval to the Engineer on request.

The wattage and type of lamp suitable for use in the luminaire shall be clearly marked on the base of the luminaire close to the lampholder. For incandescent luminaires, the maximum wattage of the lamp shall apply.

The contractor shall submit details of the luminaires, including photometric data, to the Engineer for approval on request.

The contractor is to note that in the case of board and acoustic tile ceilings, i.e. as opposed to concrete slabs, close co-operation with the Building Contractor is necessary



to ensure that as far as possible, the luminaries are symmetrically positioned with regard to the ceiling pattern.

Where luminaries are mounted on ceilings consisting of panels, care has to be taken that the work is performed symmetrically. Conduit work above false ceilings shall be fully coordinated in level, plan and sequence of installation with the Building and Ceilings Contractor, the Air Conditioning Contractor and any other Contractor installing services in the false ceilings.

Fluorescent fittings installed against concrete shall be screwed to the outlet boxes and in addition 2 x 6.35 mm expansion or other approved type fixing bolts are to be provided. The bolts are to be spaced 75% of the length of the fitting part.

Fluorescent fittings to be mounted on board ceilings shall be secured brandering (additional to that used for ceiling construction if necessary) using two wood screws with round heads of a size that will provide secure fixing. The fittings shall also be bonded to the circuit conduit by means of locknuts and brass bushes. The fixing screws are to be placed $\frac{3}{4}$ of the length of the fitting apart.

Incandescent fittings are to be screwed directly to outlet boxes in concrete slabs. Against board ceilings, the fittings shall be secured to the brandering or joints by means of Mo 38, 1mm x 4,88mm round head screws.

Luminaires narrower than 225mm shall be fixed at the outlet point and at two further positions. Luminaires wider than 225mm shall have four fixings exclusive of the outlet point.

Where luminaires but they shall be fixed together with brass bushes and lock nuts.

Conduits shall be screwed directly into all weatherproof luminaries and other outside lights. No outlet boxes are permitted. The conduit shall be installed in such a way that it falls from the wall to the luminaries at an angle.

The bases of all luminaries shall be installed after the first coat of paint has been applied. The luminaries shall then be left until the painting has been finished, after which the Contractor shall complete the installation and adjusting of the luminaries.

All luminaires shall be fixed and suspended in accordance with the manufacturer's requirements and as specified.

12. MAINTENANCE REQUIREMENTS

The free maintenance period of 12 months from handover is as detailed in the contract conditions and sub-contract preliminaries. It is however a further requirement of this contract that three months after handover of the installation, all faulty lamps and tubes shall be replaced by the contractor at no additional cost to the client. The replacement parts such as tubes, lamps, starters, ballasts, etc. will be supplied and delivered by the supplier of the luminaires, but the contractor shall include in his tender price for all other costs associated with this requirement.

It is a further requirement of this contract that any tenderer not situated within Gauteng, shall make arrangements with local contractors to perform the maintenance function on his behalf during the maintenance period. Details of this arrangement shall be included with the tender that is submitted by such a tenderer. It should furthermore be noted that

the maintenance requirements entail a 24-hour call-out 7 days a week during the maintenance period and in all cases, as response time of less than one hour is required.

13. LOAD BALANCING

The tenderers attention is drawn to the fact that it is imperative that the load should be evenly distributed over the three phases. Although the distribution boards may be factory wired, the onus is still on the contractor to ensure that this requirement is met.

14. ITEMS FOR APPROVAL

Where this specification refers to a specific brand name or "similar and equivalent" or "Other approved type" and alternative equipment is offered in lieu of that specified, then written approval must be obtained from the Engineer before such equipment is installed.

The right is reserved to reject any equipment which does not, in the opinion of the Engineer, conform to specification or which is of an inferior grade. Should such equipment be rejected, the contractor shall at his own expense provide for alternative equipment and tenderers are thus warned to ensure that all equipment offered is in strict accordance with the requirements of this specification.

In certain cases the contractor may be required to submit samples and where necessary, tests will be performed to establish the quality of the material offered.

15. CONTRACT ADMINISTRATION, COMPLETION, TESTING AND COMMISSIONING

15.1 QUALITY CONTROL DURING THE EXECUTION OF THE CONTRACT

Day by day inspections of the Works shall be carried out by the Contractor or his authorized representative to ensure that all work is executed in accordance with the drawings, specifications and regulations. These inspections will be monitored by the Engineer or his duly authorized representative.

If the quality of the installation suffers due to a lack of supervision, then the Engineer will appoint a site agent to ensure that a high standard of workmanship is maintained. The full cost of such a step shall be for the contractors account.

15.2 STANDARD OF WORKMANSHIP

All installation work in this contract is to be executed by qualified electricians and cable jointers in accordance with modern techniques. The Engineer shall have the right to reject any work which does not meet with his approval or which is not in accordance with standard practice.

15.3 MAINTENANCE OF AS-BUILT DRAWINGS

During execution of the contract the contractor shall update the drawings daily with all the relevant information.



At the end of the contract and prior to handover being accepted, the contractor shall prepare as-built drawings of the installation. These drawings shall be a set of the latest drawings issued by the Engineer on which the contractor shall highlight all changes. The contractor shall take great care to ensure that all underground services are shown in the correct places.

The contractor shall also issue three (3) sets of any other drawings, wiring diagrams, service and instruction manuals for equipment supplied by him and these will have to be acceptable to the Engineer prior to handover being approved.

15.4 SETTING OF PROTECTIVE DEVICES AND CONTROLS

All protective devices shall be correctly installed by the Contractor to the approval of the Engineer before the installation is energized.

Data, with regard to all commissioning documentation and diagrams of all circuits, are to be provided for approval prior to their installation. These diagrams shall include:

- Wiring diagrams
- Schematic wiring diagrams

The correct operation of all circuits is to be verified on site in the presence of the Engineer or his authorized Representative.

15.5 PRELIMINARY TESTING OF MAJOR EQUIPMENT

All items of major equipment are, where feasible, to be factory tested prior to delivery to site, and results of such tests, in a format to be agreed in advance, are to be produced before the equipment is delivered.

All such tests are to be in accordance with the relevant codes of practice, and with any other requirements as set out in this document.

15.6 COMPLETION OF INSTALLATION

Before the commencement of any test or commissioning procedures, the Contractor is to ensure that all nuts and bolts are securely fastened, and that paintwork on all items supplied has been touched up where damage has occurred.

15.7 INSPECTION AND TESTING

On completion of the entire installation or any particular section thereof, as may be decided by the Engineer, tests shall be carried out in full accordance with the current edition of the "Code of Practice for the Wiring of Premises", in the presence of the Engineer or his authorized Representative.

The Contractor should note that, where applicable, at least the following tests must be carried out:-



- Insulation test.
- Continuity test
- Loop Line Earth Impedance test
- Polarity test
- Earth Leakage Circuit Breaker test
- Earth termination test.

Any further tests as deemed necessary by the Engineer.

All instrumentation necessary for testing shall be provided by the Contractor.

The results of the above tests must be clearly recorded, signed and handed to the Engineer or his authorized Representative together with a Certificate of Compliance and any other form or forms as required by the Client.

15.8 DOCUMENTATION

The following documentation shall be required:-

- Set of schematic wiring and function diagrams.
- Operating and maintenance instructions on equipment.
- Guarantees ceded to the Client.

Once the Engineer has inspected the complete installation and satisfied himself that all testing has been completed and the contract is complete in all respects, will he issue a letter to the Client stating that first delivery has been taken. Once the retention period has expired, the installation shall be inspected for final delivery.

15.9 LABELLING

All switchgear and equipment installed in the switchboards, plus isolator boxes, cables, etc., shall be clearly labelled as indicated elsewhere in this specification and schedules.

15.10 TRAINING OF INSTITUTIONAL STAFF

Where applicable, allowance is to be made by the Contractor for the training of Institutional Staff in the setting up and operation of the various items of equipment supplied under the contract.

15.11 TESTING AND COMMISSIONING DOCUMENTATION

On completion of the testing and commissioning, the following documents shall be compiled and presented to the Engineer.

- A Certificate of Compliance and other form/s as required by the Engineer and Client.
- Drawings of the installation marked up "As Built" as described elsewhere.
- Completed set of test and commissioning sheets.

16. TELEPHONE INSTALLATION

The electrical contractor shall allow for the complete installation of all conduits, outlet boxes, G.P.O. Distribution Boards, etc., required for the installation of the telephone system as shown on the drawings.

The size of all telephone conduits are indicated on the drawings and must be installed in the slab, walls or ceiling void. Galvanised steel draw-wires shall be installed in all conduits.

End boxes must consist of a 50 mm x 100 mm x 100 mm outlet box fitted with suitable blank cover plates, flush mounted 350mm above the floor or behind the lower channel of the power skirting.

Cover plates will be installed on all the outlet boxes. The outlet points on the power skirting must be fitted with grommets.

The G.P.O. Distribution Boards must consist of a 150 mm x 600 mm x 600 mm metal box and hinged door with a 20 mm thick wooden backboard. The board must be flush mounted 1,37 m above the floor.

The contractor will be responsible for the supply and installation of the 100mm \varnothing sleeve pipe for the G.P.O. cable, which will be pointed out on site, but the principal contractor will erect the two manholes.

17. POWER POINTS

Allow for the installation of power points and equipment as listed in the schedule, indicated on the drawings and described below:

17.1 POWER TO AIR CONDITIONING INSTALLATION

The supply, installation and connecting of the air conditioning units will be part of this contract and will be done by others.

The electrical contractor will be responsible for the power points for the air conditioning installation as showed on the drawings.

Where applicable, flush mounted 30 Amp double/three pole isolator shall be provided in the power skirting within 1 m of the unit. An isolator must be provided with a cord grip to clamp the outside installation of the cable.

Each air conditioner shall be connected to a separate circuit and wired with 2 x 4 mm² PVC insulated conductors and 1 x 2,5 mm² bare conductor.



17.2 WATER HEATERS AND HAND DRYERS

The supply, installation and plumbing work shall be the responsibility of the Main Contractor.

The electrical contractor must electrically connect all water heaters and hand dryers as specified.

The conduit from the switchboard to the equipment shall terminate in a draw box with a 30 Amp double pole isolator within 1 m of the terminals. The connection from the draw box to water heaters shall be PVC insulated flexible conduit, insulated conductors and a separate earth conductor. The flexible conduit must not be longer than 600 mm.

Each water heater or hand dryer shall be connected to a separate circuit with 2 x 4 mm² PVC insulated conductors and 1 x 2,5 mm² earth conductor in a 20 mm diameter conduit.

The electrical contractor must liaise with the plumbing contractor with regard to the method of mounting the equipment, as well as the electrical connection thereof.

18. WIRING CHANNELS

Where the channels are used as wire ways for all lighting, power and plug circuits they shall be surface mounted against the concrete slab above the ceiling. Tenderers should furthermore allow fully for the crossing of other services and at each crossing the channel is to be cut and bent so as to cross the other services on a lower level above the ceiling.

19. SWITCHED SOCKET OUTLETS

All switch socket outlets must have a rating of 250 Volt 16 Amp, unless otherwise specified.

All switches must meet the requirements of SABS 163, as amended and socket outlets, SABS 164 and 1514, as amended. All the circuits for socket outlets shall be supplied with 4mm² PVC insulated stranded copper wire and 2,5mm² bare copper earth wire.

19.1 DESIGNATED SOCKET OUTLETS

All designated socket outlets must comply with the quality specification and be approved by the Engineer.

The designated switch socket outlet will be of the Red type (with a flat earth pin in the 12 O'clock position) and where applicable, for the installation in a power skirting complete with cover plate.

20. MANHOLES

The pre-cast concrete circular manholes will be of the circular type pre-cast concrete manholes, formed of 900mm ø x 300mm 20 MPA/90mm mass concrete bottom on minimum 75mm 10 MPA/90mm mass concrete bedding, with manhole shaft formed of 600mm ø internal pre-cast concrete rings with joints, sealed with bitumen putty, with and including 150mm thick 20 MPA/90mm reinforced concrete slab, with opening for and including manhole cover and frame as Type 9A set in cement mortar and sealed with tello, including all necessary holes for cables, slow bends, sleeves, etc.

21 MOUNTING HEIGHTS OF LUMINAIRES & SOCKETS

21.1 OUTDOOR

Outdoor wall mounted luminaires must be mounted at a height of 2300mm AFFL, unless stated otherwise in Part 4: Schedules.

21.2 INDOOR

Passages and Stairs

Wall mounted luminaires must be mounted at a height of 1800mm AFFL, unless stated otherwise in Part 4 : Schedules

Mounting Heights

- Recessed socket outlets in passages and open areas must be installed at 350mm AFFL.
- Recessed socket outlets in kitchens must be installed at 1350mm AFFL for fridges and 350mm above worktops for kettles, etc.
- Socket outlets mounted in power skirting will be on final ground level.
- The above mentioned mounting heights must be used, unless stated otherwise in the schedules.

22. LIGHTNING PROTECTION AND EARTHING

This item covers the supply, delivery and installation of a complete lightning conductor system and shall comply in all aspects with the requirements set in the SABS Users' Code 03 of 1985 (as amended).

IT IS SPECIFIC REQUIREMENT OF THIS CONTRACT THAT THIS PART OF THE INSTALLATION SHALL BE DONE BY SPECIALISTS WHO ARE CONVERSANT WITH THIS TYPE OF WORK.

22.1 GENERAL

The terms Contract, Works, Works or Installation shall mean the Sub-contract works as specified in this contract.

The Sub-contractor shall carry out the complete sub-contract works as indicated in and in accordance with the specification and drawings and shall provide and install all items necessary for the proper functioning of the installation, even though such items may not specifically be referred to in the specification and drawings.

The terminology in this section has the same meaning as in SABS 03 (as amended).

All materials and equipment used in the installation shall be of recent design and manufacture and of the best quality available and shall, wherever possible, carry the latest mark of the South African Bureau of Standards.

The Sub-contractor shall make allowance for all scaffolding, which he may require for the execution of his work.



22.2 DRAWINGS

22.2.1 Contract Drawings

The drawings accompanying this specification are as stipulated in part hereof. The working drawing of the Building Contract shall, however, consist of:

- The electrical drawings
- The architects' drawings
- The Structural Engineer's drawings, as applicable
- The drawings of other service installations that are relevant for co-ordination and installation purposes.
- The Engineer's drawings of other disciplines, as applicable
- The installation drawings of other Sub-contractors, where applicable.

All drawings and layouts shall be regarded as diagrammatic and all positions and dimensions shown on the drawings shall be verified on site. The Sub-contractor shall check with the Builder 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 Sub-contractor's drawings as issued by the Engineer and those in possession of the Builder, the matter shall be referred to the Engineer for clarification. No extra will be allowed for alterations or making good resulting from lack of verification.

22.2.2 Shop Drawings for Approval

A complete set of all shop drawings shall be submitted to the Engineer for approval and to demonstrate compliance with the sub-contract specification.

These drawings shall indicate the complete design of the proposed installation, including the method and materials employed in effecting earth terminations, down conductor systems, air terminations, etc.

Approval of shop drawings by the Engineer does not relieve the Sub-contractor of his responsibility for compliance with the specification, nor does it relieve him of his responsibility for errors or omissions in shop drawings.

22.3 SITE SURVEY

The Tenderer shall survey the premises prior to submitting his tender to establish, in particular, the soil resistivity and, in general, any other prevailing conditions so as to include in his tender for the entire installation.

22.4 TESTS AND INSPECTIONS

- (a) The Sub-contractor shall arrange for all necessary installation tests and inspections required.
- (b) The Sub-contractor shall attend on the Engineer during all site/equipment inspections and tests and shall advise the Engineer in good time of the proposed completion of works in order that these may be inspected prior to installation. All tests and inspections by the Engineer shall be to his satisfaction.
- (c) A permanent testing point shall be provided between each down conductor and its associated earth conductor, consisting of a recessed 100 x 100mm conduit box and coverplate engraved "Lightning Protection Test Point".

The following test records shall be submitted to the Engineer:

- Earth resistance at each test point, duly recorded on as-built drawings.
- Continuity of each trench.
- Earth resistance of main substation earth bar and clean earth bar also recorded on as-built drawings.
- Final test certificate.

22.5 COMPONENTS

22.5.1 Conductors

Where conductors are required, they shall comply with the requirements as prescribed herein after.

The conductors shall consist of 55mm PVC insulated copper stranded conductors from the earth electrode to the test link and shall be protected from subterranean level to the test link by way of a 20mm diameter galvanised conductor tube which shall be surface mounted.

The test link shall be connected to abovementioned conductor in a surface mounted 100 x 50 x 50mm box with a blind coverplate 2500mm above ground level.

22.5.2 Earthing Electrodes

Earthing electrodes shall be of the expandable vertical 16mm diameter copper bar type consisting of copper (for soft ground only) or copper covered steel or phosphor bronze. Where use is made of the copper covered steel bars the two metals shall be provided with an interlocking crystal connection between the metals in order to prevent moisture penetration. Where it is necessary to connect two metals together, a non-ferriferous, corrosion proof connecting piece shall be used to prevent moisture penetration in the joint.

Earthing electrodes shall be installed in positions as indicated on the drawings and shall be at least 1200mm long.

All trenching, drilling, blasting and backfilling, etc. will be by the Sub-contractor. Due care shall be taken to ensure that no clashes occur in respect of other external services. Should the Tenderer wish to exclude this item for any reason, this shall be specifically stated in his Tender, including the exact extent of works to be effected by others. The Sub-contractor shall still be responsible for the co-ordination in respect of other external services.

The Sub-contractor shall allow for the painting of all air termination conductors fixed to the roof the applicable colour to match the respective roof finish.

22.5.3 Alternative Conductor Material

Although this document in various places refers to aluminium or alloy conductors, the tenderer is at liberty to use alternative conductor material however, in all cases the cross-sectional area of the alternative conductors shall not be smaller than the specified values. Also, the prescriptions regarding connections to non-similar material shall be adjusted accordingly.



23. WIRING CHANNELS

127 x 76mm and 76 x 76mm wiring channels as shown on the drawings will be supplied and installed by the contractor as part of this contract.

Where the channels are used as wire ways for all lighting, power and plug circuits they shall be surface mounted against the concrete slab above the ceiling or above beams in the ceiling void.

24.TRENCHING

24.1 GENERAL

The provision of trenches for the laying of cables and the installation of and cable sleeves forms part of this contract. All cables and sleeves shall be laid at a depth of 600mm except that sleeves below the building may be laid at a lesser depth provided that the Engineer is satisfied that no damage to the sleeves can occur.

The bottom of the trenches shall be of smooth contour and shall have no sharp dips or rises which may cause tensile forces in the cable during backfilling.

Prior to cable laying, the trench shall be inspected thoroughly and all objects likely to cause damage to the cables either during or after laying shall be removed.

Where ground conditions are likely to reduce maximum current carrying capacities of cables or where the cables are likely to be subject to chemical or other damage or electrolytic action, the Engineer shall be notified before installing the cables and will then advise on the course of action to be taken.

24.2 DIMENSION OF TRENCHES

Cable trenches for one or two cables or sleeves shall not be less than 300mm wide and need not be more than 450mm wide. This dimension shall be valid for the total trench depth.

Where trenches change direction or where cable slack is to be accommodated, the contractor shall ensure that the requirements of the relevant SABS Specification regarding the bending radii of cables are met when determining trench widths.

Trench depths shall be determined in accordance with cable laying depths and bedding thickness.

24.3 BEDDING

The bottom of the trench shall be filled across the full width with a 75mm layer of suitable soil sifted through a 6mm mesh and levelled off.

Only sandy clay or loam soil with a satisfactory thermal resistivity (not exceeding 1,5 C m/W) may be used for this purpose. Sea or river sand, ash, chalk, peat, clinker or clayey soil shall not be used. The use of crusher sand is acceptable.

Where no suitable soil is available on site, the Electrical Sub-Contractor shall import fill from elsewhere and make all the necessary arrangements to do so. The cost of importing soil for bedding purposes shall be included in the unit rates for excavations.



After cable laying a further layer of bedding shall be provided to extend to 75mm above the cables.

24.4 BACKFILLING

The Electrical Sub-Contractor shall not commence with the backfilling of trenches without prior notification to the Engineer so that the cable installation may be checked. Should the Electrical Sub-Contractor fail to give a timeous notification, the trenches shall be re-opened at the Electrical Sub-Contractor cost. Such an inspection will not be unreasonably delayed.

Backfilling shall be undertaken with soil suitable to ensure settling without voids. The maximum allowable diameter of stones present in the backfill materials is 75mm.

The Electrical Sub-Contractor shall have allowed in his tender for the importation of suitable backfill material if required and such costs shall be included in the unit rates for excavations.

The backfill shall be compacted in layers of 150mm and sufficient allowances shall be made for final settlement. The Electrical Sub-Contractor shall maintain the refilled trench at his expense for the duration of the contract. Surplus material shall be removed from site and suitably disposed of.

On completion of the contract the surface shall be made good to match the surrounding area.

In the case of roadways or paved areas the excavations shall be consolidated to the original density of the surrounding material and the surface finish reinstated.

24.5 MEASUREMENT

Trench excavations shall be measured and paid for as per the unit rate included by *Tenderers* for excavations. In all cases the cost of excavations shall include the total cost of excavating, bedding, backfilling and making good.

Definitions for the different type of excavations are as follows:

- Earth: Excavations which can be performed with pick and shovel.
- Soft rock: Excavations where it is clear that compressor operated jack hammers are required to remove the rock and includes for areas where large boulders must be mechanically moved.
- Hard rock: Hard rock will be measured where excavations can only be performed by means of earth moving equipment and/or blasting



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1 PREAMBLE

The Design Report is used to document the outcomes of the Design Process or the design solution to a unique problem. This Design Report is a document which is written to document the design when it is finalised. As such, the document is finalised by the Professional Service Providers just before going out to tender (ECSA Stage 4). In order to reduce comebacks, a draft report for the Project Manager's comments should be prepared as soon as the Final Designs are accepted and signed off by all Stakeholders.

The purpose of the design report is to document the design approach adopted, norms and standards used, assumptions, design standards used and factors of safety adopted by the Professional Consultants in coming up with the final design.. The Design Report is critical and provides design information for future use and upgrades that may be required. The Design Report shall be signed by duly Professionally Registered Consultant as proposed in the bid documents for the 'design' work. Where the original proposed consultants are no longer with the project, the report must be signed by equally competent replacements who must have been accepted by CDC beforehand. The design report shall include all the disciplines making up the Professional Team except the Quantity Surveyor who will complete Basis of Estimate Template for different Estimates in the Project Lifecycle. All the disciplines shall sign off this document.

This template is one of the suite of documents developed in line with the CDC's Project Management Methodology – APM2. This template is controlled by the Centre of Excellence.

2 PROJECT SCOPE DESCRIPTION

The mechanical scope works include the following

- HVAC- air conditioning and ventilation
- Wet services- Cold water supply, hot water plants and hot water supply.
- Fire protection- Rational fire designs

3 DESIGN APPROACH AND METHODOLOGY

The air conditioning and ventilation air system will primarily be designed according to SANS10400 – building regulations and SANS204 – energy efficiency in buildings.

The following was incorporated into the design of the HVAC system:

- Components to be installed:
 - All indoor units;
 - All outdoor units;
 - Existing fresh air system will be utilized and only the fan of this system will be replaced with one of the same specification;
 - Fresh and extraction air ducting complete with connections to indoor units such as diffusers and grilles;
 - Electrical reticulation for HVAC system;
 - Condensate drainage reticulation for indoor and outdoor units;
 - Controls and instrumentation for HVAC system;

VENTILATION

Ventilation requirements

Ventilation design requirements are based on the larger of the required air changes per room per hour or the amount of people inside the room as stipulated in the building regulations SANS 10400-part O and the IUSS, where the two differs IUSS taking precedence.

Area Description	Room code	People [m ² /person)	Air change [l/h]	Air supply per Person [l/s/p]	Extraction supply
Offices	1	15	4	7.5	s
Laboratories	2	7.5	2	5	s
Toilet	3	15	10	7.5	s
General store	4	15	4	7.5	s
Boardroom	5	15	10	10	s
Staff restroom	6	15	4	7.5	s
Waiting area	7	15	8	60	e

Ventilation Fans

Artificial ventilation is provided by the ventilation air fans situated in the ceiling void and complete with attenuators, filters and weather louver. The air will be distributed through ducting to the diffusers and disk valves throughout the building to the required areas. For effective ventilation, mechanical ventilation will be supplied to all areas regardless of the openable areas provided in form of windows. Please see drawing ME-AC-3001 for more information.

DUCT SIZING

The fundamental duct design is based on a combination of constant air velocity and constant pressure drop for each section of the different ducting lines.

Airflow in various duct lines is limited to the following velocities in order to limit air friction losses and noise levels:

2 – 4 [m/s] in indoor visible ducting.

4 – 6 [m/s] in indoor ducting located in the ceiling void.

6 – 8 [m/s] in ducting located outside of the building where noise is not a concern.

Air velocity in ductwork is calculated based on the following principle:

$$Q=VA$$

With: Q = Air Flow [m³/s]

V = Air velocity [m/s]

A = Duct cross sectional area [m²]

Ground floor:

The fresh air system will stay in place as mentioned before.

For the air conditioning units on the ground floor will utilize 200ø round ducts to move air to desired locations.

Please refer to drawing ME-AC-3001 for more detailed information.

NB: The maximum height of the mezzanine of a maximum of 3.7 m and the crossbeam has been taken into consideration when the ducting has been designed.

Mezzanine floor:

On this floor level new fresh air system will be installed.

The sizing of the ducting is indicated on the detailed design drawing please refer to drawing ME-AC-3002 for the different sizes on each section.

Duct sizing calculations

Section [-]	Section length [m]	Air flow [l/s]	Round Duct Size [mm]	Hight [mm]	Width [mm]	Velocity Round Ducting [m/s]	Velocity Rectangular Ducting [m/s]	Pressure drop [Pa/m]	Sectional Pressure Drop [Pa]	Component [-]	Pressure Drop [Pa]
1.2	2.3	873.0	200	400	500	27.80	4.37	0,917	2.14	Louver	40
2.3	3.5	783.0		400	450	#DIV/0!	4.35	0,925	3.24	Attenuator	25
2.4	3.4	693.0		400	400	#DIV/0!	4.33	0,898	3.05	Filter	45
4.5	3.8	625.0		350	400	#DIV/0!	4.46	0,252	0.96	90 deg	6
		535.0		350	350		4.37			180 deg	4
		445.0		300	350		4.24			Reducer	12
		212.0		250	250		3.39			Outlet	40
7.9	2.0	130.0		200	200	#DIV/0!	3.25	0,737	1.48		
6.10	1.0	98.0		200	150	#DIV/0!	3.27	0,898	0.90		
10.11	2.5	49.0		200	150	#DIV/0!	1.63	0,252	0.63		
										Quantities	
										100	9.0
										150	15.0
										200	2.3
										250	9.7
10.14	9.7	669.0	250	400	400	13.64	4.18	1.4	#VALUE!		
14.15	2.8	521.0		350	400	#DIV/0!	3.72		0.00		
14.16	3.7	373.0		300	350	#DIV/0!	3.55	1.2	#VALUE!		
16.17	2.8	305.0		300	300	#DIV/0!	3.39		0.00		
16.18	3.7	182.9				#DIV/0!	#DIV/0!	0.6	#VALUE!		
18.19	2.8	35.2				#DIV/0!	#DIV/0!		0.00		
18.20	2.8	35.2				#DIV/0!	#DIV/0!		0.00		

Figure 1: Duct sizing calculation for the Mezzanine floor of the mechanical lab

Section [-]	Section length [m]	Air flow [l/s]	Round Duct Size [mm]	Hight [mm]	Width [mm]	Velocity Round Ducting [m/s]	Velocity Rectangular Ducting [m/s]	Pressure drop [Pa/m]	Sectional Pressure Drop [Pa]	Component [-]	Pressure Drop [Pa]
1.2	2.3	721.3	200	400	400	22.97	4.51	0,917	2.14	Louver	40
2.3	3.5	634.2		350	400	#DIV/0!	4.53	0,925	3.24	Attenuator	25
2.4	3.4	559.2		350	350	#DIV/0!	4.57	0,898	3.05	Filter	45
4.5	3.8	349.2		300	300	#DIV/0!	3.88	0,252	0.96	90 deg	6
		259.2		350	350		2.12			180 deg	4
		169.2		300	350		1.61			Reducer	12
		-63.8		250	250		-1.02			Outlet	40
7.9	2.0	130.0		200	200	#DIV/0!	3.25	0,737	1.48		
6.10	1.0	98.0		200	150	#DIV/0!	3.27	0,898	0.90		
10.11	2.5	49.0		200	150	#DIV/0!	1.63	0,252	0.63		
										Quantities	
										100	9.0
										150	15.0
										200	2.3
										250	9.7
10.14	9.7	669.0	250	400	400	13.64	4.18	1.4	#VALUE!		
14.15	2.8	521.0		350	400	#DIV/0!	3.72		0.00		
14.16	3.7	373.0		300	350	#DIV/0!	3.55	1.2	#VALUE!		
16.17	2.8	305.0		300	300	#DIV/0!	3.39		0.00		
16.18	3.7	182.9				#DIV/0!	#DIV/0!	0.6	#VALUE!		
18.19	2.8	35.2				#DIV/0!	#DIV/0!		0.00		

Figure 2: Duct sizing calculation for the Mezzanine floor of the mechanical lab

The duct sizing calculations is done by starting with the full amount of airflow and pressure required by the system. Then at each point in the system where the grills are located, the sizing of the duct decreases due to the fact that the volume carrying on is less.



PRESSURE DROPS

In addition to the fresh air volume requirements of the building, the fresh air fan will be subjected to the pressure accumulations caused by various elements in the ducting system. The first of these pressure inducing elements is created from the friction between the air flow and the inner surface of the ducting. In order to calculate the pressure loss induced by the ducting the following variables are selected from professional considerations and calculated from measurements taken:

- Equivalent diameter (D_{eq}) calculated for rectangular ducting
- Length of ducting segments (L)
- Air flow velocity (V)
- Inner surface roughness of ducting (ϵ)
- Density of Air (ρ)
- Reynolds Number (Re)
- Friction factor of ducting for specific ducting segment (f)

Once the pressure loss (friction loss) in the straight ducting is calculated the pressure loss from components in the ducting are then calculated. These components include any radius bents, Tee-connections, reductions, volume- and fire dampers located where the ducting passes through any fire walls. At the diffusing point of the ducting, the minimum pressure requirements for the fresh air diffusers located in the applicable rooms in the building must be considered as per the product information from the supplier. This ensures adequate pressure is available to introduce fresh air as per the applicable room requirements.

Finally, the fresh air fan requirements are established from total system resistance which includes the accumulated pressure loss in the ducting system. These include various components namely; fresh air filters, sound attenuators and the outdoor louvers. The fresh air fans are selected considering the fan with the highest efficiency for the required total air flow at the pressure of the single ducting run with the highest accumulated pressure losses – highest pressure load.

In order to allow for friction losses in rectangular ducting, the formula below is used to calculate the hydraulic diameter of rectangular ducting:

$$\phi_H = 1.3 \times (l \times b)^{0.625} / (l + b)^{0.25}$$

Where

- ϕ_H = Hydraulic diameter [mm]
- l = Rectangular duct length [mm]
- b = Rectangular duct width [mm]

Hence, the total pressure required by each fan can be calculated as follow:

$$P_{Total} = P_{friction} + P_{Components}$$

With: P_{Total} = Total pressure head [Pa]

$P_{Friction}$ = Pressure loss due to friction and bends in duct line [Pa]

$P_{Components}$ = Pressure loss due to filters, louvers, attenuators, etc. [Pa]

Air Distributors and Extractors (Diffusers, Grilles)

The above mentioned items will be selected and placed in such manner to ensure even distribution and extraction of air. Round plate type diffusers and disk valves with adjustable air flow are considered for air supply to meet the total fresh air requirements where indoor units are unable to meet the requirements. Square plate type grilles to be considered for the return air into system. With the installation the following will be considered:

- Direction of airflow (supply or extraction).
- Airflow.
- Operating pressure limitations.
- Connection ducting.
- Area’s sensitivity to noise.
- Air-throw area.
- Architectural requirements

Air-conditioning is designed based on the site outdoor climatic conditions as well as internal heat gains to obtain maximum thermal comfort within the building. To compensate for efficiencies and losses, a design factor of 20% is incorporated into the heat load design.

Internal heat gains

Internal heat gains are categorised as:

- Occupant heat gains
- Electrical equipment heat gains
- Lighting heat gains

Internal heat gains are allocated to each zone as follow:

Table 3 - Heat Gains

Area Description	Room Code [-]	Occupant Heat Gain [W/person]	Equipment [W/m ²]	Lighting [W/m ²]
Office space	a	145	8	12
Lobby area	b	165	6	10
Library	c	150	8	12
Board room	d	140	12	15
Training room	e	145	15	10
IT rooms	f	145	250	12
Printer area	g	155	150	10
Dining area	h	160	2	10
Laboratory	i	155	85	10
Storage	j	135	5	8
Bathroom	k	135	10	8

Internal heat gains for each room are therefore calculated by the formula bellow:

$$q_{Internal} = A \cdot \left(\frac{q_{Occupant}}{qA_{People}} + q_{Equipment} + q_{Lighting} \right)$$



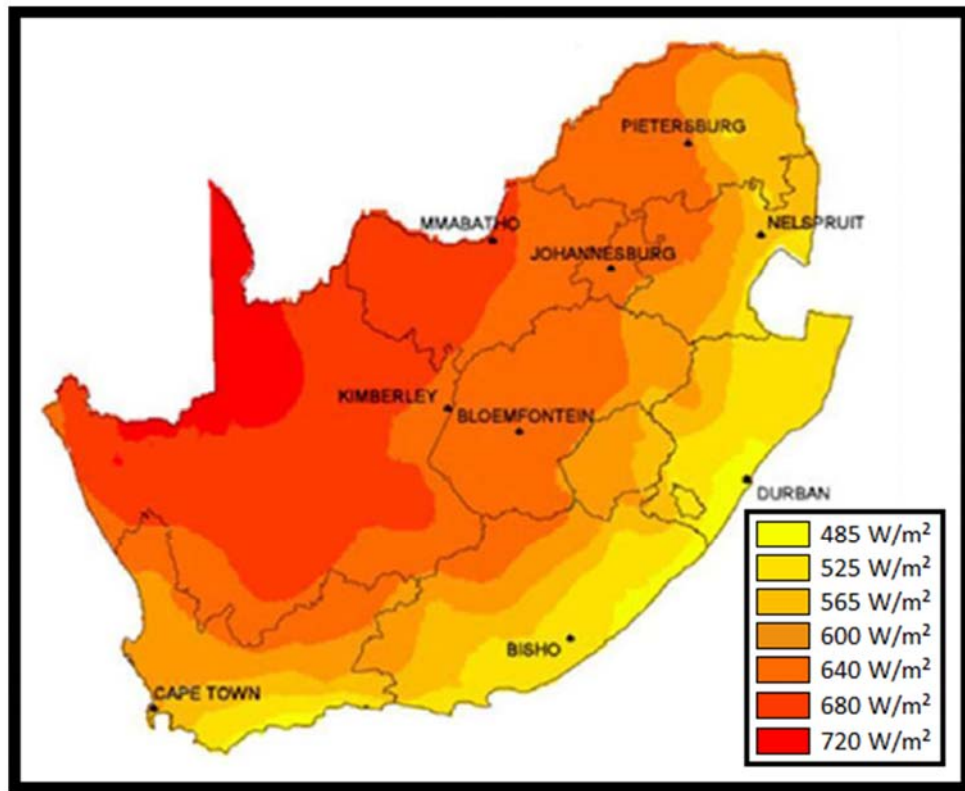
With: Q_{Internal} = Internal heat gains [W]
 Q_{Occupant} = Heat gain per occupant [W / person]
 $Q_{\text{Equipment}}$ = Equipment heat gain [W / m²]
 Q_{Lighting} = Lighting heat gain [W / m²]
 A_{People} = Room density [m² / person]
 A = Room floor area [m²]

External heat gains

Windows, especially windows exposed to direct sunlight, have a vast influence on heat gains due to solar radiation. External heat gains can be categorised as:

- Warm air mechanically introduced into the building.
- Warm air through cracks, windows and doors.
- Conduction from exterior walls and windows.
- Solar radiation

From the image below, the average solar radiation at UNISA site was considered to be 600 [W / m²].



Solar Radiation

The following base formulas were followed for external heat gains:

$$q_{\text{Air}} = (C_{p_{\text{Air}}} + C_{p_{\text{Vapour}}} \times SH) \times Q_{\text{Air}} \times \rho \times \Delta T$$

$$q_{\text{Conduction}} = k \times A \times \frac{\Delta T}{x}$$



$$q_{Radiation} = A \times SR \times SHGC \times \cos\theta$$

- With:
- q_{Air} = Heat gain from fresh air [W]
 - $q_{Conduction}$ = Conduction heat transfer [W]
 - $q_{Radiation}$ = Heat gain from solar radiation [W]
 - $C_{p, Air}$ = Specific heat of air [J / kg.K]
 - $C_{p, Vapour}$ = Specific heat of water vapour [J / kg.K]
 - SH = Specific humidity [kg_{Water} / kg_{Air}]
 - Q_{Air} = Air flow [m³ / s]
 - Rho = Density of air for given properties [kg / m³]
 - ΔT = Temperature difference [°C]
 - k = Thermal conduction coefficient [W/m.K]
 - A = Area [m²]
 - x = Medium thickness [m]
 - SR = Solar radiation [W / m²]
 - SHGC = Solar heat gain coefficient [-]
 - θ = Angle of incidence [°]

The table below indicates design parameters used for external heat gains:

Description	Value	Unit
Radiation	600	[W/m ²]
Window SHGC	0.42	[-]
Window U Value	3.339	[W/m ² /K]
External cavity wall U value	1.744	[W/m ² /K]

4 DESIGN REQUIREMENTS

- Due to the inconsistency of natural ventilation, it was proposed at the concept stage that the mechanical and industrial laboratories must utilise 100% mechanical ventilation which ensures sufficient ventilation and correct pressures in the respective rooms.
- The existing fresh air system will be utilized in the new HVAC design.



5 ASSUMPTIONS

The following assumptions were made in accordance to the design:

- The average daylight hours is 12 hours;
- Building office hours are open 10 hours;
- Operational requirement will therefore be 8 hours per day, 5 days per week for general office use; and 24 hours on days that is requested by the student to finish work.

6 DESIGN DESCRIPTION, CALCULATIONS AND DESIGN DATA

a) Overview

In the clinic area a central VRF system was selected. Energy efficiency and operational control were the determining factors in comparing between split AC system and centralised AC system. Full mechanical ventilation was designed for the clinic area.

Concept comparison		
Description	Concept 1 – Split units	Concept 2 - VRF system
Overall efficiency	Lower	Very Good
Capital expense	Lower than VRF	Higher than chilled water plant
System Control Layout	Individual control	Central control
Modular	No	Yes – Easier expandable
Construction requirements	Less effort	Relatively more effort and skill
Maintenance	Easier	More effort
Service accessibility	Easier than VRF	More service points
Condensate water	Easy exposable	Additional reticulation required
Effect of mechanical failure	Affect one room	Possible affect the whole building

b) Detailed Description

The heating and cooling load for the Laboratory building was calculated per each room which will require air conditioning. Afterwards, cassette units and hideaway units were allocated to each room based on the calculated heat load. Placement of condenser units was done in consideration of the Architectural requirements; distance of refrigerant pipe runs and aesthetics. The ventilation requirements were calculated using SANS 1 0400 part O. The air ducts were design using the velocity method and considering the available space in the ceiling void and riser service tunnel. Afterwards the pressure loses in the ducts were calculated using the darcy-weisbach equation and the size of the fan was determined which is the required flow and the static pressure.



Area Description [-]	Room Code [-]	People [m ² /person]	Air changes [1/h]	Air Supply Per Person [l/s/p]
Offices		1 15	4	7,5
waiting		2 15	8	60
Medice Store		3 15	4	7,5
Medicine Dispensery		4 15	4	7,5
General Store		5 15	4	7,5
Sterile surgical store		6 15	4	7,5
Linen Store		7 15	8	7,5
Stationery store		8 15	4	7,5
Staff restroom		9 15	4	7,5
Toilet		10 15	10	7,5
Server room		11 15	2	7,5
Procedure room		12 15	20	7,5

Calculations

FRESH AIR					MINIMUM VENTILATION (SANS 10400, 2011), WC Technical Memo 1 Industrial labs 2022				FRESH AIR PROVIDED
SPACE	AREA (m ²)	LENGTH OF VENTILATION SYSTEM	VOLUME (m ³)	No PEOPLE	MINIMUM L/s FRESH AIR PER PERSON	MINIMUM L/s FRESH AIR @7.5L/s / PERSON	MINIMUM ACHR	L/s FRESH AIR @ACHR	L/s FRESH AIR PROVIDED
Engine testing lab	31.00	2.80	86.80	9	7.5	67.50	2.00	48.22	67.50
Turbo dynamics lab	31.00	2.80	86.80	12	7.5	90.00	2.00	48.22	90.00
Machine learning lab	31.00	2.80	86.80	13	7.5	97.50	2.00	48.22	97.50
Material lab	31.00	2.80	86.80	8	7.5	60.00	2.00	48.22	60.00
Solar energy lab	28.00	2.80	78.40	5	7.5	37.50	2.00	43.56	43.56
Research lab	42.00	2.80	117.60	10	7.5	75.00	2.00	65.33	75.00
Store	14.00	2.80	39.20	3	7.5	21.00	2.00	21.78	21.78
Kitchen	8.00	2.80	22.40	2	7.5	12.00	2.00	12.44	12.44
Research x6 lab	19.00	2.80	53.20	6	7.5	45.00	2.00	29.56	45.00
Fluid mechanics lab	31.00	2.80	86.80	12	7.5	90.00	2.00	48.22	90.00
Mechanical testing	31.00	2.80	86.80	12	7.5	90.00	2.00	48.22	90.00
Heat exchange	31.00	2.80	86.80	12	7.5	90.00	2.00	48.22	90.00
Bio Diesel	22.00	2.80	61.60	12	7.5	90.00	2.00	34.22	90.00
Femal abluotion	20.00	2.80	56.00	4	20	80.00	20.00	311.11	311.11
Disabled abluotion	4.00	2.80	11.20	1	20	16.00	20.00	62.22	62.22
Male Ablutions	19.00	2.80	53.20	4	20	76.00	20.00	295.56	295.56

Figure 3: Fresh air calculations for the added system.

NB: actual lengths of the ducts and pipes can only be fully established when the design is approved and BOQ is setup for the project.



1 FIRE PROTECTION

DESIGN CONDITIONS

The fire design/conditions are based on building following criteria/classification from the;

- South African National Standard, the application of the National Building Regulations Part W Fire Installation i.e. SANs 10400 –W: 2011.
- South African National Standard, the application of the National Building Regulations Part T Fire Protection i.e. SANs 10400 –T: 2020.
- South African Standard, the application of the National Building Regulations 10400

BUILDING CLASSIFICATION

The building will need to be categorised as per the SANS requirements.

According to South African National Standard, the application of the National Building Regulations Part A: General principles and requirements i.e. SANs 10400 –A: 2011, Table 1 – Occupancy or Building Classification states the laboratory fall into category A3.

SANS 10400 –A: 2011, Table 1 – Occupancy or Building Classification

A3 rooms:

The definition for an A3 Occupancy.

- Occupancy where people take part in learning activities

- 1 person per 10 m²

DESIGN CONDITIONS

Fire extinguishers

Portable fire extinguishers for the purpose of fire fighting shall be installed in the building at a rate of 1 fire extinguisher for every 200m² in floor area. For this building classification it will be a 4.5kg DCP type fire extinguisher and as per the drawing we have allowed for the installation of five fire extinguishers within the areas that fall under our scope of work.

Features:

- Robust design
- Controlled discharge
- High quality epoxy resin finish (Weather resistant)
- Fully BS-EN3 approved
- Quality lining

Any approved portable fire fighting extinguisher shall comply with the requirements contained in SABS 810, 889 or SABS 1151 and shall be installed, maintained and serviced in accordance with SANS 0105.

Fire hose reels

Any fire hose reel installed in any building shall comply with the requirements contained in SANS543.

The minimum diameter of any pipe providing water to the fire hose reel will not be less than 25mm in diameter.

The fire hose reel will be robustly constructed and with brackets that will fix the hose reel against a wall.

This hose reel rotates on a centre pin that allows the user to unwind the fire hose reel unobstructed in case of a fire.

Distribution of hose reels to be as per drawing

The standard dimensions and characteristics of a fire hose reel are as follows:

- the fire hose reel drum is 850mm in diameter
- A guide will prevent the fire hose reel from jamming
- The maximum length of a fire hose reel is 30m
- The diameter is 20mm

Two Hose reels will be installed per floor.

The extra fire hose reels will require 60l/min at a pressure of 300 kPa.

Design notes:

The mechanical as well as the industrial labs has only one hose reel installed for each floor level, so in total 2 more hose reels will be installed in each of the labs.

Fire Signs

- All fire equipment shall be clearly marked and signposted to indicate the placement of the fire equipment.
- Such signs are to be minimum size of 190 x 190mm and are to be SABS approved photo luminescent signs.
- Every sign will be located and of such size, distinctive colour and design as to be readily visible. All signage must stand out from the surroundings and be visible.
- Externally and internally illuminated signs will be visible in both the normal and emergency lighting mode.
- Every sign required will provide evenly illuminated letters having a minimum luminance of 0.21cd/m².
- Exit signs will be illuminated by the emergency lighting facilities.

Fire signs will be visibly installed at every hose reel and fire extinguishers, and also within the building to show where those fire protection systems are installed.

HYDRANTS

There are two fire hydrants that is installed beside the two labs. If a fire outbreak occurs, a fire hydrant can assure fast water supply. The connections to the pipes are tapped with so-called hydrant wrenches and hydrant standpipes and are further connected to the fire truck. This will ensure that the building is compliant with the SANS 10400.

The extra hydrant that we need to install will need 1200L/min at pressure of 300 KPa



2 WET SERVICES

7 DESIGN APPROACH AND METHODOLOGY

Design notes:

At the time of the were no confirmation given regarding extra water connections on the ground floor, so the wet services were only designed and calculated for the mezzanine floor.

WATER SUPPLY

GENERAL

Materials, components, fittings and fixtures shall be so selected that they are suitable for the expected conditions of use.

If required, approval shall be obtained from the local authority regarding the use of specific materials or workmanship in the area concerned.

All rubber products that are in contact with potable water, such as joint rings, tap washers and flange packings, shall, in order to control the multiplication of Legionella pneumophila bacteria in water installations, be of a composition that will not promote microbiological growth. Rubber joint rings that comply with the relevant requirements of SANS 4633 and that have the dimensions, composition and hardness that are suitable for the particular application shall be deemed to be acceptable.

The use of dissimilar metals in the same below-ground installation should be avoided wherever practicable, or otherwise special measures shall be taken to prevent corrosion where pipes, pipe joints or connected fittings are of dissimilar metals.

DOMESTIC USE

Connections, sizes and types of material must be shown. Water supply for domestic use will be a separate network from a connection point provided next to the building by others.

PIPES AND FITTINGS

Where galvanized mild steel pipes and copper pipes are used in the same system, the corrosion rate of galvanized steel is usually substantially increased by the traces of copper present in the water. Thus where galvanized mild steel pipes and copper pipes are to be used in the same system especially at temperatures in excess of 60 °C, the copper pipe should be downstream of the galvanized steel pipe.

COPPER AND COPPER ALLOYS

All copper alloy components in contact with potable water shall comply with the minimum standard when tested in accordance with SANS 6509.

Notwithstanding the requirements in 1.3.1.1, the following shall be deemed to be acceptable:

- a) Copper tubes recommended in SANS 460 for the design conditions
 - b) Solders, fluxes and the method of soldering described in SANS 460 and the manufacturer's instructions; and
 - c) Copper-based fittings for copper tubes that comply with the requirements of SANS 1067-1, or SANS 1067-2, as relevant.
- 1.3.1.1. Unless the water is suitably treated, copper piping shall not be used where
- a) The water can so dissolve an undue amount of copper that an unacceptable green staining is produced, or
 - b) Copper deposits onto aluminium or zinc surfaces will promote galvanic attack.

PLASTICS

Plastic materials, plastic pipes or plastic fittings shall be selected and used in accordance with the relevant standards, and the manufacturer's recommendations.

Piping systems manufactured from polyethylene shall comply with the requirements of SANS 4427-1, SANS 4427-2, SANS 4427-3 and SANS 4427-5, and piping systems manufactured from polypropylene shall comply with the requirements in SANS 15874-1, SANS 15874-2, SANS 15874-3 and SANS 15874-5. The working pressure (for cold water temperatures exceeding 20 °C) of polyethylene and polypropylene pipes shall be rated in accordance with requirements in SANS 4427-1, SANS 4427-2, SANS 4427-3 and SANS 4427-5, and SANS 15874-1, SANS 15874-2, SANS 15874-3 and SANS 15874-5, respectively.

PVC-U pipes and fittings that comply with the requirements of SANS 966-1; PVC-M pipes and fittings shall comply with requirements in SANS 966-2 and PVC-O pipes shall comply with the requirements in SANS 16422.

For pipes and fittings, guidance on the application of the system shall be found in SANS 4427-5, SANS 15874-5, SANS 15875-5, SANS 15876-5, SANS 15877-5, SANS 22391-5 and SANS 21003-5. Any plastic piping systems for hot water use shall be class 2 (70 °C operating temperature), and shall have a minimum operating pressure (M.O.P) of 600 kPa (6 bar) at 70 °C.

VALVES

Copper alloy gate valves that comply with the requirements in SANS 776 and SANS 1857, as relevant for isolating purposes only, not for dispensing or flow control, shall be deemed acceptable.

Unless otherwise required, or does not apply, a specific isolating valve shall be provided

- a) In the case of any water meter installed outside the boundary of the premises, in the service pipe at a point not exceeding 1.5 m inside the boundary of site,
- b) In the case of any water meter installed inside the boundary of the site, at a suitable point on the consumer's side of the water meter,
- c) Where a pipe enters any building or any portion of a building in separate occupation,
- d) On any branch that serves an automatic flush valve, or a flushing valve, unless such flush valves incorporate their own isolating valves,
- e) On each side of, and next to, any backflow preventer or any combination of the backflow preventer and pressure reducing valve,
- f) On each side of, and next to, any pressure reducing valve of nominal inlet diameter exceeding 25 mm,
- g) On the upstream side of any pressure reducing valve of nominal inlet diameter not exceeding 25 mm,
- h) In such positions that, should it become necessary to drain any pipe, the total length of the pipe that has to be drained between isolating valves does not exceed 30 m, and
- i) In the case of any storage tank
 - a. On the inlet pipe next to, and upstream of, the valve controlling the supply to the tank, and
 - b. On the outlet pipe from the storage tank and next to the tank that supplies water to the water installation



THERMAL INSULATION

Pipes, fittings and components shall, when necessary, be protected against freezing. The insulation provided shall be appropriate to the minimum temperatures that can be expected in that geographical area.

All exposed pipes to and from the hot water cylinders and central heating systems shall be insulated with pipe insulation material with a thermal resistance (R-value) measuring unit ($m^2 \cdot K/W$) in accordance to the following table:

Table 1 – Minimum R-Value of pipe insulation

1	2
Internal Diameter of pipe [mm]	Minimum R-value ^a [$m^2 \cdot K/W$]
≤ 80	1,00
> 80	1,50
^a Determined with a hot surface temperature of 60 °C and ambient temperature of 15 °C	

Insulation shall:

- a) Be protected against the effects of weather and sunlight
- b) Be able to withstand the temperatures within the piping, and
- c) Achieve the minimum total R-value given in Table 1.

WATER SUPPLY QUALITY – HUMAN CONSUMPTION

Conditions unfavourable for the development of the bacterium Legionella Pneumophila shall be maintained as far as possible in installations where cold water is stored for drinking purposes, or where hot water could be used for drinking purposes. For this reason:

- a) The presence of organic matter in the water as well as the final products of metal corrosion, mainly iron, shall be kept to a minimum,
- b) Compositions of rubber used shall not form a source of nutrient for the bacterium,
- c) Storage tanks shall be regularly cleaned and kept free of contamination,
- d) Stored cold water shall be maintained at a temperature not exceeding 20 °C,
- e) In a hot water installation, there shall be no zones where water is stored at temperatures of between 25 °C and 45 °C,
- f) The stored hot water shall be maintained at a temperature of at least 55 °C and
- g) The quality of the water shall be such as to comply with SANS 241-1 and SANS 241-2.

8 DESIGN REQUIREMENTS

- Solar geysers with backup electrical element is to be used for the hot water supply of the building.
- The solar plants will be installed on the roof right next to the mezzanine floor on both sides of the building.
- New water connections to basins, toilets and tabs that is added on the mezzanine floor on top of the two labs.



1 SAFETY FACTORS ADOPTED

- The fire protection rule the deemed to satisfy rules as per SANS 10400-Part T 2020
- 20% safety factor was used on the heat load calculation.

2 NORMS AND STANDARDS USED

- SANS 10400: The Code of Practice for the building regulations issued by the South African National Standards.
- SANS 204: The Code of Practice for designing efficient systems.
- The South African Occupational Health and Safety Act. (Act 85 of 1993).
- SANS 1125: Room air conditioners.
- SANS 0139: The presentation, automatic detection and extinguishing of fire in buildings.
- SANS 0147: Refrigeration systems including plants associated with air conditioning systems.
- SANS 0173: The installation, testing and balancing of air-conditioning duct work.
- SANS193: Fire dampers.
- SANS 1238: Air conditioning ductwork.
- SANS 1424: Filters for air-conditioning and general ventilation.
- SANS 10400 –W: Fire Installation
- SANS 10400 –T: Fire Protection 2020
- SANS 10252 part 1-Water supply
- SANS 10252 part 2- Water supply

3 Conclusion:

The HVAC system will incorporate the existing fresh air system that is already installed in the labs with additions just the replace the fan. On the fire side there is to extra hose reels and 2 fire hydrants added to the building. Please keep in mind that the where not an exiting wet services indication on the architect drawings at the time of design so this is subject to change. The air-condition units that recommended for the project is mitshubishi as mentioned in the concept design due to a good standing record and high quality products that they supply.

4 ANNEXURES

- i. Design Drawings
- ii. Mitsubishi preliminary quote

Refer to the attached drawings and BOQ for detailed scope definition:

Architectural:

0000 – UNISA Labs – Site Plan – Rev A
 1000 – UNISA Labs – Ground Floor & Mezzanine Level Plan – Rev B (Hot Water Comment)
 1000 – UNISA Labs – Ground Floor & Mezzanine Level Plan – Rev B
 1001 – UNISA Labs – Ground Floor & Mezzanine Level Plan – Electrical Layouts
 1003 – UNISA Labs – Ground Floor & Mezzanine Level Plan – HVAC Layouts
 1004 – UNISA Labs – Mezzanine Level Plan – Fire Layout – Rev A
 1005 – UNISA Labs – Mezzanine Level Plan – Water Reticulation – Rev A
 2000 – UNISA Labs – Sections & Elevations – Rev B
 5000 – UNISA Labs – Doors, Gate & Window Schedules – Rev B

Interior Architectural:

A-Series Drawings (Floor & Wall Finishes):

A002 – UNISA Labs – Mezzanine Level – Floor & Wall Finishes
 A012 – UNISA Labs – Floor & Wall Design
 A014 – UNISA Labs – Renders

C-Series Drawings (Ceilings):

C001 – UNISA Labs – Ceiling & Electrical Plan
 C002 – UNISA Labs – Ceiling Structure

G-Series Drawings (Joinery):

G001 – UNISA Labs – Furniture Plan
 G002 – UNISA Labs – Joinery Drawings
 G003 – UNISA Labs – Timber Screen Detail

Structural:

STR 10 – Foundation Floor Layout
 STR 11B – Mezzanine Floor Layout
 STR 12A – Concrete Roof Layout
 20221107 – BS – Strip Footing – Unisa
 Dwg Issue – UNISA – Structural

Electrical:

0001 – LL_Lighting
 0002 – PL_Power
 0003 – TRK_Trunking

Mechanical:

Ground Fire – Layout1
 Ground HVAC
 Mezz_Fire
 Mezz_HVAC Fresh Air
 Mezz_HVAC Gas Lines
 Mezz_Water – Layout1

