

# **PROJECT SPECIFICATION**

## **Rehabilitation of Police Facilities Specification**



UNDP Libya

## 2.1.1 DEMOLITION

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### 2.1.1.1 Interpretation

#### Demolished materials classes

Salvaged for re-use: Demolished materials scheduled for re-use in the works.

Salvaged for disposal: Demolished materials scheduled for re-use elsewhere.

Demolished for re-use: Non-scheduled demolished materials proposed by contractor for re-use in the works.

Demolished for removal: Other demolished materials.

### 2.1.1.2 Inspection

#### Notice

Give sufficient notice so that inspection may be made of the following:

Adjacent structures before commencement of demolition.

Propping of structures prior to demolition works.

Structure after stripping and removal of roof coverings and other external cladding.

Underground structures after demolition above them.

## 2.1.2 PRODUCTS

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### 2.1.2.1 Demolished Materials

#### Demolished Materials

Ownership: Ownership of demolished materials is described in the **Demolished Materials Classes** table.

#### *Demolished Materials Classes Table*

Class	Ownership
Salvaged for reuse	Principal/Proprietor
Salvaged for disposal	Principal/Proprietor
Demolished for re-use	Principal/Proprietor
Demolished for removal	Contractor

Reuse: If it is proposed to reuse demolished materials in the works, submit proposals.

Salvage: Recover without damage materials to be salvaged, for reuse in conformance with the **Salvaged Materials for Reuse Schedule** or for disposal in conformance with the **Salvaged Materials for Disposal Schedule**.

Removal: Remove from the site demolished materials which are the property of the contractor. Do not burn or bury on site.

Transit: Prevent spillage of demolishing materials in transit.

## 2.1.3 EXECUTION

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### 2.1.3.1 Support

#### Temporary Support

If temporary support is required, certification for its design and installation is required from a professional engineer engaged by the contractor.

Until permanent support is provided, provide temporary support for sections of existing buildings which are to be altered and which normally rely for support on work to be demolished.

Support excavations for demolition of underground structures. Provide supports to adjacent structures where necessary, sufficient to prevent damage resulting from the works.

#### Permanent Supports

If permanent supports for adjacent structures are necessary and are not described, give notice and obtain instructions.

### **2.1.3.2 Protection**

#### Encroachment

Prevent the encroachment of demolished materials onto adjoining property, including public places.

#### Weather Protection

If walls or roofs are opened for alterations and additions or the surfaces of adjoining buildings are exposed, provide temporary covers to prevent water penetration. Provide covers to protect existing plant and equipment and materials intended for re-use.

#### Dust Protection

Provide dust-proof screens, bulkheads and covers to protect existing finishes and the immediate environment from dust and debris.

#### Security

If a wall or roof is opened for alterations and additions, provide security against unauthorised entry to the building.

### **2.1.3.3 Demolition**

#### Explosives

Do not use explosives in the demolition process.

### **2.1.3.4 Hazardous Materials**

#### General

General: Hazardous materials that have already been identified are set out in the **Identified Hazardous Materials Schedule**.

#### Hazardous Materials

General: Give notice immediately hazardous materials or conditions are found, including the following:

- Asbestos or material containing asbestos.
- Flammable or explosive liquids or gases.
- Toxic, infective or contaminated materials.
- Radiation or radioactive materials.
- Noxious or explosive chemicals.
- Tanks or other containers which have been used for storage of explosive, toxic, infective or contaminated substances.

### **2.1.3.5 Completion**

#### Notice of Completion

Give at least 3 working days' notice of completion of demolition so that adjacent structures may be inspected following completion of demolition.

Make good any damage arising out of demolition work. Obtain written acceptance from the owner of each adjoining property of completeness and standard of making good.

#### Temporary Support

General: Clear away at completion of demolition.

## **2.2 WINDOWS AND WINDOW HARDWARE**

### **2.2.1 GENERAL**

#### **2.2.1.1 Interpretation**

##### Definitions

For the purposes of this work section windows also includes louvres, either vertical or horizontal, set into frames.

#### **2.2.1.2 Inspection**

##### Notice

Give sufficient notice so that inspection may be made of the following:

- Openings prepared to receive windows (where windows are to be installed in prepared openings).
- Fabricated window assemblies delivered to the site, before installation.
- Commencement of window installation.

### **2.2.2 PRODUCTS**

#### **2.2.2.1 Louvre assemblies**

##### General

Provide louvre blades mounted in a surround frame and able to withstand the wind pressure for that location without failure or permanent distortion of blades, and without blade flutter.

##### Adjustable louvres

Provide louvre blades clipped into holders which pivot, linked together in banks, each bank operated by an operating handle incorporating a latching device, or by a locking bar.

##### Screens

Provide metallic coated steel wire mesh screens behind louvres to prevent the entry of birds, rodents and wind-blown leaves and papers.

#### **2.2.2.2 Insect screens**

##### Aluminium Framed Screens

Provide insect screens with mesh frame channel. Provide an extended frame section where necessary to adapt to window opening gear.

Mesh: Fix the mesh into the frame channel with a continuous resilient gasket, so that the mesh is taut and without distortion.

##### Fixed Screens

Provide fixed screens to the window frames with a clipping device which permits removal for cleaning.

##### Hinged Screens

Hinge at the side to give access to opening sash.

#### Sliding Screens

Provide a matching aluminium head guide, sill runner, and frame stile sections for screens not part of the window frame.

Hardware: Nylon slide runners and finger pull handle.

### **2.2.2.3 Security Window Grilles**

#### General

Provide security grilles in accordance with the drawings or proprietary metal security grille screens, fixed to the building structure with tamper resistant fastenings.

### **2.2.2.4 Window Hardware**

#### Hardware

Provide hardware of sufficient strength and quality to perform its function, appropriate to the intended conditions of use and climate and fabricated with fixed parts firmly joined.

## **2.2.3 EXECUTION**

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### **2.2.3.1 INSTALLATION**

#### General

Install windows so that the frames:

- Are plumb, level and straight within acceptable building tolerances.
- Are fixed or anchored to the building structure to resist the wind loading.
- Will not carry any building loads, including loads caused by structural deflection.
- Allow for thermal movement.

#### Flashing and Weathering's

Install moulds, sealant and cement pointing as required so that water is prevented from penetrating the building between the window frame and the building structure.

#### Fixing and Fasteners

Materials: Use materials compatible with the item being fixed and of sufficient strength, size and quality to perform their function.

Concealed fixings: Provide a corrosion resistant finish.

Exposed fixings: Match exposed fixings to the material being fixed.

Support: Provide appropriate back support (for example blocking and backing plates) for hardware fixings.

Window fastener spacing (nominal): 600 mm.

Window fasteners: Conceal fasteners where possible.

Packing: Pack behind fixing points with durable full width packing.

Prepared masonry openings: If fixing timber windows into existing prepared openings with fastenings through the frame face, make the fastener heads finish below the surface and fill the hole for a smooth surface finish.

#### Joints

Make accurately fitted tight joints so that neither fasteners nor fixing devices such as pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

## Operation

Ensure moving parts operate freely and smoothly, without binding or sticking and are lubricated.

## Supply

Deliver window hardware items, ready for installation, in individual complete sets for each window.

In a separate dust and moisture proof package labelled for the specific window.

Including the necessary templates, fixings and fixing instructions.

Refer to the drawings and **Window, Louvre and Security grille/shutter schedules** for details of windows.

Refer to the **Window hardware schedule** for details of window hardware.

## **2.2.4 COMPLETION**

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### **2.2.4.1 Cleaning**

The Contractor is to clean all frames, glass, hardware at completion. Any damage to frames, or broken glass is to be repaired or replaced to the satisfaction of the Engineer.

### **2.2.4.2 Adjustment**

Leave the hardware properly adjusted with working parts in working order and lubricated where appropriate.

## **2.3 Doors and door hardware**

### **2.3.1 General**

#### **2.3.1.1 Interpretation**

##### Definitions

For the purposes of this work section the definitions given below apply.

- Door frame: Includes door trims.
- Door set: An assembly comprising a door or doors and supporting frame, guides and tracks including the hardware and accessories necessary for operation.

Fire-door set: A door set which retains its strength and limits the spread of fire.

Smoke-door set: A door set which restricts the movement of smoke.

- Flush door: A door leaf having two flat faces which entirely cover and conceal its structure. It includes doors with cellular and particleboard cores.
- Joinery door: A door leaf having stiles and rails, framed together. A joinery door may also incorporate glazed panels.

Louvered door: A joinery door in which the panel spaces are filled in with louvre blades.

#### **2.3.1.2 Inspection**

##### Notice

Give sufficient notice so that inspection may be made of the following:

Door frames standing in place before building in to brickwork.

Door frames installed before fixing trim.

#### **2.3.1.3 Submissions**

##### Samples

Submit samples of all hardware items for approval by the Engineer before use in the works.

##### Subcontractors

Automatic sliding door assemblies: Submit names and contact details of proposed supplier and installer.

##### Product Warranties

Automatic sliding door assemblies: Submit a warranty from the supplier and installer for the system and its installation, for a period of at least twelve months from the date of completion.

Hardware: Submit the warranties offered by the manufacturer for the hardware items provided in the works.

### Keys

Key codes: Submit the lock manufacturer's record of the key coding system showing each lock type, number and type of key supplied, key number for re-ordering, and name of supplier.

Keys: For locks keyed to differ and locks keyed alike, verify quantities against key records, and deliver all keys and records to the Engineer at completion.

## **2.3.2 Products**

### **2.3.2.1 Frames**

#### Aluminium Frames

To be assembled from aluminium sections, including necessary accessories such as buffers, strike plates, fixing ties or brackets, and suitable for fixing specified hardware.

#### Timber Frames

To be constructed with best quality timber. Obtain approval from the Engineer for the timber selection before use. Construct as shown on the drawings and ensure that all joints are securely made to avoid distortion of the frame in use.

#### Steel Frames

To be folded from metallic-coated steel sheet sections, joints to be continuously welded, including necessary accessories such as buffers, strike plates, spreaders, fixing ties or brackets, and suitable for fixing specified hardware.

Finish: Grind the welds smooth, prepare and paint the welded joints with primer. Then prime the entire frame.

Hardware and accessories: Provide for fixing hardware including hinges and closers, using 4 mm back plates inside the frame. Screw fix the hinges into the back plates.

Base metal thickness:

General:  $\geq 1.1$  mm.

Fire rated door sets:  $\geq 1.4$  mm.

Security door sets:  $\geq 1.6$  mm.

### **2.3.2.2 Doors**

#### Flush Doors

Cellular core flush doors:

Provide a sub frame of 25 mm minimum width timber around openings for louvres and glazing.

Provide additional material to take hardware and fastenings.

Cut outs: If openings are required in flush doors (e.g. for louvres or glazing) make the cut outs not closer than 120 mm to the edges of the doors.

Solid core flush doors:

Core of timber strips laid edge to edge, fully glued to each other and to facings each side of no less than two sheets of timber veneer.

Single thickness of moisture resistant general purpose particleboard.

- Refer to drawings and **Flush Doors** schedule for details.

#### Joinery Doors

Fabricate joinery doors as shown on the drawings and in the **Joinery Doors** schedule.

#### PVC Doors

Fabricate PVC doors as shown on the drawings and in the **PVC Doors** schedule.

### Construction

Form rebates to suit standard rebated door hardware.

Louvre grilles: Construct by inserting the louvre blades into a louvre frame, and fix the frame into the door.

### Double doors

Provide rebated meeting stiles unless the doors open in both directions. Chamfer square edged doors to prevent binding between the leaves.

#### **2.3.2.3 Door sets**

##### Automatic Sliding Door Assemblies

Provide auto sliding door assemblies in accordance with the **Automatic door schedule**.

##### Toughened Glass Door Assemblies

Provide toughened glass door assemblies with matching concealed hinges and patch fittings as appropriate. Ensure that all glass edges are protected during installation and polish on completion.

##### Fire-Resistant Doors etc

Provide fire resistant doors and frames as matched sets for door openings required to have a fire rating. Refer to the **Fire and smoke resistant doors etc schedule** for details.

Provide copies of test certificates from recognised authorities proving the performance of the door sets.

##### Smoke-Resistant Door sets

Provide smoke resistant doors and frames as matched sets for door openings required to have a smoke stopping capability. Refer to the **Fire and Smoke Resistant Door sets** schedule for details.

Provide copies of test certificates from recognised authorities proving the performance of the door sets or seals to frames.

##### Security Screen Door sets

Provide security screen door sets in accordance with the **Security Screen Doors** schedule.

#### **2.3.2.4 Ancillary materials**

##### Nylon brush seals

To be dense nylon bristles locked into galvanized steel strips and fixed in a groove in the edge of the door or in purpose-made anodised aluminium holders fixed to the door

##### Pile weather strips

To be polypropylene or equivalent pile and backing, low friction silicone treated, ultra-violet stabilised.

##### Door Seals

To be proprietary items as identified in Schedules and to approval of Engineer.

#### **2.3.2.5 Hinges**

##### Butt hinge sizes

Refer to **Hinge Table A** and **Hinge Table B** in which length (l) is the dimension along the knuckles, and width (w) is the dimension across both hinge leaves when opened flat.

Steel, stainless steel, brass, bronze butt hinges for timber doors in timber or steel frames: To **Hinge table A**.

Aluminium hinges for aluminium doors, or for doors of other materials in aluminium frames: To **Hinge Table B**.

##### Hinge materials

Aluminium hinges: High tensile aluminium with fixed stainless-steel pins in nylon bushes, and with nylon washers to each knuckle joint.

Doors fitted with closers: Provide low friction bearing hinges.

##### Hinge Pins

Exterior or security doors opening out: Provide fixed pin hinges.



*Hinge Table A*

1 2	Nominal hinge size l x w x t (mm)	3 Door leaves not exceeding any of the following		
		4 Mass (kg)	5 Width (mm)	6 Thickness (mm)
	70 x 50 x 1.6	16	620	30
	85 x 60 x 1.6	20	820	35
	100 x 75 x 1.6	30	920	40
	100 x 75 x 2.5	50	920	50
	100 x 75 x 3.2	70	1020	50
	125 x 100 x 3.2	80	1220	50

*Hinge Table B*

7 8	Nominal hinge size l x w x t (mm)	9 Door leaf not exceeding mass (kg)	10 Minimum construction	
			11 Knuckles	12 Screws/hinge leaf
	100 x 70 x 3	30	3	3
	100 x 80 x 3.5	50	5	4

#### Number of Hinges

Provide 3 hinges for doors up to 2200 mm high, and 4 for door leaves between 2200 mm and 3000 mm high.

#### Wide Throw

If necessary, provide wide throw hinges to stop doors binding on obstacles such as nibs or deep reveals.

### **2.3.2.6 Door Hanging Systems**

#### General

Provide sliding door tracks in conformance with the schedules.

### **2.3.2.7 Locks and Latches**

#### General Door Hardware

Provide hardware of sufficient strength and quality to perform its function, appropriate to the intended conditions of use and climate and fabricated with fixed parts firmly joined.

#### Bolts

Provide bolts including barrel bolts and tower bolts with associated hardware, including lock plates, ferrules or floor sockets.

#### Furniture

Provide lock and latch furniture suitable for use with the lock or latch to which it is installed with the corresponding level of performance.

#### Strike Plates

Use strike plates provided with the locks or latches.

#### Fire Rated Door closers

Provide closers tested and certified for use as components of fire door assemblies.

#### Door Controllers Performance

Provide door controllers, including door closers, floor or head spring pivots which are suitable for the door type, size, weight and swings required and the operating conditions, including wind pressure.

### **2.3.3 Execution**

### 2.3.3.1 Frames

#### General

Install doors so that the frames:

Are plumb, level and straight within acceptable building tolerances.

Are fixed or anchored to the building structure to resist the wind loading.

Will not carry any building loads, including loads caused by structural deflection.

Allow for thermal movement.

#### Flashing and Weathering's

Install moulds, sealant and cement pointing as required so that water is prevented from penetrating the building between the door frame and the building structure.

#### Aluminium frames

Building in to masonry: Screw galvanized steel brackets twice to jambs and build in.

Fixing to masonry openings: Use proprietary expansion anchors and screw through jambs at each fixing.

#### Frame Fixing

Brackets: Metallic-coated steel:

Width:  $\geq 25$  mm.

Thickness:  $\geq 1.5$  mm.

Jamb fixing centres:  $\leq 600$  mm.

#### Fixing and Fasteners

Materials: Use materials compatible with the item being fixed and of sufficient strength, size and quality to perform their function.

- Concealed fixings: Provide a corrosion resistant finish.
- Exposed fixings: Match exposed fixings to the material being fixed.

Support: Provide appropriate back support (for example blocking and backing plates) for hardware fixings.

Packing: Pack behind fixing points with durable full width packing.

Prepared masonry openings: If fixing timber door frames into existing prepared openings with fastenings through the frame face, make the fastener heads finish below the surface and fill the hole for a smooth surface finish.

#### Joints

Make accurately fitted tight joints so that neither fasteners nor fixing devices such as pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

#### Operation

Ensure moving parts operate freely and smoothly, without binding or sticking and are lubricated.

#### Supply

Deliver door hardware items, ready for installation, in individual complete sets for each door.

- In a separate dust and moisture proof package labelled for the specific door.
- Including the necessary templates, fixings and fixing instructions.
- Refer to the drawings and **Flush doors, Joinery doors, PVC doors, Security screen doors, Fire and smoke resistant door set** and **Automatic door schedules** for details of frames, doors and hardware.

### 2.3.4 Completion

#### 2.3.4.1 Cleaning

The Contractor is to clean all frames, doors, glass, hardware at completion. Any damage to frames and doors, or broken glass is to be repaired or replaced to the satisfaction of the Engineer.

#### **2.3.4.2 Adjustment**

Leave the hardware properly adjusted with working parts in working order and lubricated where appropriate.

### **2.4 Joinery**

#### **\* General**

#### **2.4.1.1 Tolerances**

##### Responsibilities

Fabricate and install joinery items. Items to be undamaged, plumb, level, straight and free of distortion and to the **Tolerances** table.

##### *Tolerances Table*

<b>Property</b>	<b>Tolerance criteria</b>
Plumb and level	2 mm in 800 mm
Offsets in flush adjoining surfaces	< 1 mm
Alignment of adjoining doors	< 1.5 mm

#### **2.4.1.2 Inspection**

##### Notice

Give sufficient notice so that inspection may be made of the following:

Shop fabricated or assembled items ready for delivery to the site.

Site erected assemblies on completion of erection.

#### **2.4.1.3 Submissions**

##### Samples

Submit samples to the *Sample Table* for approval by the Engineer.

##### *Sample Table*

<b>Description</b>	<b>No. of samples</b>
Each type of board to be used complete with finish and edge stripping	2
Typical item of hardware indicating each finish	2
Stone benchtop indicating range of colours	2
Timber balustrade section	1
The finish to all stainless-steel items	2
Complete timber bench cupboard door, including hardware	1
Complete drawer front, including hardware	1

#### **\* Products**

#### **2.4.1.4 Joinery Materials and Components**

##### Joinery Timber

- All joinery timber shall be to approval of the Engineer.

##### Plywood

All plywood shall be to approval of the Engineer.

#### Decorative Overlays

Timber veneer or laminate to approval of the Engineer.

Thickness (minimum):

- For horizontal surfaces fixed to a continuous background: 1.2 mm minimum.
- For vertical surfaces fixed to a continuous background: 0.8 mm.
- For edge strips: 0.8 mm.

#### Stone Facings

Provide stone slabs to benchtops within the visual range of the approved samples.

#### Timber Veneers

Provide veneers falling within the visual range of the approved samples.

### **2.4.1.5 JOINERY ITEMS**

#### General

Provide materials noted on drawings as follows:

- Joinery components and their location, indicative construction details, trims, materials, dimensions and thicknesses, and finishes shall be as detailed.
- All dimensions noted on drawings shall be confirmed on site before construction of the joinery.
- Finishes selections and hardware are noted in the **Joinery Fixtures** schedule.

### **2.4.1.6 Kitchen Assemblies**

#### Plinths

Material: Construct from exterior grade general purpose plywood unless already in place as a concrete plinth.

Thickness: 16 mm.

Fabrication: Form up with front and back members and full height cross members at not more than 900 mm centres.

Finish: Decorative laminated sheet or ceramic/ stone tile finish unless otherwise specified.

Installation: Fix to floor and secure to wall to provide level platform for carcasses.

#### Carcasses

Material: Select from the following:

- Melamine overlaid high moisture resistant particleboard.
- Approved solid timber sections.

Thickness: 16 mm minimum.

Joints: Select from the following:

- Proprietary mechanical connections.
- Screws and glue.

Shelves: Support on battens or fix directly into grooves in side walls of joinery units.

Finish: Decorative laminated sheet or solid timber finish.

Fasteners: Conceal with finish.

Installation: Secure to walls at not more than 600 mm centres.

#### Drawer Fronts and Doors

Material: Refer to the drawings for specific details of joinery or select from the following:

- Melamine overlaid high moisture resistant particleboard.

- Approved solid timber sections with or without inset glass panels.
- Metal grille or sheet metal panels fixed over timber frames

Thickness: 16 mm minimum.

Maximum door size: 2400 mm high, 900 mm wide, 1.5 m<sup>2</sup> on face.

Finish: Decorative laminated sheet, solid timber finish or paint.

#### Drawer Backs, Sides and Bottoms

Material: Select from the following:

- Melamine overlaid high moisture resistant particleboard.
- Approved solid timber sections.

Thickness: 12 mm minimum.

Finish: Decorative laminated sheet or solid timber finish.

#### Laminated Benchtops

Material: High moisture resistant particleboard.

Benchtop thickness: 33 mm.

Finish: Decorative laminated sheet.

Exposed edges: Extend laminate over shaped nosing, finishing > 50 mm back on underside or provide solid timber edge trim.

Installation: Fix to carcass at least twice per 600 mm length of benchtop.

Joint sealing: Clamp with proprietary mechanical connectors to ensure high quality connection between benchtop sections. Ensure joints in benchtops are clear of sinks to avoid water damage to joint.

#### Stone or Concrete Benchtops

Material:

- Thickness is to be minimum of 40mm unless noted otherwise on the drawings.
- Concrete benchtops may have a polished finish or be covered with ceramic tiles.

#### Splashback:

- Material is identical to benchtop unless noted otherwise in the **Joinery fixtures schedule**.
- Thickness is to be 16mm for high moisture resistant particleboard with laminate finish.
- Thickness is to be 20mm minimum for stone.
- Thickness is to be 40mm minimum for concrete. Alternatively use ceramic tile splashback for concrete benchtops.
- Waterproof silicone sealant is to be used as a continuous seal between the benchtop and splashback.

#### Drawer and Door Hardware

Hinges, drawer runners, door handles and locks are to be to the approval of the Engineer.

#### **2.4.1.7 Timber Balustrades**

Provide materials for the approval of the Engineer before installation. Ensure all dimensions are checked on site before construction starts. Refer to BOQ and drawings for extent of work.

#### **\* Execution**

#### **2.4.1.8 Joinery**

##### General

Joints: Provide materials in single lengths whenever possible. If joints are necessary make them over supports.

Framing: Frame and trim where necessary for openings, including those required by other trades.

### Accessories and Trim

Provide accessories and trim necessary to complete the installation.

### Fasteners

Visibility: Do not provide visible fixings except in the following locations:

- Inside cupboards and drawer units.
- Inside open units.

Visible fixings: Where fastenings are unavoidable on visible joinery faces, sink the heads below the surface and fill the sinking flush with a material compatible with the surface finish. In surfaces which are to have clear or tinted timber finish provide matching wood plugs showing face (not end) grain. In surfaces which are to have laminate finish provide proprietary screws and caps finished to match.

Fixings: Screws with washers into timber or steel framing, or masonry anchors to brickwork.

### Adhesives

Provide adhesives to transmit the loads imposed and to ensure the rigidity of the assembly, without causing discolouration of finished surfaces.

### Finishing

Edge strips: Finish exposed edges of sheets with edge strips which match sheet faces or use solid timber trims as noted on the drawings.

Matching: For surfaces which are to have clear or tinted finish, arrange adjacent timber pieces to match the grain and colour.

Hygiene requirements: To all food handling areas and voids at the backs of units to all areas, seal all carcass junctions with walls and floors, and to cable entries, with silicone sealant for vermin proofing. Apply water resistant sealants around all plumbing fixtures and ensure the sealants are fit for purpose.

## **2.4.1.9 Delivery and storage**

### General

Deliver joinery units to site in unbroken wrapping or containers so that its moisture content is not adversely affected. Do not store in areas of wet plaster. Keep storage to a minimum by delivering items only when required for installation.

Examine joinery units for completeness and repair defects before installing in place.

### Background

Clean all background surfaces that will be permanently concealed behind joinery before installing in place.

## **2.4.1.10 Timber Balustrades**

### General

Provide a balustrade to the stair and landing, consisting of posts, handrail, infill panels, and associated mouldings as noted in the BOQ and drawings.

## **2.4.1.11 Completion**

### Cleaning

Temporary coatings: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

General: Remove all dust, marks and rubbish from all surfaces and internal spaces. Clean and polish all surfaces such as solid timber, anodised or painted metals, glass, stone, concrete, ceramic tiles and laminates.

Refer to the **Joinery** fixtures schedule for locations, type and finishes of joinery items.

## **2.5 Plastering**

### **2.5.1 General**

### **2.5.1.1 Interpretation**

#### Abbreviations

For the purpose to this work section the abbreviations given below apply.

CRF: Cement render – finish.

CRM: Cement render – medium.

CRS: Cement render – stronger.

CRW: Cement render – weaker.

LF: Lime felting render- weaker.

GPM: Gypsum render - medium

GPF: Gypsum plaster – finish.

### **2.5.1.2 Inspection**

#### Notice

Give sufficient notice so inspection may be made of the following:

Backgrounds immediately before applying base coats.

Finish treatments before decoration.

### **2.5.2 Products**

#### **2.5.2.1 Materials and components**

##### Accessories

Beads: To be metal proprietary sections manufactured to be fixed to backgrounds and/or embedded in the plaster to form and protect plaster edges and junctions.

##### Aggregates

Sand: To be fine, sharp, well-graded sand with a low clay content and free from efflorescing salts.

##### Bonding products

To be proprietary products manufactured for bonding cement-based plaster to solid backgrounds.

##### Cement

Cement shall conform to the requirements of ASTM specification C-150 Type 1 or similar approved standard for normal Portland cement.

##### Colouring Products

To be proprietary products manufactured for colouring cement plaster.

Integral pigment proportion: 5% by mass of cement.

##### Curing Products

To be proprietary products manufactured for use with the plaster system.

##### Gypsum Plaster

To be a proprietary product containing calcium sulphate hemihydrate with additives to modify setting.

##### Lime

Confirm source of Lime with Engineer to ensure highest quality Lime is used in the mortar. Protect from damage on site and store minimum 300mm above ground in waterproof storage facility.

Preparing lime putty:

Using hydrated lime: Add lime to water in a clean container and stir to a thick creamy consistency. Leave undisturbed for at least 16 hours. Remove excess water and protect from drying out.

Using quicklime: Run to putty as soon as possible after receipt of quicklime. Partly fill clean container with water, add lime to half the height of the water, then stir and hoe ensuring that no lime remains exposed above the

water. Continue stirring and hoeing for at least 5 minutes after all reaction has ceased, then sieve into a maturing bin. Leave undisturbed for at least 14 days. Protect from drying out.

### Mixes

Select a mix ratio to suit the application in conformity to the **Mixes** table.

Measurement: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

Plaster mixing: Machine mix for greater than 3 minutes and less than 6 minutes.

Strength of successive coats: Ensure successive coats are no richer in binder than the coat to which they are applied.

*Mixes Table*

Mix type		Application	Upper and lower limits of proportions by volume			
			Gypsum	Cement	Lime	Sand
Cement render coats in: Single or multi-coat systems with integral finishing treatments Base coats in multi-coat systems with cement or gypsum finishes	CRS	Dense and smooth concrete and masonry	-	1	0	3
		Thrown finishing treatments	-	1	0.5	4.5
		Tiled finishes				
		Gypsum finishes				
		Cement finishes				
	CRM	Clay or concrete masonry	-	1	0.5	4.5
			-	1		6
	CRW	Lightweight concrete masonry and other weak backgrounds	-	1		6
			-	1		9
Cement finish coats	CRF	Cement render base coats	-	1	1	1.5
			-	1		2
Lime felting finish coats	LF	Cement render base coats			1	3
Gypsum medium coats	GPM	Gypsum render base coats	Ready-Mix			
Gypsum finish coats	GPF	Gypsum render finish coat	Ready-Mix			

### Movement Control Joint Products

To be proprietary products manufactured for use with the plastering system and to accommodate the anticipated movement of the backgrounds and/or the plaster.

### Water

To be clean and free from any deleterious matter.

Refer to the **Plastering** schedule for details of plastering and locations.

## **2.5.3 Execution**

### **2.5.3.1 Preparation**

#### Substrates

Ensure substrates have:



Any deposit or finish which may impair adhesion of plaster cleaned off.

If solid or continuous, excessive projections hacked off and voids and hollows filled with plaster stronger than the first coat and not weaker than the background.

Absorbent substrates: If suction is excessive, control it by dampening but avoid over-wetting and do not plaster backgrounds showing surface moisture.

Dense concrete: If not sufficiently rough to provide a mechanical key, roughen by scratching or hacking to remove 2 mm of the surface and expose the aggregate then apply a bonding treatment.

Painted surfaces: Remove paint and hack the surface at close intervals.

Untrue substrates: If the substrate is not sufficiently true to ensure conformity with the thickness limits for the plaster system or has excessively uneven suction resulting from variations in the composition of the background, apply additional coats.

### Beads

Location: Fix beads as follows:

Angle beads: At all external corners.

Drip beads: At all lower terminations of external plaster.

Mechanical fixing to background: at 300 mm centres.

Movement control beads: At all movement control joints.

Stop beads: At all terminations of plaster and junctions with other materials or plaster systems.

### Bonding Treatment

If bonding treatment is required, throw a wet mix onto the background as follows:

Cement plaster: 1 part cement to 2 parts sands.

Gypsum plaster: 1 part gypsum to 2 parts sands.

Curing: Keep continuously moist for 5 days and allow to dry before applying plaster coats.

Thickness: From greater than 3mm but less than 6 mm.

### Embedded Items

If there are water pipes and other embedded items, sheath them to permit thermal movement. Ensure embedded items will have a suitable level of corrosion resistance prior to embedment.

### **2.5.3.2 Application**

Plastering is to follow ASTM C842-05 standard for Application of Interior Gypsum Plaster.

### Plastering

General: Provide plaster finishes as follows:

Resistant to impacts expected in use.

Free of irregularities.

Consistent in texture and finish.

Firmly bonded to substrates for the expected life of the application.

As a suitable substrate for the nominated final finish.

Base coats: Scratch-comb each base coat in two directions when it has stiffened.

A bonding agent is required before the application of Gypsum Plaster – Medium (GPM) on concrete surfaces.

### Finishing Treatments

Bag: To be a finish mainly free from sand by rubbing the finish coat with a Hessian pad when it has set firm.

Carborundum stone: To be a smooth finish free from sand by, rubbing the finish coat with a fine carborundum stone when it has set hard.

Steel trowel: To be a smooth dense surface by steel trowelling which is not glass-like and is free from shrinkage cracks and crazing.

Wood or plastic float: To be an even surface by wood or plastic floating the finish coat on application.

#### Incidental Work

Return plaster into reveals, beads, sills, recesses and niches. Plaster faces, ends, and soffits of projections in the background, such as string courses, sills, and other wall features. Trim around openings. Plaster exposed inside of built-in cupboards.

#### Joining-Up

If joining up is required, ensure joints will not be visible in the finished work after decoration.

#### Movement Control Joints

Provide movement control joints in the finish to coincide with movement joints in the background. Ensure that the joint in the background is not bridged during plastering.

Depth: Extend the joint right through the plaster and reinforcement to the background.

Width: 3 mm, or the same width as the background joint, whichever is greater.

Damp-proof courses: Do not continue plaster across damp-proof courses.

V-joints: Provide V-joints, cut right through the plaster to the background, at the following locations:

Abutments with metal door frames.

Abutments with other finishes.

Junctions between different backgrounds.

#### Plaster Thickness

Conform to the **Plaster Thickness** table.

*Plaster Thickness Table*

Plaster	Application	Upper limit of thickness (mm)			
		Single coat systems	Multi-coat systems		
			Base coat(s)	Finish coat	System
Cement render base coats and cement finish	On clay and concrete brickwork and other backgrounds	15	13	4	16
Gypsum Plaster	On smooth dense concrete	-	10	4	13
	On clay and concrete brickwork and other backgrounds	-	13	4	16

#### Temperature

If the ambient temperature is less than 10°C or more than 30°C ensure that the temperature of mixes, backgrounds and reinforcement are, at the time of application, greater than 5°C or less than 35°C.

#### **2.5.3.3 Tolerances**

##### General

Conform to the **Tolerances** table.

*Tolerances Table*

Property	Tolerance criteria: Permitted deviation (mm)
Features <sup>1</sup> : Verticality in 2000 mm	3
Features: Horizontality in 2000 mm	3
Soffits: Horizontality in 2000 mm	5
Walls: Verticality in 2000 mm	5
Walls: Flatness <sup>2</sup> in 2000 mm	4
<sup>1</sup> Features: Conspicuous horizontal or vertical lines including external corners, parapets, reveals, heads, sills, movement control joints and mouldings.	
<sup>2</sup> Flatness: Measured under a straightedge laid in any direction on a plane surface.	

#### 2.5.3.4 Completion

##### Curing

General: Prevent premature or uneven drying out and protect from the sun and wind.

Keeping moist: If a proprietary curing agent is not used, keep the plaster moist as follows:

Cementitious Base coats and single coat systems: Keep continuously moist for 2 days and allow to dry for 5 days before applying further plaster coats.

Cementitious finish coats: Keep continuously moist for 2 days.

## 2.6 tiling

### 2.6.1 General

Furnish all tools, equipment, materials, supplies, accessories and perform all labor to install ceramic tile work indicated on the Contract Drawings and as hereinafter specified.

#### 2.6.1.1 Inspection

##### Notice

Give sufficient notice so that inspection may be made of the following:

Floor preparation and set out of floor tiles before fixing.

Wall preparation and set out of wall tiles before fixing.

Control joints before sealing and grouting.

#### 2.6.1.2 Submissions

##### Samples

Submit labelled samples of tiles, including fittings, accessories, grout and sealants, illustrating the range of variation in colour and finish.

#### 2.6.1.3 Interpretations

##### Definitions

For the purposes of this work section the definitions given below apply.

- Substrates: The surfaces on which tiles are bedded.
- Bedding: Mixtures of materials which are applied to substrates in a plastic state and dry and cure to adhere tiles to substrates.

Adhesive bedding: Tiling adhered by adhesives.

Mortar bedding: Tiling adhered in a cementitious mortar bed.

- **Pavers:** Slabs made from clays, stone, precast concrete and/or other inorganic raw materials generally over 20 mm thick used as coverings for floors and supported over continuous substrates.
- **Tiles:** Thin slabs made from clays and/or other inorganic raw materials used generally as coverings for floors and walls and adhered to continuous supporting substrates.

Natural stone: Tiles cut from natural stone.

Industrial cast: Tile products of reconstituted stone. Also known as manufactured stone.

Cementitious: Manufactured cement based pre-finished tiles.

Terrazzo – cementitious: Manufactured cementitious terrazzo tiles formed in a suitable machine to give sufficient compaction and density to the finished surface, and moisture cured before grinding and honed at the place of manufacture. Thickness usually 35 mm.

- **Wet areas:** Areas within buildings with water supply and drainage systems.

#### 2.6.1.4 Tolerances

##### Completed tiling

Conform to the **Tolerances** table.

*Tolerances Table*

13 Property	14 Tolerance criteria
Alignment: Deviation of the finished tiles from a 3-m straight edge laid against any joints	< 4 mm
Flatness: Deviation of any plane surface under a 3-m straight edge laid in any direction on an area of uniform grade	< 4 mm

#### 2.6.2 Products

##### 2.6.2.1 Tiles and accessories

Provide tiles and accessories to the **Wall Tiling** and **Floor Tiling** schedules.

Coves, nosing's and skirtings: To be matching stop-end and internal and external angle tiles moulded for that purpose.

Exposed edges: To be purpose-made border tiles with the exposed edge glazed to match the tile face. If such tiles are not available, round edge with grout.

##### 2.6.2.2 Adhesives

###### Type

General: Provide adhesives to the **Wall Tiling** schedule and to the **Floor Tiling** schedule and compatible with the materials and surfaces to be adhered.

Prohibited uses: Do not provide the following combinations:

- Cement-based adhesives on wood, metal, painted or glazed surfaces, gypsum-based plaster.
- Organic solvent-based adhesives on painted surfaces.
- Organic PVC-based adhesives and organic natural rubber latex adhesives in damp or wet conditions.
- PVA (polyvinyl acetate) based adhesives in wet areas or externally.

##### 2.6.2.3 Mortar

###### Materials

Cement: Cement shall conform to the requirements of ASTM specification C-150 Type 1 or similar approved standard for normal Portland cement.

- White cement: Iron salts content  $\leq 1\%$ .
- Off-white cement: Iron salts content  $\leq 2.5\%$ .

Lime: Confirm source of Lime with Engineer to ensure highest quality Lime is used in the mortar. Protect from damage on site and store minimum 300mm above ground in waterproof storage facility.

Sand: Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts.

Measurement of volume: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

#### Bedding mortar

Proportioning: Select proportions from the range 1:3 – 1:4 cement: sand to obtain satisfactory adhesion. Provide minimum water.

Terra cotta tiles: Use proprietary polymer modified mortar.

#### Water

General: To be clean and free from any deleterious matter.

### **2.6.2.4 Grout**

#### Type

Cement based proprietary grout: Mix with water. Fine sand may be added as a filler in wider joints.

Terra cotta tiles: Use proprietary polymer modified grout.

Portland cement based grout: Mix with fine sand. Provide minimum water consistent with workability.

- For joints < 3 mm: 1 cement:2 sand.
- For joints  $\geq$  3 mm: 1 cement:3 sand.

#### Pigments

Pigments for coloured grout: Provide colourfast fillers compatible with the grout material. For cement-based grouts, provide lime-proof natural or synthetic metallic oxides compatible with cement.

### **2.6.3 Execution**

Provide tiling systems to walls, floors and other substrates as follows:

- Consistent in colour and finish.
- Firmly bonded to substrates for the expected life of the installation.
- Resistant to expected impacts in use.
- Set out with joints accurately aligned in both directions and wall tiling joints level and plumb.
- To direct all water flowing from supply points to drainage outlets without leakage to the substrate or adjacent areas.

#### **2.6.3.1 JOB CONDITIONS**

Provide tiling systems to walls, floors and other substrates as follows:

- Consistent in colour and finish.
- Firmly bonded to substrates for the expected life of the installation.
- Resistant to expected impacts in use.
- Set out with joints accurately aligned in both directions and wall tiling joints level and plumb.
- To direct all water flowing from supply points to drainage outlets without leakage to the substrate or adjacent areas.

#### Protection

Protect adjacent surfaces against damage during progress of the work of this Section.

#### Coordination and Cooperation

Coordinate work of this Section with work of other trades. Perform work without delay to the work in progress.

### Workmanship

In accordance with best practice; work performed by skilled workers; jointing's, intersections and returns well formed; drilling and cutting neatly done without marring the material; joints straight and solidly filled conforming to applicable "Standard Specifications" of the American National Standards Institute, Inc. ANSI A108.1 and ANSI A108.2.

### **2.6.3.2 Substrates**

#### Drying and Shrinkage

Before tiling, allow at least the following times to elapse (for initial drying out and shrinkage) for these substrates:

- Concrete slabs: 42 days.
- Concrete blockwork: 28 days.
- Toppings on slabs and rendering on blockwork: A further 21 days.

### **2.6.3.3 Preparation**

#### Ambient temperature

Install mortar and set and grout the tile, only when the temperature is at least 10°C and rising.

If the ambient temperature is less than 10°C or more than 35°C, do not lay tiles.

#### Substrates

Ensure substrates are as follows:

- Clean and free of any deposit or finish which may impair adhesion or location of tiles.
- If solid or continuous, excessive projections are hacked off and voids and hollows are filled with a cement: sand mix not stronger than the substrate nor weaker than the bedding.

Absorbent substrates: If suction is excessive, control it by dampening but avoid over-wetting and do not apply mortar bedding to substrates showing surface moisture.

Dense concrete: If not sufficiently rough to provide a mechanical key, roughen by scratching or hacking to remove 3 mm of the surface and expose the aggregate; then apply a bonding treatment.

### **2.6.3.4 Tiling Generally**

#### Sequence

General: Fix wall tiles before floor tiles.

#### Cutting and Laying

Cutting: Cut tiles neatly to fit around fixtures and fittings, and at margins where necessary. Drill holes without damaging tile faces. Rub edges smooth without chipping.

Laying: Return tiles into sills and openings. Butt up to returns, frames, fittings, and other finishes.

#### Variations

Distribute variations in hue, colour, or pattern uniformly, by mixing tiles or tile batches before laying.

#### Protection

Floor tiles: Keep traffic off floor tiles until the bedding has set and attained its working strength.

Cleaning: Keep the work clean as it proceeds and protect finished work from damage.

### **2.6.3.5 Setting out**

#### Tile joints

Set out tiles to give uniform joint widths within the following limits:

- Ceramic floor tiles: 4 to 6 mm.

- Quarry floor tiles: 6 to 12 mm.
- Terrazzo and stone pavers to floor: 2 to 3 mm.
- Large and/or irregular floor tiles: 6 to 12 mm.
- Mounted mosaics: To match mounting pattern.
- Ceramic wall tiles: 3 to 5 mm.
- Terrazzo and stone wall panels: 2 to 3 mm.

#### Margins

Provide whole or purpose-made tiles at margins where practicable, otherwise set out to give equal margins of cut tiles. If margins less than half tile width are unavoidable, locate the cut tiles where they are least conspicuous.

#### Fixtures

If possible position tiles so that holes for fixtures and other penetrations occur at the intersection of horizontal and vertical joints or on the centre lines of tiles. Continue tiling fully behind fixtures which are not built in to the tiling surface. Before tiling ensure that fixtures interrupting the tile surfaces are accurately positioned in their designed or optimum locations relative to the tile layout.

### **2.6.3.6 Falls and levels**

#### Grading

Grade floor tiling to even and correct falls to floor wastes and elsewhere as required. Make level junctions with walls. Where falls are not required lay level.

Fall, general: 1:100 minimum.

Fall, in shower areas: 1:60 minimum.

### **2.6.3.7 Bedding**

#### Preparation of Tiles

Adhesive bedding: Fix tiles dry; do not soak.

Mortar bedding: Soak porous tiles in water for half an hour and then drain until the surface water has disappeared.

Terra cotta tiles: Use pre-sealed tiles or apply a breathable sealer and lay dry. If a final sealed finish is selected, use a compatible laying sealer.

#### Bedding

Use bedding methods and materials which are appropriate to the tile, the substrate, the conditions of service, and which leave the tile firmly and solidly bedded in the bedding material and adhered to the substrate. Form falls integral with the substrate.

#### Thin Adhesive Beds

Provide only if the substrate deviation is less than 3 mm when tested with a 3-m straight edge. Cover the entire tile back with adhesive when the tile is bedded.

Thickness: 1.5 – 3 mm.

#### Thick Adhesive Beds

Provide on substrates with deviations up to 6 mm when tested with a 3-m straight edge, and with tiles having deep keys.

Nominal thickness: 6 mm.

#### Adhesive Bedding Application

Apply adhesive by notched trowel to walls and floors and direct to tiles if required, to provide evenly distributed coverage after laying.

Wall tile spacers: Do not use spacer types that inhibit the distribution of adhesive.

Curing: Allow the adhesive to cure for the period nominated by the manufacturer prior to grouting or allowing foot traffic.

#### Mortar Beds

For floor tiles: Either lightly dust the screeded bed surface with dry cement and trowel level until the cement is damp, or spread a thin slurry of neat cement, or cement-based thin bed adhesive, on to the tile back. Do not provide mortar after initial set has occurred.

- Nominal thickness: 20 to 40 mm.

### **2.6.3.8 Movement joints**

#### General

Provide movement joints to the **Tile Movement Joints** schedule and as follows:

Over structural (isolation, contraction, expansion) joints.

Close to external corners in large tiled areas.

Around the perimeter of the floor.

At junctions between different substrates.

To divide large tiled areas into bays, maximum 5 m wide, maximum 16 m<sup>2</sup>.

At abutments with the building structural frame and over supporting walls or beams where flexing of the substrate is anticipated.

- Depth of joint: Right through to the substrate.
- Sealant width: 6 – 10 mm.
- Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

#### Movement Joint Materials

Divider strip: A proprietary expansion joint consisting of a neoprene filler sandwiched between plates with lugs or ribs for mechanical keying. Set flush with the finished surface.

Sealant: Two-pack self-levelling non-hardening mould resistant, one-part silicone or polyurethane sealant applied over a backing rod. Finish flush with the tile surface.

Backing rod: Compressible closed cell polyethylene foam with a bond-breaking surface.

### **2.6.3.9 Grouted and caulked joints**

#### Grouted joints

Commence grouting as soon as practicable after bedding has set. Clean out joints as necessary before grouting.

Face grouting: Fill the joints solid and tool flush. Clean off surplus grout. Wash down when the grout has set. When grout is dry, polish the surface with a clean cloth.

Edges of tiles: Grout exposed edge joints.

#### Mosaic Tiles

Grouting mosaics: If paper faced mosaics are to be bedded in cement mortar, pre-grout the sheeted mosaics from the back before fixing. After fixing, rub grout into the surface of the joints to fill any voids left from pre-grouting. Clean off surplus grout. When grout has set, wash down. If necessary use a proprietary cement remover.

#### Sealant Joints

Provide joints filled with sealant and finished flush with the tile surface as follows:

- Where tiling is cut around sanitary fixtures.
- Around fixtures interrupting the tile surface, for example pipes, brackets, bolts and nibs.
- At junctions with elements such as window and door frames and built-in cupboards.

Width: 5 mm.



Depth: Equal to the tile thickness.

### **2.6.3.10 Joint Accessories**

#### Floor Finish Dividers

Finish tiled floors at junctions with differing floor finishes with a corrosion resistant metal dividing strip suitably fixed to the substrate, with top edge flush with the finished floor. Where changes of floor finish occur at doorways make the junction directly below the closed door.

### **2.6.3.11 Completion**

#### Cementitious Terrazzo Tiled Surfaces

In situ grind and polish the completed installation with equipment nominated by the tile supplier.

#### Spare Tiles

Supply spare matching tiles and accessories of each type for future replacement purposes. Store the spare materials on site where directed by the Engineer.

Quantity: At least 1% of the quantity installed.

#### Cleaning

Clean tiled surfaces using an appropriate tile cleaning agent, and polish:

1. Remove mortar and grout prior to hardening during progress of work.
2. Clean surfaces thoroughly after grouting and pointing have set sufficiently; remove all cement, dust and other foreign matter with plain water or mild alkaline cleaner. Sandblasting of exposed surfaces is prohibited.
3. Cleaning with a solution not stronger than 10 percent muriatic acid to 90 percent water permitted only on unglazed tile; thoroughly wash afterwards with clean water. Completely protect hardware and fittings metal surfaces, cast iron and vitreous items from acid and fumes.
4. Cleaning shall be done in accordance with the manufacturer's recommendations.

## **2.7 Painting**

### **2.7.1 General**

#### **2.7.1.1 Inspection**

##### Notice

Give sufficient notice so that inspection may be made of the substrate immediately before application of paint finishes.

##### Materials and Equipment Not to be Painted

Unless scheduled, specified, or required by the drawings to be painted, the following items do not require painting. These surfaces shall be left completely clean and free from droppings and accidentally applied material.

1. Non-ferrous metals, chrome plated metal, and stainless steel.
2. Finish Hardware.
3. Ceramic tile.
4. Floor finish materials.
5. Acoustic tile.
6. Equipment furnished with complete factory-applied finish, (except A.C. units) unless specifically noted on the drawings or specified herein to be painted.

#### **2.7.1.2 Submissions**

Prior to start of painting, submit three copies of a complete list of all materials, identified by manufacturer's name and product label or stock number, to the Engineer for approval. This list shall be in the form of a repetition of the paint finishes specified, with the addition of the specific product intended for each coat.

### Clear Finish Coated Samples

Submit pieces of timber or timber veneer matching the timber to be used in the works, prepared and coated in accordance with the paint system.

### Opaque Coated Samples

Provide approx. 600x600mm samples on representative substrates of each paint system showing surface preparation, colour, gloss level and texture.

## **2.7.2 Products**

### **2.7.2.1 Materials General**

Thinners, vehicles, pigments, and other incidental materials intended to be combined with or used with factory-mixed products shall be of the types and kinds recommended by the paint manufacturer for the intended purpose. Include listing of such materials in the material list required hereinafter.

Deliver materials to the job in unopened containers bearing manufacturer's name and product designation corresponding to designation on material list.

Insofar as practicable, each kind of coating for the various types of paint finish shall be factory-mixed to match approved samples and colors, and of consistencies ready for immediate application.

### **2.7.2.2 Paints**

#### *Combinations*

Do not combine paints from different manufacturers in a paint system.

Clear timber finish systems: Provide only the combinations of putty, stain and sealer recommended by the manufacturer of the top coats.

#### *Delivery*

Deliver paints to the site in the manufacturer's labelled and unopened containers.

#### *Tinting*

Provide only products which are colour tinted by the manufacturer or supplier.

### **2.7.2.3 Putty**

Non-timber substrates: Oil-based or polymeric based.

Timber finishes: Lacquer or water based only.

## **2.7.3 Execution**

### **2.7.3.1 General**

Store and mix paint materials in places as directed. Portions of the building used for paint storage and mixing shall be suitably safeguarded against stains, damage and defects. Take adequate precautions against fire hazard.

Mixing and thinning of prepared paints: In accordance with recommendations of manufacturer whose material is being altered, where necessary to produce satisfactory results.

Painting materials required for use on the project shall conform in all respects, with applicable air pollution control regulations.

### **2.7.3.2 Preparation**

#### Order of Work

Other trades: Before painting, complete the work of other trades as far as practicable within the area to be painted, except for installation of fittings and laying flooring materials.

Clear finishes: Complete clear timber finishes before commencing opaque paint finishes in the same area.

#### Acceptance of Surface

Inspect surfaces to be treated to effectively safeguard work of others and to preserve painted work free from damage of every nature.

All surfaces which are found to be unsuitable for application of paint finish, shall be properly prepared before painting is started. Application of the first coat of paint shall be construed as acceptance of the surface as satisfactory for application of painter's finish.

Report unsatisfactory conditions disclosed by inspections in writing for correction. Do not proceed with the work until such unsatisfactory conditions have been properly corrected.

#### Protection

Fixtures: Remove door furniture, switch plates, light fittings and other fixtures before starting to paint, and refix in position undamaged on completion of the installation.

Adjacent surfaces: Protect adjacent finished surfaces liable to damage from painting operations.

Under no circumstances is the painter allowed to get paint on any surface which is not to be painted. The painter is required to protect all surfaces other than the one which is to be painted immediately, with coverings. These include, but are not limited to: drop cloths, masking tape, plastic sheeting, and paper. No paint may be allowed on glass, stone, floors, stone walls, suspended ceilings, windows or any other surface which is not mean to be painted.

Cover well with drop cloths and do not use fixtures or finished building construction of any type for scaffolding or support of scaffolding.

Post signs immediately following application of paint. Exercise proper care to completely protect fixtures, and cabinets that will be installed before painting operations are complete.

In the event finish materials which require no painting should be accidentally splashed with paint or otherwise disfigured by unauthorized application of paint, and if the paint cannot be removed without damage to the material involved, then these materials shall be removed and replaced with new materials, and all costs incidental thereto shall be paid by the Contractor. Cleaning and removal of unauthorized paint or other such materials shall be accomplished with materials and procedures which are non-injurious to the surface, all as approved by the Architect.

After completion and acceptance of the painter's work in any area, the Contractor shall be responsible for provision and maintenance of such forms of protection that may be required to protect finished work from damage from any cause prior to acceptance of the job by the Owner. Schedule the work, and exclude traffic and unauthorized personnel from finished areas, to the extent necessary to prevent damage.

#### "Wet paint" warning

Place notices conspicuously and do not remove them until paint is dry.

#### Restoration

Clean off marks, paint spots and stains progressively and restore damaged surfaces to their original condition. Touch up damaged decorative paintwork or misses only with the paint batch used in the original application.

#### Substrate preparation

Prepare substrates to receive the painting systems.

Cleaning: Clean down the substrate surface. Do not cause undue damage to the substrate or damage to, or contamination of, the surroundings.

Filling: Fill cracks and holes with fillers, sealants, putties or grouting cements as appropriate for the finishing system and substrate, and sand smooth.

Clear finish: Provide filler tinted to match the substrate.

Clear timber finish systems: Prepare the surface so that its attributes will show through the clear finish without blemishes, by methods which may involve the following:

Removal of discolouration's, including staining by oil, grease and nailheads.

Puttying.

### **2.7.3.3 Painting**

Provide coating systems to substrates as follows and as scheduled:

Consistent in colour, gloss level, texture and thickness.

Free of runs, sags, blisters, or other discontinuities.

Fully adhered.

Resistant to expected impacts in use.

Resistant to environmental degradation within the manufacturer's stated life span.

#### Number of Coats

The number of coats specified is minimum that shall be applied. It is intended that paint finishes of even, uniform color, free from cloudy or mottled surfaces, be provided. The work shall be "spot-coated" or undercoated as necessary. Unless specified as one coat or two coat systems, each paint system consists of at least 3 coats comprising priming coat and 2 top coats.

Each coat shall be of a proper ground color to receive a succeeding coat, and wherever practicable, shall differ in color tint. Each coat shall be approved by the Architect before the next coat is applied; otherwise an extra coat will be required over the entire surface involved, except where otherwise directed.

#### Drying

Ensure that the moisture content of the substrate is at or below the recommended maximum level for the type of paint and the substrate material.

#### Paint application

Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Apply subsequent coats after the manufacturer's recommended drying period has elapsed.

#### Priming before fixing

Apply one coat of wood primer (2 coats to end grain) to the back of the following before fixing in position:

Timber door and window frames.

Bottoms of external doors.

Associated trims and glazing beads.

#### Spraying

If the paint application is by spraying, use conventional or airless equipment which does the following:

Satisfactorily atomises the paint being applied.

Does not require the paint to be thinned beyond the maximum amount recommended by the manufacturer.

Does not introduce oil, water or other contaminants into the applied paint.

#### Sanding

Clear finishes: Sand the sealer using the finest possible abrasive and avoid cutting through the colour. Take special care with round surfaces and edges.

#### Repair of Galvanizing

For galvanized surfaces which have been subsequently welded, prime the affected area.

### **2.7.4 Selections**

#### **2.7.4.1 Paint Systems**

##### Paint System Description

Choose from the following paint systems and substrates and paint in accordance with manufacturers recommendations and **Interior** and **Exterior Painting** schedules.

##### Paint Systems

Flat water based: Interior

Low gloss water based: Interior

Flat or low gloss water based: Exterior

Semi-gloss water based: Interior

Semi-gloss water based: Exterior  
Gloss water based: Interior  
Gloss water based: Exterior  
Semi-gloss, oil based: Interior  
Full gloss, oil based: Interior  
Full gloss, oil based: Exterior  
Texture finish, water based: Interior  
Texture finish, water based: Exterior  
Varnish clear: Interior  
Varnish clear: Exterior  
Varnish tinted: Interior  
Opaque timber finish, water based: Exterior  
Clear or tinted timber finish, oil based: Interior  
Clear or tinted timber finish, oil based: Exterior  
Paving paint - Semi gloss oil based  
Roofing paint, oil based  
Low flame spread specialised coating

#### Substrate Types

Existing paintwork (oil based)  
Existing paintwork (water based)  
Concrete  
Cement render  
Fibre cement  
Brickwork  
Stonework  
Set plaster  
Glass reinforced gypsum plaster  
Plasterboard (paper faced)  
Iron and steel  
Aluminium  
Metallic-coated steel  
Oil-based air-drying primed metal  
Organic or inorganic zinc primed metal  
Timber  
Particleboard  
UPVC

#### Colour Selection

As nominated in the **Interior** and **Exterior painting** schedules.

## **2.8 Mechanical services**

### **2.8.1 General**

### **2.8.1.1 Aims**

#### Air-conditioning Load Calculations

Calculate the cooling and heating loads using one of the following:

Manual methods: AIRAH DA9, ASHRAE or Carrier.

Electronic methods: ACADS-BSG Camel, Carrier E20 or Trane Trace.

#### Design

*General: Provide systems designed in conformance with the following unless specific items of equipment are identified in the schedules.*

Outside design conditions: Use outdoor design conditions listed in AIRAH DA9, Table 1 or Table 1A for the location geographically closest to the site and Comfort Conditions.

Inside design conditions:

Summer: 25°C dry bulb, 50% relative humidity

Winter: 20°C dry bulb.

Zoning: Divide the systems into temperature controlled zones to suit the proposed uses of the facility and heat loss/gain conditions.

Fresh air: Supply fresh air to spaces with air-conditioning systems via the air handling systems as applicable.

Windows, walls, floors and roofs: Refer to drawings for construction and insulation.

Lighting load: Refer to drawings for lighting layout and details.

Supply air: To each air-conditioned space  $\geq 4.5 \text{ L/s/m}^2$  at all times the plant is operational.

Ambient noise emitted: Lower than the level that can be heard within a habitable room in any neighbouring premises, regardless of whether any door or window to that room is open.

Fire separation: Refer to drawings.

Heating: Use reverse cycle plant to provide heating.

Duct design: Size ductwork as follows:

Rigid sheet metal duct:  $\leq 6 \text{ m/s}$  and  $\leq 1.2 \text{ Pa/m}$ .

Flexible duct:  $\leq 4.0 \text{ m/s}$ .

### **2.8.1.2 Submissions**

#### General

Before starting work, submit the following for approval from the Engineer:

Outside design conditions, corresponding geographic location and source of data.

Calculated total and sensible cooling capacities and heating capacity.

Name of calculation method used.

Makes and model numbers of proposed equipment.

Any assumptions on which the calculations are based.

Details of any departures from this specification.

Details of fire provisions.

A drawing of the proposed duct, pipe and equipment layout. Show proposed zoning and methods of heating.

### **2.8.1.3 Inspection**

#### Notice

Give sufficient notice so that inspection may be made of the equipment in place before connection and commissioning.

## **2.8.2 Products**

Refer to **Non-ducted** and **Ducted Air Conditioning System Schedules** for details.

### **2.8.2.1 Air-conditioning Equipment**

#### Standards

Ducted air conditioners: To appropriate international standards from country of origin.

Non-ducted air conditioners: To appropriate international standards from country of origin.

#### Equipment

Performance: Provide equipment as follows:

Is made by a manufacturer with a demonstrated ability to provide spare parts and service promptly to the site.

Will operate within the specified range of outdoor design conditions under the calculated loads without excessive head pressure or icing.

Reverse cycle units: Provide an effective outdoor coil defrost facility that prevents room temperature dropping more than 3°C during defrost.

Cabinet: Aluminium, powder coated steel or moulded ABS plastic with metallic-coated steel or stainless-steel fasteners. Insulate and vapour seal cabinet and drain trays to prevent external condensation under all operating conditions.

Drain trays: Aluminium, stainless steel or plastic to collect all moisture inside indoor and outdoor units.

Filters: Washable panel type.

Coils: Copper tube with aluminium plate fins.

#### Controls

Provide the following functions:

Temperature control for each zone located to accurately sense zone temperature.

Fan speed selection for multi and variable speed fans.

### **2.8.2.2 Electric Duct Heaters**

#### General

Standard: To appropriate international standards from country of origin.

Elements: Sheathed in steel or nickel alloy.

Frames: Assemble elements in a galvanized steel frame with terminal connections contained in an enclosed terminal box.

Heating section: Install to allow access to the terminal box and removal of the assembly without disturbing other components.

Refer to **Power Accessories Schedule**.

### **2.8.2.3 Grilles and Diffusers**

Refer to **Air Grills Schedule** for details.

#### General

Size and locate diffusers to provide even air distribution and temperatures without draughts.

Ceiling diffusers: Provide at least one per air-conditioned room and at least one per 12 m<sup>2</sup>.

Construction:

Variable volume diffusers: Powder coated pressed steel.

All others: Powder coated aluminium.

Dampers: Provide a damper to each diffuser and grille. If connected by flexible duct, locate the damper at the duct spigot unless a damper in this position is inaccessible.

#### Supply Diffusers and Grilles

Louvre ceiling diffusers: Multi-bladed, removable core 4-way blow configuration, fitted with a matt black blanking plate for 1, 2, or 3-way blow, as appropriate. If the outlet neck is smaller than the outlet necessary to suit the louvre face size, provide a matt black reducer neck.

Side wall registers: Double deflection type with horizontal front louvre blades and vertical rear blades at 19 mm maximum centres, capable of field adjustment of air throw over the range  $\square$  45°. Support blades > 600 mm long at mid-point on a notched support bar.

#### Return or Exhaust Grilles – Indoor

Ceiling and wall louvre type: Half chevron louvres at 25 mm maximum centres.

Egg crate type (ceiling use only): Elements at 90° to each other, and at 15 mm maximum centres.

Door grilles: Full chevron, 50% minimum free area. Frame to suit door thickness.

#### External Intake and Discharge Louvres

General: Refer to *Windows* work section.

### **2.8.2.4 Fans**

Refer to **Power Accessories Schedule** for details.

#### General

Guards: Provide galvanized steel or bronze mesh guards.

Steel components: Corrosion protect by zinc plating or better.

Motors in air stream: Direct mount to impellers. Provide terminal boxes external to fan casings and wired to fan motors.

Motor minimum degree of protection: IP55.

Bearings: Provide sealed for life or grease packed bearings.

Balancing: Dynamically balance impellers.

Connections: Provide flexible duct connections at fan.

#### Centrifugal and Mixed-Flow In-Line Fans

Casings: Rectangular or circular manufactured from metallic-coated steel sheet, fibreglass or plastic with spigot or flanges for duct mounting.

Impellers: Backward or forward curved blades, constructed from metallic-coated steel, aluminium or polypropylene. Provide fans with non-overloading power characteristics.

#### Propeller Fans

Mounting: Mount on contoured diaphragm plate.

Impellers: Aluminium or UV stabilised ABS or polypropylene.

#### Window or Wall Mounted Fans

Propeller type: Complete with isolating mountings, discharge cowls or louvres, bird mesh guards and backdraft shutters.

#### Roof Mounted Fans

Type: Centrifugal, mixed flow or propeller. Comply with the respective clauses above.

Housing: House fans in compact bases fitted with weathering skirts and manufactured from zinc-coated steel or UV stabilised plastic or composite.

Finish:

Metallic-coated steel: UV stabilised powder coat to match roof colour.



Other materials: Manufacturer's standard colour.

Vertical discharge fans: Provide weatherproof galvanized steel, plastic or aluminium backdraft dampers where the weather may enter when units are stopped.

Bird mesh: Where backdraft dampers are not fitted, provide bird mesh guards.

### **2.8.3 Execution**

#### **2.8.3.1 Ductwork**

##### Rigid Duct

Material: Metallic-coated sheet steel.

##### Flexible Duct

Material: Aluminised fabric clamped on formed metal helix with insulation blanket wrapped around duct and covered with an outer vapour barrier.

Installation: Install flexible duct as straight as possible with minimum number of bends. Maximise bend radius. Check for and rectify any crushed flexible duct.

Support: Limit sag to < 40 mm/m.

##### Duct Insulation

Insulate ducts to reduce heat gain and prevent condensation. Provide continuous vapour barrier around ducts carrying conditioned air. Insulate flexible connections on ducts carrying air below ambient temperature.

##### Cleaning

Clean interior of ductwork progressively during installation.

#### **2.8.3.2 Refrigeration Pipework**

##### General

Conform to equipment manufacturer's recommendations for the refrigerant used.

Deemed to comply: Split system manufacturer's standard pre-charged piping kit.

##### Pipe Insulation

Insulate all refrigerant and drain piping that may sweat with chemically blown closed cell nitrile rubber in tubular form to ASTM C534. Apply to manufacturer's recommendations. Protect insulation from sunlight and mechanical damage.

Insulation thickness: 13 mm for pipes < DN 20, 19 mm otherwise.

##### Condensate Drains

Provide trapped ≥ DN 20 condensate drains from each indoor coil and safety tray. Provide drains from each reverse cycle outdoor coil unless casing freely drains to a roof or other location where condensate will not cause damage or pond.

#### **2.8.3.3 Unit Installation**

##### General

Supply all components and install to manufacturer's recommendations.

Outdoor equipment: Provide clearance around units for condenser air flow and maintenance access. Ensure discharge air does not short-circuit to condenser intake.

Equipment at ground level: Mount on 100 mm high concrete plinth or equivalent impervious material.

Duct connections: Provide internal or external flexible duct connections at indoor unit.

##### Vibration Isolation

Suspended units: Provide ≥ 4 metal spring or rubber-in-shear isolation mountings with ≥ 25 mm static deflection and 98% isolation efficiency.

Floor mounted units: Provide neoprene waffle pads. Bolt in place.

### Safety Trays

If leaks or condensation from equipment could cause nuisance or damage to the building or its contents, provide a galvanized steel safety tray under the equipment.

#### **2.8.3.4 Completion**

##### Commissioning

Commission the systems to manufacturer's recommendations. Check ductwork for leaks. Test all safety controls by simulating fault.

Air quantities: Balance systems to accord with design air quantities.

Tolerance on air quantities: +10%, -0%.

Check list: Submit signed commissioning check list on completion.

##### Cleaning

Clean filters, outdoor coils, grilles and diffusers on completion.

##### Operating and Maintenance Instructions

Provide written operating and maintenance instructions containing:

Contractor's contact details for service calls.

Manufacturer's maintenance and operation literature.

Manufacturer's warranty certificates if the manufacturer's warranty period is greater than the defects liability period.

Description of day to day operation.

Schedule of recommended maintenance.

Record drawing: Provide a drawing of the system as installed.

#### **2.8.3.5 Maintenance**

##### General

Provide corrective maintenance on the installation.

Maintenance period: 6 months from the date of commissioning of the systems or the duration of the Defects Liability Period if greater than 6 months.

Warranty: Warrant the installation for the whole of the maintenance period.

Corrective maintenance: Attend site and undertake corrective maintenance within 24 hours of receipt of verbal or written advice.

Maintenance reports: Provide a signed maintenance report setting out the work done and any measured values after each visit.

3 Electrical

### **3.1 ELECTRICAL SERVICES**

#### **3.1.1 GENERAL**

##### **3.1.1.1 AIMS**

##### **Responsibilities**

Provide electrical systems in conformance with the **Electrical Systems Schedule**.

##### **Qualification**

Use only persons appropriately experienced and qualified to undertake the electrical design and construction work on the systems documented.

##### **Performance**

Carry out verification tests and measurements to show compliance with the specification.

## **Rates for installation work**

Rates for installation of cabling, light fittings, sockets, switches and all other electrical components are to include allowance for fixings, connection, chasing of wiring and any other works required for the installation of the electrical system to a fully operational and safe working condition.

### **3.1.1.2 Inspection**

#### **Notice**

Give sufficient notice so that inspection may be made of the following:

Underground electrical services conduits prior to concealment.

Above ground electrical services conduits in walls prior to concealment.

Switchboards prior to installation.

#### **Inspection and testing on completion**

To verify that the requirements of this specification have been met, all electrical installations and any alterations, additions or repairs to an existing electrical installation, after completion and before being energised shall be:

- Inspected as far as is practicable
- Tested

Precautions shall be taken to insure the safety of persons and to avoid damage to property and the electrical installation equipment during inspection and testing.

NOTE: if requires, the contractor is responsible to provide temporary power generator in order to undertake all needed testing.

A visual inspection shall be made when work on an electrical installation has been completed in order to verify that the work complies with the requirements of this specification. The visual inspection shall be carried out before, or in association with testing and shall where practicable be made before the relevant part of the electrical installation is placed in service. Visual inspections shall be carried out prior to the completion of the installation where that part of the electrical installation will be covered by following works.

The following items provide a guide to the matters to be checked during the visual inspection to assess that the relevant requirements of this specification have been met.

#### **General:**

- Protection against direct contact with live parts e.g. Insulation and enclosure.
- Protection against indirect contact with exposed conductive parts, e.g. Double insulation or isolating transformers.
- Protection against hazardous part, e.g. Enclosure, guarding or screening of flammable materials, hot surfaces and parts that may cause physical injury.
- Protection against spread of fire, e.g. Penetration of fire barriers.
- General condition of the electrical equipment, e.g. Signs of damage that could impair safe operation, disconnection of unused electrical equipment.

#### **Consumers Mains:**

- Current carrying capacity.
- Voltage drops.
- Underground installation conditions, e.g. Enclosure, depth of burial and mechanical protection.
- Aerial installation conditions.
- Connection of wiring.
- Protection against external influences.

#### **Switchboards:**

- Location, e.g. Access and egress.
- Protective devices, e.g. Overload and residual current rating, fault current rating.
- Isolating devices, e.g. Main switches.
- Connecting devices, e.g. Neutral bars, earth bars and live links.
- Connection and fixing of wiring and switchgear.
- Identification and labelling of electrical equipment.
- Protection against external influences.

#### Wiring systems:

- Conductor size, e.g. Current-carrying capacity and voltage drop.
- Identification of cable cores.
- Adequate support and fixing.
- Connections and enclosures.
- Particular installation conditions, e.g. Underground, aerial and emergency systems.
- Segregation from other services and electrical installations.
- Protection against external influences, e.g. Enclosure.

#### Electrical equipment:

- Isolation and switching devices for protection against injury from mechanical movement devices and motors.
- Isolation and switching devices for protection against thermal effects, e.g. Motors, room heaters and water heaters.
- Switching devices for particular electrical equipment, e.g. Socket outlets and cooking appliances.
- Particular installation conditions, e.g. Locations affected by water, explosive atmospheres, extra low voltage and high voltage.
- Compliance with required standard.
- Connection, support and fixing.
- Protection against external influences.

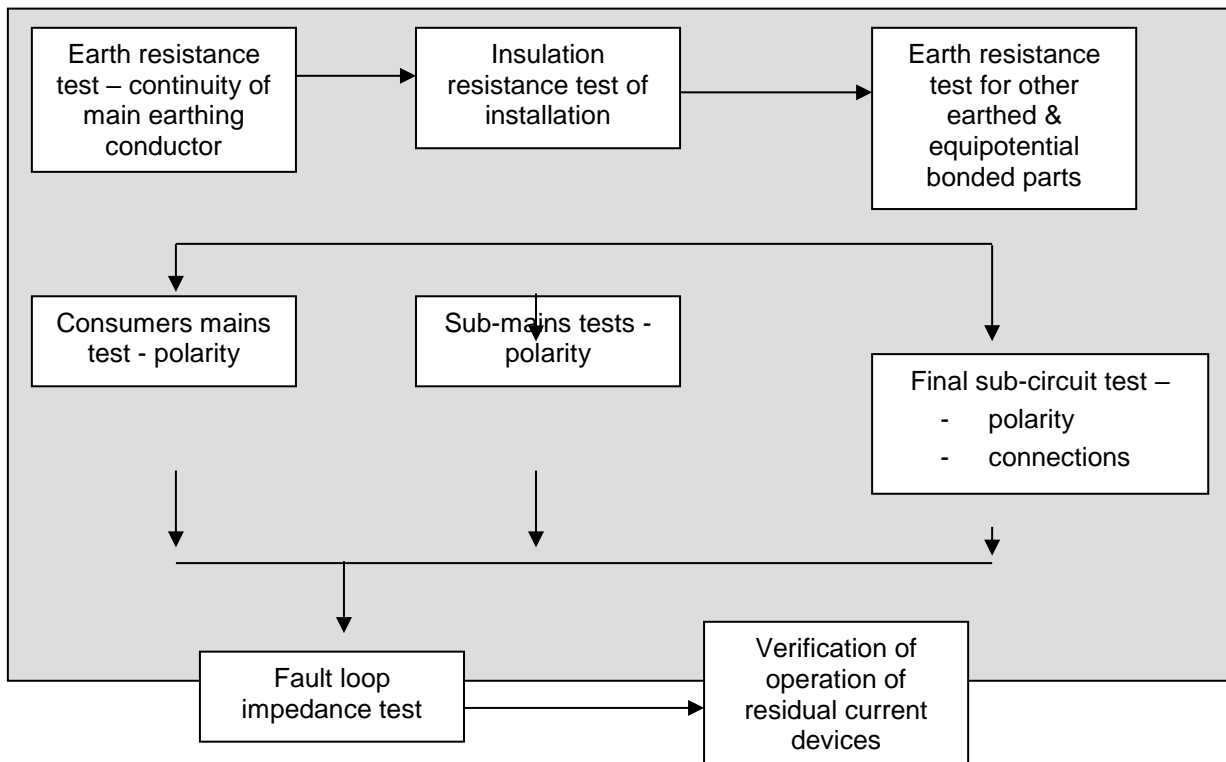
#### Earthing:

- Multiple earth neutral (MEN) connection.
- Earth electrode.
- Earthing conductors, e.g. Size and identification.
- Equipotential bonding conductors, e.g. Size and identification.
- Connections, joints and terminations.
- Protection against external influences.
- Connection to earthing arrangements for other systems.
- Creation of earthed situation that may require earthing of additional electrical equipment.

#### Testing:

After completion of, or in association with the visual inspection tests, testing shall be carried out on the electrical installation to verify that it complies with their requirements of this specification and that it is suitable for the use intended.

Sequence of tests as noted:



### 3.1.2 EXECUTION

#### 3.1.2.1 GENERAL

##### General

**Arrangement:** Arrange services so that services running together are parallel with each other and with adjacent building elements.

**Installation:** Install equipment and services plumb, fix securely and organise reticulated services neatly. Allow for movement in both structure and services.

**Lifting:** Provide heavy items of equipment with permanent fixtures for lifting as recommended by the manufacturer.

**Suspended ground floors:** Keep all parts of services under suspended ground floors > 150 mm clear of the ground surface. Make sure services do not impede access.

##### Samples

**Samples:** Provide samples of all accessories and light fittings for the approval of the Engineer prior to use in the project.

##### Installation of accessories

**General:** Install accessories in conformance with the Installation of accessories table.

**Flush mounting:** Provide flush mounted accessories except in plant rooms.

**Mounting heights:** To on-site direction

**Restricted location:** Do not install wall boxes across junctions of wall finishes.

**Surface mounting:** Proprietary mounting blocks.

#### 3.1.2.2 Installation of Accessories Table

Wall construction	Installation and concealed cabling facilities
Rendered brickwork partition	Flush wall box with conduit chased into wall
Double sided face brick partition	Vertically mounted flush wall box with conduit concealed in cut bricks
Concrete wall or slab	Flush wall box or flush mounted outlet with thermoplastic insulated cables in conduit integral with slab. Do not chase into concrete walls without obtaining approval from the Engineer.

### Installation of ceiling mounted appliances

Connections: Provide flush mounted outlets on the ceiling next to support brackets.

Fixing: Provide support brackets fixed through ceiling to the building structure. Brace appliances that have excessive bending moments, are heavy or vibrate, to prevent horizontal movement.

### Electrical installations

All cabling and wiring is to be installed in approved PVC conduit or within a metal cable tray for horizontal runs within the ceiling, there will be no exceptions. Any cabling installed otherwise will be removed and replaced correctly at the contractor's expense. All below ceiling level electrical circuits are to be installed in surface mounted conduits.

International standard connectors (chocolate block) for the wiring and cabling are to be used for all connections, no other method is acceptable.

All IP ratings given refer to Ingress Protection (IP) Codes to AS1939.

NOTE: Simple twisting of wires as a means of connecting wires and cables with protective electrical tape is not acceptable.

### Earthing/Grounding

All installed electrical fixtures and fittings are to be earthed to the main earth system for the facility, there are no exceptions to this requirement.

All protective earthing conductors should be incorporated in the same wiring enclosure as the associated live conductors or in the adjacent vicinity.

Where a 'clean' earth is specified for a particular item of electrical equipment, the manufacturer of the electrical equipment shall be consulted in order to confirm the necessary arrangements.

Precautions shall be taken against the risk of damage to the earthing arrangement and other metallic part of the electrical installation through electrolysis or galvanic action.

The size of an earthing conductor shall be such that it meets the requirements of the IEC regulations and is in accordance with the Earth conductor size table.

**Earth Conductor Size Table**

Nominal size of live conductor (mm <sup>2</sup> )	Nominal size of copper earthing conductor (mm <sup>2</sup> )	
	With copper live conductors	With aluminium live conductors
1	1*	-
1.5	1.5*	-
2.5	2.5	-
4	2.5	-
6	2.5	2.5
10	4	2.5

16	6	4
25	6	6
35	10	6
50	16	10
70	25	10
95	25	16
120	35	25
150	50	25
185	70	35
240	95	50
300	120	70
400	120	95
500	120	95
630	120	120

\* These earthing conductors may be used only where incorporated in a multicore cable or flexible cord.

### 3.1.2.3 LOW VOLTAGE POWER SYSTEMS

#### General

Provide a complete operational low voltage power system, comprising the following and to the Electrical supply mains **and** Electrical switchboard design schedules:

Supply from mains power

Metering.

Consumers mains and switchboard.

Submains and sub boards.

Final sub circuits.

#### Submissions

Technical data: Submit documentation to fully describe the proposed installation. As a minimum provide:

Submain cable routes and support or enclosure method.

Switchboard cupboard layouts including risers.

#### Accessories

Provide the following and to the Power accessories **and** Lighting control and fittings schedules:

General power outlets.

Isolating switches.

Three phase outlets.

Ceiling mounted sweep fans

Duct heaters

Wall, window or roof mounted exhaust fans

Light switches

Light fittings

Emergency lighting and exit signs

Other equipment as identified in the Schedule

### **Junction and terminal boxes**

Shall be manufactured from PVC and rated to IP56. They shall come complete with a rigid PVC cover attached by means of screws.

### **Switches**

All switches are to be manufactured in compliance with international standards IP24. rate is to include allowance for installation of switches recessed into the wall. Switches are to be installed in locations as shown on the drawings.

### **Wiring systems**

Selection: Provide wiring systems appropriate to the installation conditions and the function of the load. All wiring quality to be approved by the Engineer before installation commences.

### **Power cables**

Copper cable generally, multi-stranded except for MIMS. All cabling is to be manufactured to international standard (BS 5467 or BS 6500) and meet all appropriate safety and performance requirements.

Minimum size:

Lighting sub circuits: 1.5 mm<sup>2</sup>.

Power sub circuits: 2.5 mm<sup>2</sup>.

Submains: 6 mm<sup>2</sup>.

Voltage drop: Install final sub circuit cables within the voltage drop parameters dictated by the route length and load.

### **Dummy load tests**

Where electrical tests are required and the actual load is not available, provide a dummy load equal to at least 75% of the design load.

## **3.1.2.4 SWITCHBOARDS**

### **General**

Provide proprietary switchboards to the following and to the Electrical switchboard design schedule:

Main switchboard.

Distribution boards.

Distribution boards shall be constructed from steel with a lockable door. Boards shall be sealed to meet a rating of IP56. All cable entry and exit points shall be constructed using suitable sized, proprietary PVC cable glands.

### **Statutory authority's equipment**

Refer to local supply authority service rules to determine their requirements. Install equipment supplied by the statutory authority, and provide wiring to complete the installation.

### **Cable entries**

Single core cables rated > 300 A: Arrange to minimise eddy currents.

### **Construction**

Fixing: Before making interpose connections, fix assemblies and metering equipment enclosures into position, level and plumb.

Cable entries: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Provide the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Single core cables rated > 300 A: Pass separately through non-ferrous gland plates. Do not provide metal saddles.

Cable enclosures: Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.



Cable supports: Support or tie mains and submains cables within 200 mm of terminations.

### **3.1.2.5 SWITCHBOARD COMPONENTS**

#### **Switch-isolator and combination fuse-switch units**

Rated current: To suit unit installed in enclosure.

Rated fault capacity: Provide units selected for short-circuit making capacity that is at least the fault level at assembly incoming terminals.

Breaking capacity: At least the rated full load current.

Rated duty: Uninterrupted in non-ventilated enclosure.

Operation: Independent manual operation including positive '*ON/OFF*' indicator.

Locking: Provide for padlocking in the '*OFF*' position.

Handles: Removable only when switch is in open position.

Fuse links: Isolated when switch contacts are open.

#### **Moulded case and miniature circuit breakers**

Moulded case breakers to International Standards.

Miniature circuit breakers to International Standards

Fault capacity > 10 kA circuit breakers to approval of Engineer

Fault capacity < 10 kA, current rating < 100 A: Miniature overcurrent circuit breakers

Mounting: Mount circuit breakers so that the '*ON/OFF*' and current rating indications are clearly visible with covers or escutcheons in position. Align operating toggles of each circuit breaker in the same plane.

Clip tray chassis: For miniature overcurrent circuit breakers provide clip tray assemblies capable of accepting single, double, or triple circuit breakers, and related busbars. Provide moulded clip-on pole fillers for unused portions.

#### **Residual current devices**

Integral type: Incorporate earth leakage in circuit breaker protection operation.

Maximum tripping current: 30 mA.

#### **Fuses with enclosed fuse links**

Standards: To International Standards

Fault level: Provide fuses suitable for the fault level at the assembly, and which discriminate with other protective equipment.

Let-through energy and peak cut-off current: To suit protected equipment.

Fuse-holders: Mount fuse-holders so that fuse carriers may be withdrawn directly towards the operator and away from live parts. Provide fixed insulation which shrouds live metal when the fuse carrier is withdrawn.

Barriers: Provide barriers on both sides of each fuse link, preventing inadvertent electrical contact between phases by the insertion of screwdriver.

Fuse links: Enclosed, high rupturing capacity type mounted in a fuse carrier. If necessary for safe removal and insertion of the fuse carrier, provide extraction handles. Mount on clips within the spares cabinet.

Identification: Clearly indicate manufacturer or distributor.

#### **Contactors**

Standard: To International Standards.

Rated operational current: Full load current of the load controlled.

Minimum rating: 16 A.

Mounting: Mount with sufficient clearance to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.

Interconnection: Do not connect contactors in series or parallel to achieve ratings.

### **3.1.2.6 LIGHTING**

#### **General**

Provide a complete operational lighting system, tested and commissioned.

Proprietary equipment: Provide only proprietary lights, fittings and accessories.

Modifications and refurbishing: Carry out to the original manufacturer's standards.

#### **Lamps**

Lamps: Provide all lights complete with lamps and accessories.

Verify operation: Install lamps in all lights and verify correct operation before completion

Low voltage lamps: Provide lamps strictly in accordance with the light manufacturer's recommendation.

Dichroic lamps: Provide dichroic lamps with integral reflector which match the design specification.

#### **Lighting Control System**

Provide the following and to the Schedules:

Lighting switches.

Dimmers.

Automatic control systems.

External light fittings.

Internal light fittings.

Documentation: Provide complete technical and operational documentation for the lighting control system where installed.

#### **Installation**

Supports: Mount lights on proprietary supports by means of battens, trims or packing material to suit location.

#### **Completion**

Verify the operation of all lights.

### **3.1.2.7 EMERGENCY EVACUATION LIGHTING**

#### **General**

Provide a complete operational emergency evacuation lighting system, tested and commissioned to International Standards.

#### **Single-point system lights**

Visual indicator lights: Provide a red indicator, readily visible when the light is in its operating location, which indicates that the battery is being charged.

Inverter system: Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.

Local test switches: Provide a momentary action test switch, accessible from below the ceiling, on each fitting to temporarily disconnect the mains supply and connect the battery to the lamp.

Common test switches: Provide a common test switch on the distribution board which disconnects main supply to the lights and tests for discharge performance, after testing, this switch must automatically revert to normal operating mode.

#### **Batteries**

Type: Lead-acid or nickel-cadmium batteries capable of operating each lamp at its rated output continuously at least 2 hours during completion tests and 1.5 hours during subsequent tests.

Battery life: At least 3 years when operating under normal conditions at an ambient temperature of 25°C and subjected to charging and discharging at 6 monthly intervals.

Marking: Indelibly mark each battery with its date of manufacture.

#### **Power supply to single-point systems**

Provide an unstitched active supply to each fitting and exit sign, originating from the test switch control panel.

### **3.1.2.8 TELECOMMUNICATION CABLING**

#### **General**

Provide a complete operational telecommunications cabling system, tested and commissioned to International Standards. Provide accommodation for telecommunications cabling infrastructure complying with relevant clearance requirements from power cable distribution systems.

Include the following and to the Telecommunication equipment schedule:

Building distributor.

Backbone cabling.

Floor distributors.

Consolidation points.

Equipment racks and patch cords.

Horizontal cabling.

Telecommunications outlets.

Fly leads.

#### **Equipment racks**

Type: 19-inch rack.

Free standing racks: Provide adjustable feet.

#### **Modular connector patch panels**

Terminations: Terminate directly to the modular connector.

Patch cords: Terminate cord ends with appropriate registered jacks.

#### **Optical fibre termination panels**

Break out trays: Provide fibre optic cable break out trays at each group of fibre optic cable terminations.

Loom cables: Neatly loom cables and lay stripped cables into the break out tray.

Secure cables: Ensure that cables are secured by the sheath and that there is no stress on the fibre optic cores.

#### **Patch cords**

Provide terminated patch cords for 60% of the total incoming and outgoing ports used.

#### **Records**

Record book: Provide a record book at each cross connect.

Records in pencil: Complete the records in pencil for each termination and jumper, providing origin and destination and type of service.

Location: Secure log books in each distribution frame records holder.

#### **Cable separation**

Low voltage cables: Separate telecommunications cables not enclosed in conduits or ducts from low voltage services by at least 150 mm.

Electromagnetic interference (EMI): Provide clearance to minimise the effect of EMI where communications cables are installed parallel and adjacent to power cables carrying loads in excess of 200 A.

#### **Installation**

Crossover: Install cables neatly and without crossovers between cables.

Loom size: Loom cables into groups not exceeding 50 cables, and hold looms in place using reusable cable ties at least 20 mm wide. Do not exert compressive force on the cables when installing cable straps.

#### **Telecommunications outlets**

Outlets: Provide RJ45 8 way modular jacks except where documented otherwise.

Pinouts: The pinouts vary with the application. Determine required pinouts before making cable terminations.

#### **Fly leads**

Provide minimum 2000mm long fly leads to 50% of the outlets installed.

#### **Earthing system**

Communication earth system (CES): Provide a communications earth terminal (CET) associated with the local protective earth (PE) system adjacent to each electrical distribution board.

### **3.1.2.9 AUTOMATIC FIRE DETECTION**

#### **General**

Provide a fully operational system, tested and commissioned in accordance with International Standards.

#### **Base station monitoring system connection**

Connection: Connect the installation to the fire alarm monitoring base station via telecommunication carrier lines where identified in the **Fire detection equipment schedule**.

#### **Installation wiring**

Conductor size: > 1.5 mm<sup>2</sup> TPI 220 V rated, with red and white insulation.

Sheathing: Red.

#### **Fire indicator panels**

Provide metal cubicle-type enclosures to locations identified on drawings.

#### **Detectors**

Provide the following detector types as indicated on the drawings:

- Point type heat detectors.
  - Duct sampling units.
  - Integral heat detector/alarm units.
- Point type smoke detectors.
  - Integral smoke detector/alarm units.

#### **Self-indicating detectors**

Provide a light emitting diode mounted in a clearly visible position, which illuminates whenever detector operation causes an alarm condition to register on the fire indicator panel. Provide self-indicating devices which, if faulty, will not render the detector inoperative under fire conditions.

Mounting positions of light emitting diodes:

Visible detectors: On the outside of the detector or its base.

Detectors concealed above ceilings: On the underside of the ceiling immediately below the detector.

Detectors in other concealed spaces: On a visible panel close to the entry to the concealed space housing the detector.

#### **Installation**

Install detectors so they can be easily inspected and tested in situ, and readily withdrawn for service.

#### **Control facilities**

Provide ancillary control device circuits and connections for automatically controlling and releasing magnetic door holders to operate the relevant fire doors under fire alarm conditions.

#### **Fire fan control and indication panels**

Provide fire detection and alarm signals for the fire fan control panel to be incorporated by mechanical services.

### **3.1.2.10 ACCESS CONTROL**

#### **General**

Provide a complete operational access control system, tested and commissioned in accordance with International Standards as applicable. Refer to the **Access control equipment schedule**.

#### **Processors or panels**

Capacity: Provide separate entry/exit control modules for each designated door.

Users: Program the system to match the number of authorised users with unique access codes.

Time zones: At least 3 per day, with provision for weekends and public holidays.

#### **Door control devices**

Provide electric strikes, electric locks, drop bolts, or similar devices to suit door construction and hardware.

Fail-safe: Connect door control devices in a fail-safe mode to permit exit in the event of power failure.

Authorised products: Provide equipment approved for use by the Engineer.

Double leaf doors (solid frame): Provide an electric strike or lock on the fixed leaf, connected to the door frame by concealed flexible wiring.

#### **Activation**

Provide keypads, card readers or other activation devices, and locate next to entry points.

External: Provide weatherproof (IP56) hoods or housings for external units.

Mounting height: 1200 mm from floor level.

#### **Vehicle control**

Vehicle access control: Provide a vehicle access control system combining connection to vehicular doors and boom gates, and interconnection to the main access control system.

Exit Loop detection: Provide a buried loop detection system adjacent to the exit point to activate boom gates or vehicular doors on approach by a vehicle. Connect so that doors or gates close after a pre-set time.

Interlock: Provide a photo electric beam safety interlock.

Interlock function: To prevent door or gate from closing until the vehicle has cleared the exit point.

Push-buttons and readers: Where practicable, provide direct wall mounting for push-buttons or readers; otherwise provide a mounting bollard and extension arm.

Mounting height: 1000 mm from floor level.

Reed switches: Provide heavy duty reed switches on both sides of vehicle doors, which generate a door closed indication at the control panel.

#### **Intercom**

Base station: Provide an intercom base station at each external entry point, interconnected with the individual local stations. Include speakers and microphones.

Construction: Wall mounted flush stainless-steel panel.

Weatherproofing: IP56.

Dial: Digital push-button type.

Schedule: Provide a weatherproof (IP56) schedule holder and card identifying individual local stations. Locate next to the intercom panel.

Local station: Provide wall mounted intercom local stations, interconnected with the base stations and external entry points.

Type: Surface mounted, removable handset type.

Operation: Provide an audible tone device to indicate that the individual station is being called, and a press-to-talk switch so that the local station can communicate with the base station only when the switch is held down.

Door control: Provide integral momentary action door release switches to operate the door release or opening mechanisms at each external entry point.

### **3.1.2.11 LABELLING**

#### **General**

Provide labels including control and circuit equipment ratings, functional units, notices for operational and maintenance personnel, incoming and outgoing circuit rating, sizes and origin of supply and kW ratings of motor starters.

#### **Identifying labels**

Provide labels fixed to access panels, doors, covers and escutcheon panels and internal equipment, indicating the relevant information and componentry.

#### **Single-line diagrams**

Custom-built assemblies: Provide single-line diagrams.

Format: Non-fading print, at least A3 size, showing the situation as installed.

Mounting: Enclose in a folder and fix close to assembly.

#### **Marking cables**

Identify the origin of all wiring by means of legible indelible marking.

Identification labels: Provide durable labels fitted to each core and sheath, permanently marked with numbers, letters or both to suit the connection diagrams.

#### **Telecommunications Cabling**

Label telecommunications cables, cross connects and outlets.

Labels: Label cables to indicate the origin and destination of the cable. Label outlets to show the origin of the cross connect, the workstation or outlet number, and the port designation.

#### **Location marking**

Accurately mark the location of underground cables with route markers consisting of a marker plate set flush in a concrete base.

Location: Place markers at each joint, route junction, change of direction, termination and building entry point and in straight runs at intervals of not more than 100 m.

Concrete bases: 200 mm diameter x 200 mm deep, minimum.

Direction marking: Show the direction of the cable run by means of direction arrows on the marker plate. Indicate distance to the next marker.

Plates: Brass, minimum size 75 x 75 x 1 mm thick.

Plate fixing: Waterproof adhesive and 4 brass or stainless steel countersunk screws.

Marker height: Set the marker plate flush with paved surfaces, and 25 mm above other surfaces.

#### **Labelling – Minimum Lettering Heights**

Main assembly designation: 25 mm.

Distribution assembly designations: 15 mm.

Small proprietary distribution boards: 10 mm.

Main switches: 10 mm.

Outgoing functional units: 8 mm.

Identifying labels (on outside of cabinet rear covers): 4 mm.

Danger, warning and caution notices: 10 mm for main heading, 5 mm for remainder.

Other labels including equipment labels within cabinets: 3 mm.

### **Label colours**

Generally black lettering on white background except as follows:

Main switch and caution labels: Red lettering on white background.

Danger, warning labels: White lettering on red background.

### **Fixing**

General: Fix labels securely.

Fixing methods: Use screws and double-sided adhesive. Fixed in extruded aluminium sections attached to panels with rivets or countersunk screws.

Permanent fixing: Fix labels permanently in place.

Refer to drawings, BOQ and Electrical **Schedules** for details and locations of all fixtures, fittings and cabling.