

UN Common Services
**UN City Changing Rooms
Refurbishment**
Electrical Specifications

CHA-ARUP-ZZ-XX-SP-E-0001

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This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 279110

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1 Introduction

This specification document shall be read in conjunction with the other specifications and the rest of the contract documents.

Unless stated otherwise, the Contractor shall prepare the construction documents and carry out the construction, testing, commissioning and handover as required and described by each provision of this specification and its appendices, whether the provision is written as an obligation of the Contractor or is stated in the imperative form.

1.1 The Project

The project consists in the refurbishment of the changing rooms in the United Nations (UN) City building in Copenhagen, Denmark.

This UN Changing Room Project includes:

- Demolition works
- Refurbishment of the changing rooms area including access corridor, showers and toilets. This covers an area of approx. 90m² and is located in the basement.

1.2 General Scope

The Contractor is responsible for the preparation of the construction documents, the construction, testing, commissioning and handover of the scope of work described in this specification.

The Contractor shall take full responsibility for the construction of the elements and components included in this document.

The Contractor shall undertake all construction activities:

- in accordance with the standards outlined in this specification and all other appendices to the Contract.
- in compliance with all applicable codes and laws.
- having regard for the concerns, need and interests of:
 1. all persons who will be facility users
 2. all authorities having jurisdiction
 3. the neighbouring properties and users
- in accordance with good industry practice.

The Contractor is responsible for actively co-ordinating with its subcontractors and suppliers to ensure adherence to this technical specification and all requirements specified in the contract documents.

1.3 Codes and standards

Unless expressly stated otherwise, each reference to a code or standard in this document shall mean the latest version of that code or standard.

Compliance with the codes and standards noted in this document is mandatory. This includes any other codes and standards applicable to the project and the respective scope of work even if not listed in the contract documentation, whether noted in general or expressly referenced.

2 Scope

The electrical engineering works shall comprise, but not be limited to the following:

- Any necessary modifications needed to the main distribution board providing supplies to the corridor and the changing rooms.
- Earthing and Bonding Installation
- Electrical Services Distribution within the corridor and changing rooms
- Lighting within the corridor and changing rooms
- Emergency Lighting
- Modifications to Fire Detection and Alarm System
- Modifications to PAVA System
- Maintain power supplies to mechanical, public health, security, plant, BMS, architectural and other systems.
- Additional containment for power, lighting, fire alarm, PAVA and any security items necessary as part of the refurbishment works.

2.1 Requirements for Contractor's designed elements

2.1.1 Site Investigation

As part of their initial investigations, the Contractor shall confirm the position, number and sizes of all existing containment (cable trays, trunking, etc) located above the ceilings of both the corridor and the changing rooms and shall provide these in a drawing for review of the Engineer.

The Contractor shall inspect the existing central battery system and ensure that the system has sufficient capacity to supply the emergency luminaires indicated in the drawings and specifications. Should this not be possible, then the Contractor shall inform the Engineer prior to proceeding further with the emergency lighting portion of the installation.

3 General Requirements

3.1 Definitions

- XLPE – Cross Linked Polyethene
- LSZH - Low Smoke Zero Halogen

3.2 Codes and Standards

The Contractor shall comply with all applicable and relevant standards indicated, but not limited, to those within each section of the following specification. The latest applicable version of these specifications shall be used. These are:

- *Bygningsreglementet 2018 (BR18)*
- DS HD 60364 '*Low Voltage Electrical Installations*'
- DS/EN 50399 '*Common Test Methods for Cables Under Fire Conditions - Heat Release and Smoke Production Measurement on Cables During Flame Spread Test - Test Apparatus, Procedures, Results*'
- DS/EN 50575 '*Power, Control and Communication Cables - Cables for General Applications in Construction Works Subject to Reaction to Fire Requirements*'
- DS/EN 60228 '*Conductors of insulated cables*'
- DS/EN 60332 '*Tests on Electric and Optical Fibre Cables under Fire Conditions*'
- DS/EN 61034 '*Measurement of smoke density of cables burning under defined conditions*'
- DS/EN 61238 '*Compression and mechanical connectors for power cables for rated voltages up to 36 kV*'
- DS/EN 61439 '*Low Voltage Switchgear and Controlgear Assemblies*'
- DS/EN 60947 '*Low Voltage Switchgear and Controlgear*'
- DS/EN 61140 '*Protection Against Electric Shock – Common Aspects for Installation and Equipment*'
- Isolators, Fuse-Switches – DS/EN 60947-3
- MCBs – DS/EN 60898-1
- RCBOs – DS/EN 61009
- Surge Protection Devices – DS/EN 61643-11
- DS/EN 12464 '*Light and Lighting – Lighting of Work Places*'
- DS/EN 60598 '*Luminaires*'.
- DS/EN 1838 '*Lighting Applications – Emergency Lighting*'
- DS/EN 50172 '*Emergency Escape Lighting Systems*'
- DS/EN 60598-2-22 '*Luminaires – Part 2-22: Particular Requirements – Luminaires for Emergency Lighting*'

- DS/EN 62034 *‘Automatic Test Systems for Battery Powered Emergency Escape Lighting’*
- DS/EN 7010 *‘Graphical symbols - Safety colours and safety signs - Registered safety signs’*
- Safety, Health and Welfare at Work (General Application) Regulations 2007, Chapter 1 of Part 7 *‘Safety Signs at Place of Work’*
- DS/EN 50085-2-2:2008 *‘Cable trunking systems and cable ducting systems for electrical installations. Particular requirements for cable trunking systems and cable ducting systems intended for mounting underfloor, flush floor, or on floor’*
- DS/EN 60309 *‘Plugs, socket-outlets and couplers for industrial purposes’*
- DS/EN 61558 *‘Safety of power transformers, power supplies, reactors and similar products’*
- DEMKO 107-2-D1 *‘13A plugs, socket-outlets, adaptors and connection units’*
- DS/EN 54 *‘Fire Detection and Fire Alarm Systems’*
- DS/EN 50136 *‘Alarm Systems – Alarm Transmission Systems’*
- DBI Retningslinje 232 *‘Automatiske brandalarmanlæg. Projektering, installation og vedligeholdelse’*
- DS/EN 54-16 *‘Fire Detection and Fire Alarm Systems - Part 16: Voice Alarm Control and Indicating Equipment’*
- DS/EN 60268 *‘Sound System Equipment’*
- DS/EN 61672 *‘Electroacoustics - Sound Level Meters’*
- DS/EN 60849 *‘Sound Systems for Emergency Purposes’*
- ISO 7240-16:2007 *Fire detection and alarm systems -.Part 16: Sound system control and indicating equipment*
- DS/EN 62305 *“Protection Against Lightning – Part 1: General Principles”*
- DS/EN 62305 *“Protection Against Lightning – Part 2: Risk Management”*
- DS/EN 62305 *“Protection Against Lightning – Part 3: Physical Damage to Structures and Life Hazard”*
- DS/EN 62305-4 *“Protection Against Lightning – Part 4: Electrical and Electronic Systems within Structures”*
- DS/EN 62561 *‘Lightning Protection System Components (LPSC)’*
- DS/EN 61643 *‘Low Voltage Surge Protection Devices’*
- DS/EN 50173 *‘Low Voltage Electrical Installations’*
- DS/EN 50310 *‘Application of equipotential bonding and earthing at premises with information technology present’*
- DS/EN 50133 *‘Alarm Systems – Access Control Systems for use in Security Applications’*.
- DS/EN 50131 *‘Alarm Systems – Intrusion Systems’*

4 Building Elements Specifications

4.1 Cables and Wiring

4.1.1 Materials and Products

4.1.1.1 General

The Contractor shall supply, install, terminate and test all cables as shown on the drawings and single line diagrams, described herein and/or listed in the cable schedules.

All cables shall fully comply with European, Danish or International standards and carry an EU Notified Body (NB) such as 3P, Force Certification or equivalent. They shall be delivered to site correctly packaged with manufacturer's traceability information.

All cables shall be marked (indelibly on the sheath) with the following information at a minimum:

- Manufacturer's Name and Factory Identifier
- CE Mark
- Relevant EN or DS standard number
- Name of Third Party Approver (3P, Force Certification, etc)
- Number of Cores and Cross Sectional Area
- Voltage Rating
- Cable Code
- Year of Manufacture

4.1.2 Standards & Regulations

- DS HD 60364 '*Low Voltage Electrical Installations*'
- DS/EN 50399 '*Common Test Methods for Cables Under Fire Conditions - Heat Release and Smoke Production Measurement on Cables During Flame Spread Test - Test Apparatus, Procedures, Results*'
- DS/EN 50575 '*Power, Control and Communication Cables - Cables for General Applications in Construction Works Subject to Reaction to Fire Requirements*'
- DS/EN 60228 '*Conductors of insulated cables*'
- DS/EN 60332 '*Tests on Electric and Optical Fibre Cables under Fire Conditions*'
- DS/EN 61034 '*Measurement of smoke density of cables burning under defined conditions*'
- DS/EN 61238 '*Compression and mechanical connectors for power cables for rated voltages up to 36 kV*'

4.1.3 Sizes

All cables and wiring shall be metric sizes. Imperial sizes are not acceptable. If installed, the contractor shall remove the full imperial installation and replace with metric at his own expense.

4.1.4 Colours

The system of colour coding of conductors throughout the installation shall be as per the European harmonised core colour code as follows:

400V AC three phase circuits:	1st phase – Brown 2nd phase – Black 3rd phase – Grey Neutral – Blue
230V AC single phase circuits:	Phase – Brown Neutral – Blue
Earth/Protective conductor:	Green/Yellow
24V DC circuits:	Positive – Brown Earthed Negative – Blue

Power cables shall generally have a black sheath.

Fire alarm cables shall have a red sheath.

Instrumentation cables shall have a grey sheath.

4.1.5 General Requirements

All conductors shall have a minimum cross section of 1.5mm².

4.1.5.1 LV Power

Generally, LV power cables shall be as follows:

Multi-core cables shall be:

- Internally: AL, XLPE, LSZH, 5-Core, 600/1000V
- Externally: AL, XLPE, LSZH, UV resistant, 4-Core, armoured 600/1000V

Single core cables shall be:

- Internally: AL core, LSZH, 600/1000V
- Externally: AL core, LSZH, UV resistant, armoured 600/1000V

4.1.5.2 Small Power & Lighting Circuits

Multicore Low Smoke Zero Halogen (LSZH) insulated and LSZH sheathed flexible cable for fixed installation within buildings rated 300/500V with class 5 flexible stranded plain copper conductors (to DS/EN 60228) suitable for operation up to 70°C. Type H05Z1Z1-F / 318-B or equal and approved.

4.1.5.3 Fire Alarm Cabling

The entire system internally shall be wired using the following cable:

- Standard Fire Resistant, 110V, tested in accordance with DS/EN 60331

Cable shall be Nexans Alsecure Premium Infit PT or equal and approved.

Final cable connections to devices shall provide the same degree of fire resistance as the main cable.

Voltage drops in cables shall not exceed the limit which will prevent devices operating within their specified range at all times.

Cross-sectional area of any conductors shall be at least 1.0mm². The Contractor shall confirm the final cable size requirements of the Fire Alarm system with the designated manufacturer, Autronica (refer to the Fire Alarm & Detection specification).

4.1.6 Execution

The Contractor shall install cables generally within the existing containment and in the manner indicated on the drawings and in accordance with the notes and instructions thereon and herein.

All cables shall be delivered to site with the manufacturers' seals, labels, or other proof of origin intact. Such labels and seals shall not be removed until the cable is required for use and shall be retained for inspection.

Cables shall be handled, terminated and installed in accordance with the cable manufacturer's recommendations. The technical advice of the manufacturer's specialists shall be followed if any special conditions or unusual circumstances apply.

In order to avoid any damage, cables should be carefully laid and installed. Cables shall not be pulled over hard or sharp edges, exceed the manufacturer's recommended bending radius or exceed the maximum permissible tensile strength.

The minimum internal radius of bend shall be eight times the overall diameter of the cable.

The Contractor shall exercise all care during cable installation. Any cable which, in the opinion of the Engineer, has been damaged during storage, handling or installation shall be replaced at the expense of the Contractor. This includes damage to any part of the cable including conductors, insulation, armour, sheath etc. Re-sheathing damaged cable is not acceptable.

3-phase groups of single-core cables carrying alternating current shall be laid in trefoil formation and touching each other.

Circuits of different voltage shall not be run in the same conduit.

All cables shall have their conductors tested for insulation resistance immediately prior to terminating the cable end. Tests shall be carried out with a 500V 'Megger' insulation tester, or similar instrument, to prove the integrity of the insulation between cores and the cable sheath.

Cable clips and saddles shall be purpose-made by the cable manufacturer. The use of bare or PVC covered copper strip for site fabrication of saddles or clips will not be permitted. Clips with single hole fixings may be used when installing single cables. Where two or more cables are grouped together then saddles with two hole fixings shall be employed. Plain copper sheathed cables shall be held with bare copper clips or saddles. LSZH sheathed cables shall be held with LSZH covered clips or adjustable nylon saddles. The type of fixings employed shall be consistent throughout the installation.

Where multi-core cables are installed and one or more cores are unused, then the spare cores shall be bonded to earth.

4.1.6.1 Cables Installation

Cables shall be installed using one of the following methods:

- Laid in trays or trunking supported from walls, ceilings, structural steelwork or purpose designed steelwork.
- Supported in cleats, clips, saddles or hangers on walls, structural steelwork or purpose designed steelwork.

Where cables are installed on cable tray, they shall be neatly grouped and arranged to cause the absolute minimum of crossovers. Where crossovers are unavoidable, they shall be neatly arranged and properly secured.

All cables shall be securely fixed to cable ladders and trays using black polypropylene cable ties, tightened to the manufacturer's recommendations and neatly trimmed. Use of nylon cable ties shall not be accepted).

Where cables have to be carried on structural steelwork, the cable supports shall be attached to the steelwork by means of girder clips or other patented attachment devices not requiring drilling of the steelwork. Welding of cable supports to structural steelwork or the drilling of the steelwork for the attachment of cable supports will not be permitted.

Cables fixed to the building structure or to cable tray shall have clips or saddles spaced at the following regular intervals:

Overall Diameter of Cable (mm)	Fixing Centres (mm)	
	Horizontal	Vertical
≤ 15	300	400
15 < & ≤ 40	400	500
40 < & ≤ 100	600	750

Cables shall be fixed 150mm on either side of a set or bend.

Cable saddles and clips shall be fixed to the building fabric or cable tray as follows:

- Building fabric - brass roundhead screws and fibrous or approved plastic plugs.
- Cable trays in general - brass roundhead screws, nuts and washers.
- Cable trays in damp or wet conditions - zinc coated roundhead screws, nuts and washers.

Where cables pass through walls and/or floors which form part of the building's fire compartmentalisation, the hole(s) through which the cables pass shall be sealed after the cables have been installed, so as to give the same standard of fire resistance as the original wall or floor. Details of the proposed sealing method shall be submitted prior to implementation.

4.1.6.2 Small Power & Lighting Wiring

Wiring of small power and lighting circuits shall be carried out using one or more of the following wiring systems:

- Single-core unsheathed cables drawn into metallic or non-metallic conduit and/or trunking
- Multi-core sheathed cables, armoured or unarmoured, clipped to building surfaces or structures or to cable tray.

Cables shall not be embedded in the building fabric.

Unprotected cables shall not, under any circumstances, be installed externally or be embedded in concrete.

4.1.7 Control

No samples required.

The Contractor shall submit a technical submittal complete with all manufacturer information to the Engineer for final approval of the material prior to any orders being placed.

4.2 Cable Containment and Support Systems

4.2.1 Materials and Products

4.2.1.1 General

The Contractor shall supply and install cable support system using cable tray, trunking, conduit and support steelwork as required onsite. As part of their initial investigation the Contractor shall identify the existing containment (for lighting, power, fire alarm, PAVA and security) and provide to the engineer so that any additional containment can be agreed.

The Contractor shall include for all incidental cable tray within the changing room area, which may be required to effect cable routes to final circuits, luminaires etc.

4.2.1.2 Standards & Regulations

4.2.1.3 Cable Support Systems for Life Safety and Fire Fighting Applications

For life safety and fire-fighting applications (e.g. fire detection and alarm, fire-fighting lifts, sprinkler systems etc.) where fire-resistant cables are installed, the cable support system shall be in accordance with DS/EN 50575 “*Power, Signal and Communications Cables – Cables for general use in construction and installations with fire response requirements.*”.

The cable support system shall have a fire survival time equal to that of the cables it supports and for the same defined fire conditions.

Support brackets shall be sized to take into account the fact that the tensile strength of steel will be significantly reduced in a fire situation.

Cable accessories shall meet similar testing requirements to the cables and shall not compromise the defined performance of the cables.

Cable fixings shall be in accordance with the cable manufacturer’s recommendations. They shall be steel or cast iron with a specified non-combustible coating. Plastic, nylon or aluminium is not suitable. Cable fixing centres shall be within the cable manufacturer’s recommended maximum spacings.

4.2.1.4 Cable Tray

Cable tray types shall be as follows:

Location	Type
Internally	Manufactured from high quality galvanised sheet steel to DS/EN 10346

4.2.1.5 Conduits

4.2.1.6 General

The Contractor shall include for the design, supply, installation, testing and commissioning of the complete conduit installation complete with backboxes, boxes, bends, tees, etc. and all other accessories as indicated on the drawings and detailed herein.

Conduits and conduit fittings shall be rigid halogen free PPE/PP0 with a minimum nominal size of 20mm to DS/EN 61386-21, DS/EN 60423 and DS/EN 60614-2-2.

Couplings shall be factory threaded and manufactured from the same material as the conduit. Adaptable and accessory boxes entries shall be effected using flanged couplers and heavy pattern male brass bushings.

All conduits shall be free of defects on delivery and shall be protected from mechanical damage and weather when stored on site.

4.2.1.7 Draw-in Boxes

Draw-in boxes shall be of the same material and manufacturer as the selected conduits and shall remain part of a continuous system.

Draw-in boxes shall be of ample size to enable the cables to be neatly diverted from one conduit to another without undue cramping.

4.2.1.8 Flexible Conduit

Conduit connections to motors or other equipment subject to vibration or movement shall be made in heavy gauge, weather-proof type, oil-resistant, flexible metallic conduit, LSF-sheathed overall and provided with heavy brass screwed adaptors with a male thread for connection to the rigid conduit system via an adaptable box at each end termination.

A flexible connection greater than 1000mm long shall not be used without the Engineer's approval.

Flexible conduits shall be installed in accordance with the manufacturer's instructions and in such a way as to ensure that there is no risk to personnel in the area.

4.2.1.9 Back Boxes

Back boxes throughout for all outlets shall have a minimum depth of 32mm.

4.2.2 Execution

4.2.2.1 Conduits

All conduits shall be free of cracks or other defects on delivery and shall be protected from mechanical damage and weather when stored on site.

Where conduit is connected to surface mounted equipment or accessories it shall be additionally supported within 150mm of each side of the item. Where bends and sets occur the conduit shall be fixed at a distance of 150mm on each side of such diversion.

All conduit drops to switches, socket outlets etc. shall be vertical. Surface mounted conduit shall be run truly horizontal or vertical.

Rigid conduits shall be fixed using spacer saddles for surface work and pipe hooks for flush work. Multiple runs of conduits may be fixed to Unistrut supports

using fixings approved by the manufacturer for the purpose. Where conduit is to be fixed to structural steel, approved proprietary clamp type fasteners shall be used. Where necessary, Unistrut supports spanning the structural steelwork shall be provided by the Contractor. Drilling of steelwork shall not be permitted without the Engineer's permission.

The inner radius of any conduit bend shall not be less than 2.5 times the external diameter of the conduit. Where conduit has to be bent, it must be bent without altering its section. No more than two 90° bends shall be installed in any run of conduit without a conduit draw-in box.

Conduits shall be sealed to prevent the ingress of dirt, dust etc, after installation and shall be cleaned out and dried prior to the installation of any cables. The whole of the conduit system in any particular section shall be completed and free from any dirt or loose matter before cables are drawn in.

No cables shall be installed until all conduit and accessories are securely fixed and in the case of flush installations until the plastering has been completed and passed by the Architect as sufficiently dry.

No conduit smaller than 20mm diameter shall be installed unless shown on the drawings.

The maximum number of cables drawn into any one conduit shall not exceed those allowed by the DS HD 60364.

4.2.2.2 Draw-in Boxes

Draw-in boxes shall be provided to give access to all conduits for the drawing in or out of any cable. Generally where conduit is to be installed from point to point in a straight line, draw-in boxes shall be installed every 9m of conduit run.

No cable joints will be allowed in draw-in boxes under any circumstances.

No box shall be fixed in such a position as to be inaccessible on the completion of the building structure or other services.

All conduit boxes not carrying lighting or other fittings shall be installed with a suitable cover fixed with brass or stainless steel round head screws. Covers for external application shall have machined faces and shall be provided with neoprene type gaskets.

4.2.2.3 Flexible Conduit

A flexible connection greater than 1000mm long shall not be used without the Engineer's approval.

Flexible conduits shall be installed in accordance with the manufacturer's instructions and in such a way as to ensure that there is no risk to personnel in the area.

4.2.2.4 Final Cable Drops

The Contractor shall provide all final cable ladder, tray and droppers from the main cable support network as required to allow cabling to individual items of equipment (or small groups of adjacent equipment) installed in this project.

4.2.2.5 Back Boxes

Recessed outlet boxes or adaptable boxes shall not be installed back to back without the permission of the Engineer.

4.2.3 Control

No samples required.

The Contractor shall submit a technical submittal complete with all manufacturer information to the Engineer for final approval of the material prior to any orders being placed.

4.3 Lighting & Lighting Control

4.3.1 Materials and Products

4.3.1.1 General

The Contractor shall supply, install, test and commission a complete general lighting installation as indicated on the drawings, as listed in the Luminaire Schedule (refer to Appendix A) and detailed herein.

Internal Lighting will generally be provided by:

- Ceiling mounted, recessed, linear LED luminaires.

4.3.1.2 Standards & Regulations

4.3.1.3 Lighting

- DS/EN 12464 'Light and Lighting – Lighting of Work Places'

4.3.1.4 Luminaires & Components

- DS/EN 60598 'Luminaires'.

4.3.1.5 Luminaires

4.3.1.6 General

Refer to Appendix A for the project luminaire schedule.

Unless otherwise stated all luminaires designed for general internal use shall be constructed to minimum IP20, for internal wet areas (within the changing rooms) to a minimum of IP54.

Internal wiring shall be heat resistant to suit the service temperatures reached within each luminaire. Minimum acceptable insulation shall be PVC rated to withstand a temperature of 105°C. Where higher internal temperatures are reached silicone rubber or glass insulated wiring shall be used.

Internal wiring shall be colour coded and clipped within the luminaires at maximum 300mm centres. Grommets shall be used where wiring passes through holes. Under no circumstances shall wiring be permitted to rest or rub in raw metal edges and it shall not be allowed to rest on diffusers or louvers.

All non-current carrying metal parts of luminaires shall be effectively electrically continuous to a main earthing terminal which shall be provided within each fitting.

4.3.1.7 LED Luminaires

LED luminaires shall be photometrically tested in accordance with 'IESNA LM-79-08, IES Approved Method for the Electrical and Photometric Measurement of Solid-State Lighting Products'. Results certificates shall be provided.

LED modules shall be tested in accordance with 'IESNA LM-80-08, IES approved Method: Measuring Lumen Maintenance of Light Emitting Diode Light Sources'. Results certificates shall be provided.

LED luminaires shall have lifetimes extrapolated in accordance with 'IESNA TM-21-11, IES Approved Method: Making Useful LED Lifetime Projections'.

LED modules and luminaires shall have product information displayed in accordance with 'IEC/PAS 62717 Performance requirements, LED modules for general lighting' and 'IEC/PAS 62722 Performance requirements, LED luminaires for general lighting'.

Manufacturers of LED luminaires shall disclose information about the manufacturer of LED modules.

4.3.1.8 Lifetime

LED luminaire service lifetime shall be specified in terms of hours at LxxFxx, where Lxx represents parametric failure and Fxx represents catastrophic failure.

LED luminaires shall achieve a minimum of 50,000 hours at L70F10.

4.3.1.9 Colour Rendering Index

LED luminaires shall have an initial CRI as set out in the luminaire schedule.

4.3.1.10 Colour Temperature

LED luminaires shall have an initial CCT as set out in the luminaire schedule.

4.3.1.11 Chromaticity Tolerance

LED luminaire colour variation shall be within a 3-step MacAdam ellipse initially.

LED luminaire colour variation shall be within a 3-step MacAdam ellipse through lumen maintenance, designated at a minimum of 6,000 hours.

LED luminaire manufacturers shall provide a photometric code as defined within 'IEC/PAS 62717 Performance requirements, LED modules for general lighting' and 'IEC/PAS 62722 Performance requirements, LED luminaires for general lighting'.

4.3.1.12 Warranty

LED luminaire shall have an on-site replacement product warranty of five years minimum, as standard. This shall cover all luminaire components, inclusive of electronics, drivers, finishes, etc.

4.3.1.13 Lighting Control

All luminaires shall be controlled by DALI (Digital Addressable Lighting Interface) protocol, in line with the existing system throughout the UN City building. The UN's preferred supplier for the DALI control system is *Nordomatic*.

The Contractor shall update the system as necessary, including as necessary a source controller (which includes dimmer packs, ballast controllers, switch packs and output devices, and any other applicable units) and user interfaces (which include, touch screens, time-clocks, passive infrared detectors, interface units and any other applicable units).

The manufacturer shall include programming devices as required to program and commission the equipment once installed. These shall be in the form of PC based software.

The lighting management system shall provide fully functioning DALI dimming control to all luminaires throughout the corridor and changing rooms.

Proposed driver current shall be stated and this shall match with a driver current examined within 'IESNA LM-80-08, IES approved Method: Measuring Lumen Maintenance of Light Emitting Diode Light Sources' test results certificate. Driver currents in excess of what has been independently tested will not be acceptable.

Power consumed by LED luminaires shall be stated inclusive of control gear losses. LED drivers shall conform to IEC 61347-2-13 and IEC 62384.

4.3.1.14 Lighting Control Module

Any new switching modules shall be surface mounted or DIN rail mounted switching, fully rated output continuous duty for inductive, capacitive and resistive loads, in line with the existing system.

The switching module shall integrate, as a minimum, up to 4 individually controlled zones, each with a capacity of up to 10 amps of high in-rush lighting loads. The module shall connect to the Lighting Management Panel via TCP/IP. The module shall have LED status indicators confirming communication with occupancy sensors and daylight sensors.

The lighting controller shall be surface or DIN rail mounted and shall allow 64 ballasts per loop and 16 zones per loop; total of 3 loops per module. The controller shall provide control for DALI compliant digital addressable loads. The controller shall supply 250mA of power to each DALI loop. The controller shall provide power failure memory to retain control unit programming during loss of power. The controller shall have the ability for programming via a hand-held device.

4.3.1.15 Lighting Management System

The Contractor shall ensure that the existing lighting management system (LMS) shall be updated as necessary to control and monitor digital addressable dimming ballasts, modules, power modules, etc. The LMS shall interface with other services systems such as the Fire Alarm system and emergency luminaires as necessary to suit the new layout and design.

All testing and monitoring of the standalone emergency luminaires shall be carried out by the LMS and shall be capable of recording and storing event logs as per the existing system or for a minimum of 2 years. The LMS shall have continuous communication with emergency luminaires, real time detection of battery damage.

4.3.1.16 Presence/Absence Detectors

The Contractor shall confirm if presence/absence detectors are currently being used in the corridor or the existing changing rooms. If they are, then the Contractor shall ensure to replicate this for the new corridor and changing room works, and these shall be Passive Infrared Detectors (PIRs) and connected from the DALI Bus.

They shall generally be recessed mounted with a white trim to suit the relevant area finishes. They shall be suitable for ceiling mounting heights of 2.3 to 3.0m. They shall have a minimum detection radius of 3m within which any small movements shall be detected.

They shall have a minimum adjustable off delay of 5-60 minutes following the last observed movement. They shall be programmable with remote programming tools to allow settings to be changed without any disturbance to building occupants or the ceiling.

4.3.2 Execution

4.3.2.1 Installation of Luminaires

The Contractor shall ensure that the methods of suspension for luminaires are electrically and mechanically sound.

The Contractor shall provide all supports as necessary.

The Contractor shall ensure that all installation accessories (i.e. brackets, clips etc) are provided with the luminaires and are suitable for the location and type of ceiling in which the luminaires are to be mounted.

All fittings shall be installed in accordance with manufacturer's instructions.

Fixings for luminaires shall be as follows:

- Recessed mounted modular luminaires shall be supported by the ceiling grid or plasterboard.

The method of suspension shall permit easy and accurate adjustment of the fittings to permit accurate alignment with the ceiling and other fittings. The method of fixing shall also allow easy removal of the fittings for inspection and maintenance.

Luminaires shall be securely fixed by at least two fixings separated by at least 50% of the greatest dimensions of the light fitting.

Luminaires shall not be suspended by their flexible cord. All flexible cords shall be anchored at each end such that the cord is free from strain.

Where an exterior light fitting is mounted directly over a conduit box a neoprene gasket shall be used between the fitting and the box to prevent ingress of moisture.

Louvres and reflectors shall be packed separately from the luminaire body and protected against damage. They shall not be installed until after the building has been thoroughly cleaned.

Remote drivers and battery packs shall be easily removed for maintenance or replacement. Where access is not provided, the driver or battery pack may be installed adjacent to fitting and access may be gained by removal of the fitting.

All luminaires shall be earthed in accordance with the ETCI Rules.

Earth continuity shall be maintained from the conduit trunking system to the earth terminal in the light fitting.

4.3.2.2 Wiring

The internal lighting circuits shall be wired with cables as detailed in the cables and wiring section and circuited as shown on the drawings.

Final connection to luminaires shall be as follows:

- For recessed luminaires, connection shall be via flexible cords connected with 3-pin plug and socket luminaire connectors sited immediately adjacent to the fitting. The flexible cord shall be heat resistant with low smoke and fume sheath.
- Where conduit suspension is used, final circuit wiring shall be contained within the conduit and terminating directly within the luminaire.

4.3.2.3 Testing & Commissioning

When the installation is complete, the Contractor shall carry out a lux level survey to record lighting levels in all rooms and areas. This shall be carried out during the hours of darkness. The results of the survey shall be submitted to the Engineer for information.

All lamps and fittings shall be fully operational at handover.

4.3.2.4 Lighting Control System

The Contractor shall allow for full on-site set-up and commissioning of the Lighting Control System by the Employer's preferred specialist supplier, *Nordomatic*. The Contractor shall liaise with the Employer to determine their requirements and ensure that these are met as part of the upgrade works.

4.3.3 Control

4.3.3.1 Spares

For each different lamp type specified, the Contractor shall provide a minimum of 2No spare lamps for each type of fitting installed. The lamps shall be handed over to the Client on practical completion.

These lamps shall be additional to those required to be replaced for systems that are used prior to practical completion.

4.3.3.2 Samples

The Contractor shall submit a single luminaire for each type of luminaire indicated in the Luminaire schedule in Appendix A.

The Contractor shall submit a technical submittal complete with all manufacturer information to the Engineer for final approval of the material prior to any orders being placed.

4.4 Emergency Lighting

4.4.1 Materials and Products

4.4.1.1 General

The Contractor shall supply, install, test and commission a complete emergency lighting installation as indicated on the drawings, as listed in the Luminaire Schedule and detailed herein.

The emergency lighting system consists of luminaires connected to the existing central battery system. The exit signs will also form part of the emergency lighting system.

Emergency lighting shall generally be provided by the following:

- Switch-maintained emergency recessed LED luminaires throughout the corridor and changing rooms.
- Maintained exit signs on escape routes

All general clauses in the Lighting section of this specification (installation, lamps, wiring, samples, spares etc.) shall apply to the emergency lighting system, equipment and components.

The emergency lighting installation shall be supplied, installed and tested, in its entirety, in accordance with I.S. 3217.

4.4.1.2 Standards & Regulations

- DS/EN 1838 'Lighting Applications – Emergency Lighting'
- DS/EN 50172 'Emergency Escape Lighting Systems'
- DS/EN 60598-2-22 'Luminaires – Part 2-22: Particular Requirements – Luminaires for Emergency Lighting'
- DS/EN 62034 'Automatic Test Systems for Battery Powered Emergency Escape Lighting'
- DS/EN 7010 'Graphical symbols - Safety colours and safety signs - Registered safety signs'
- Safety, Health and Welfare at Work (General Application) Regulations 2007, Chapter 1 of Part 7 'Safety Signs at Place of Work'

4.4.1.3 Emergency Light Fittings

Refer to Appendix A for the project luminaire schedule.

On exit signs, the legend shall occupy a minimum of 80% of the height of the signs. The legend shall comply with EN 7010 and shall incorporate a directional arrow.

Emergency luminaires that incorporate inverter/battery packs shall be fitted with a green LED, fixed either to the body or the trim in such a way as to be visible at all normal times, and to indicate that the inverter supply is healthy.

4.4.1.4 Emergency Lighting Testing System

The existing central battery system shall be used to automatically test and monitor the emergency lighting system and produce accurate reports of testing results and system events. The Contractor shall carry out, with the approved emergency lighting supplier/vendor/manufacturer, an investigation of the existing central battery system and confirm that the existing system has the sufficient capacity to provide the necessary emergency lighting requirements for the new installation for both the corridor and the changing rooms.

The installation shall comply with the requirements of DS/EN 62034.

The system shall comprise:

1. Any necessary software upgrades
2. Interface units to all emergency luminaire.
3. Wiring between the panel and interface unit.

The system shall be designed to fail safe whatever event occurs.

Test routines shall be programmed to take place automatically at selected times to satisfy the requirements of I.S. 3217 or other UN City requirements.

4.4.2 Execution

4.4.2.1 Testing & Commissioning

On satisfactory completion of the installation the emergency lighting system shall be inspected, tested and commissioned by a competent person complying with the requirements of IS 3217.

The Contractor shall carry out a light level test to record the emergency lighting levels in all areas. It shall be carried out during the hours of darkness. The results of the test shall be submitted to the Engineer for information and included in the O&M Manuals.

As part of the tests, the system shall be operated for its rated duration.

Upon satisfactory commissioning of the emergency lighting system, the Contractor shall provide a Certificate for Emergency Lighting Commissioning.

A log book shall be provided and shall form part of the Operating and Maintenance Manual.

4.4.3 Control

The Contractor shall submit a single luminaire for each type of emergency luminaire indicated in the Luminaire schedule in Appendix A.

The Contractor shall submit a technical submittal complete with all manufacturer information to the Engineer for final approval of the material prior to any orders being placed.

4.5 Small Power

The Contractor shall supply, install, test and commission a complete small power services installation as indicated on the drawings and detailed herein.

4.5.1 Materials and Products

4.5.1.1 General

Socket outlets and small power services outlets shall be wired with cables as detailed in the cables and wiring section and circuited as shown on the drawings. Cable sizes shall be as follows:

- 4mm² – 230V Socket Outlets

4.5.1.2 Standards & Regulations

- DS/EN 50085-2-2:2008 ‘Cable trunking systems and cable ducting systems for electrical installations. Particular requirements for cable trunking systems and cable ducting systems intended for mounting underfloor, flush floor, or on floor’
- DS/EN 60309 ‘Plugs, socket-outlets and couplers for industrial purposes’
- DS/EN 61558 ‘Safety of power transformers, power supplies, reactors and similar products’
- DEMKO 107-2-D1 ‘13A plugs, socket-outlets, adaptors and connection units’

4.5.1.3 Accessories / Outlets

4.5.1.4 General

Each type of accessory where applicable shall be of the same manufacture and range to provide consistent appearance and finish.

Indicators on any accessories shall be long-life, low-consumption LED type only.

4.5.1.5 Outlet Types

General outlet types shall be as follows:

Area	Accessory Type	Options or Equal & Approved
Corridor	Flush mounted, steel finish	LK Fuga Slim Steel LeGrand Mosaic (with brushed aluminium finish)
Changing Rooms	Surface mounted	LK Opus 73 LeGrand Hydra

Industrial socket outlets shall as follows:

Area	Accessory Type	Options or Equal & Approved
General	Surface mounted, interlocked switched, IP44 with spring return covers	LK Opus LeGrand Hydra

4.5.1.6 Socket Outlets

Socket outlets shall be 230V, 13A, 3-pin DEMKO compliant, single or twin, outlets as shown on the drawings and detailed herein.

Inserts shall be a different colour than the plate to provide visual contrast.

4.5.1.7 Industrial Socket Outlets

Industrial socket outlets shall be single phase 16A P+N+J and three phase 32A TP+N+J outlets to IEC 60309 with CEE17 surface pattern.

Where shown on the drawings, combination units with multiple industrial socket outlets shall be provided. The units shall be surface mounted, have polycarbonate impact resistant IP44 enclosures and be factory assembled and tested.

These shall be Legrand Hydra Sockets or equal and approved.

4.5.2 Execution

4.5.2.1 General

Flush mounting accessories shall be fitted into purpose made metal boxes only and surface mounting accessories shall be fitted onto metal or all insulated moulded boxes as shown on the drawings or in the schedules.

All boxes or sections of boxes for use with accessories must incorporate a suitably marked earth terminal. Accessory plates shall be secured to boxes by not less than two fixing screws. Where these screws do not provide adequate earth continuity to metal plates or plates including parts to be earthed then a bonding connection shall be provided from the earth terminal to the plate or part. The bonding shall be protected with a green/yellow insulated sleeve. The above requirement shall not

apply to the earth socket on a socket outlet when directly connected to a protective conductor.

Where more than one phase of a supply exists in a multigang box the following requirements shall apply:

- A clearly visible label showing the maximum voltage present shall be arranged as a warning notice before access can be gained to live parts.
- Wiring and accessories connected to each phase shall be separated from each other by fixed screens or barriers.

4.5.3 Control

The Contractor shall submit a sample of each type of accessory indicated on the drawings and schedules.

The Contractor shall submit a technical submittal complete with all manufacturer information to the Engineer for final approval of the material prior to any orders being placed.

4.6 Fire Alarm

4.6.1 Materials and Products

4.6.1.1 General

The Contractor shall supply, install, test and commission a Fire Detection and Alarm System (FDAS) for the changing rooms and corridor, that is a direct extension of the existing Fire Detection and Alarm system of the UN City building, in accordance with this specification and as indicated on the drawings.

The Contractor shall include for developing fire alarm strategy with the Engineer and the Employer's designated FDAS supplier.

The Contractor shall also include for witness testing, proving to the Fire Officer, demonstrating to the Employer and demonstrating to the Occupiers the operation of the system.

The Contractor shall supply full system Operation and Maintenance Manuals, display diagrams and log book in accordance with this specification.

4.6.1.2 Standards & Regulations

- DS/EN 54 '*Fire Detection and Fire Alarm Systems*'
- DS/EN 50136 '*Alarm Systems – Alarm Transmission Systems*'
- DBI Retningslinje 232 '*Automatiske brandalarmanlæg. Projektering, installation og vedligeholdelse*'

4.6.1.3 System Description and Requirements

The system shall be supplied, installed, tested and commissioned in its entirety fully in accordance with DS/EN 54.

The system shall be an extension of the existing Autronica Autosafe 4 system installed within the UN City building.

Detector types shall be as shown on the drawings and as follows:

Area	Detector Type
Corridor	Optical smoke
Changing Rooms	Heat

The fire alarm system shall interface with all the exact same systems that the previous rooms had. The Contractor shall ensure that this is maintained, as the function of the spaces remains the same, although the overall layouts are modified.

The Contractor shall be responsible for updating the cause and effect matrix for the fire detection and alarm system and all interfaced systems and equipment.

Note the requirement in the standards and in this specification for full segregation of the fire alarm cabling and for providing a fire rated support system with marked containment. These requirements will be fully enforced by the engineer.

The Main UN City building is and will remain occupied for the duration of the electrical works to the corridor and changing rooms. The Contractor may only take the fire detection and alarm system or part of the system out of service after agreement with the Employer and their designated Fire Alarm Supplier Autronica. The fire detection and alarm system must always be left operational overnight. The Contractor shall ensure that the fire detection and alarm system is operational before close of business each day.

All wiring systems for communications, detection and alarms shall be monitored for open and short circuits, removal of detectors as well as alarm/healthy conditions.

All faults shall be registered by audible and visible fault alarms, the latter being yellow LEDs.

4.6.1.4 Components (Detectors, Call-Points, Alarms etc.)

4.6.1.5 General Requirements

All components shall comply with the relevant sections of EN 54 as a minimum and shall be part of the Autronica range of products.

All detection devices shall be independently certified to the relevant local and/or international standards.

All components shall be IP30 minimum.

Any detectors in voids or attics where they aren't visible shall have visible LED units mounted on the ceiling of the room underneath the space.

All equipment in external areas shall be minimum IP65 rated.

It shall be possible to connect and mix manual call-points and automatic detectors within the same zone irrespective of the operating principle.

4.6.1.6 Detectors

Detectors shall be of the plug-in type, the insertion and removal of which requires a push and twist action, unless otherwise specified.

Detector bases shall be of a standard type, allowing any point type detector to be plugged into any base.

Standard bases shall be equipped with clamp type wiring terminals. The cable entry shall have a grommet type seal fitting tightly around the wires. Removable dust covers shall be provided to protect the detector contacts until these are fitted. Once inserted, the detector shall be securely held in place so that it cannot become loose when subject to vibration.

Detectors shall not be damaged by reversed polarity.

Detectors shall include built-in alarm indicators and provision shall be made for the connection of remote visual indicators where required.

Detectors used in addressable systems shall have provision for fitting into the fixed base the interface card required for communication with the system.

Remote indicators shall be provided where detectors are normally concealed from view. The indicators shall be labelled to show the location of the corresponding detector.

Detectors shall have built in screens to prevent the entry of insects.

Where detectors are mounted at heights exceeding 3m above finished floor level, the Contractor shall submit proposals for the testing and exchange of detector heads.

Detectors shall not be fitted to their bases until all finishing works have been completed unless otherwise specified.

In all systems the electrical power for operation of detectors shall be provided through the circuit wiring.

4.6.1.7 Photo-Electric Smoke Detectors

Photo-electric (light-scattering) smoke detectors shall respond predominantly to white smoke. In analogue/addressable systems the detector shall automatically adjust to compensate for effects of dust and dirt accumulation. Smoke density shall be measured by a symmetrical optical system employing multiple light pulse coincidence.

4.6.1.8 Point Type Heat Detectors

Heat detectors shall incorporate both rate-of-rise and fixed temperature elements. Each element shall react to different sensitivity thresholds and shall automatically compensate for changes in ambient conditions.

The sensing elements shall be protected against mechanical shock.

Where required, the detector's sensitivity shall be programmable from the control panel within the specified limits.

Heat detectors shall be selected according to the maximum ambient temperature. The nominal operating temperature shall be selected to match the ambient temperature.

4.6.1.9 Manual Call Points

Manual call points will be clearly identifiable and have a simple method of operation.

The method of operation of call points shall be identical throughout the installation.

The call point shall give an audible or visual confirmation within 3s of being operated so that the person operating it is left in no doubt as to the success of the operation.

They shall have normally open (NO) contacts and shall be electrically compatible with the automatic detectors used.

They shall comprise baseplate, insert, cover and be suitable for fixing to standard switch boxes of the flush type or purpose surface mounted type of the same colour.

Covers shall be red in colour and of the snap-on type, secured against unauthorized removal. It shall be possible to test the call point without breaking the glass or removing the cover.

All inscriptions shall be permanently made on the cover and not on the glass.

They shall utilize frangible elements, the broken pieces of which shall be contained within the cover of the call point.

Call points shall employ acceptable sealed micro switches.

The alarm condition shall be maintained until reset by an authorized person by means of a special tool provided for that purpose.

4.6.1.10 Interfacing with Systems

4.6.1.11 General Requirements

The fire alarm system shall be interfaced with associated and ancillary systems as detailed in the specification.

The contractor shall supply, install and connect the interface units on the fire alarm system required for these interfaces.

Ancillary equipment shall be equipped with means of isolation and disabling of automatic operation so that servicing and maintenance can be carried out in complete safety.

Extension and alterations to associated systems including the isolation and removal of parts, shall be possible without affecting the operation and performance of the fire alarm system.

Indicators and detectors associated with ancillary equipment shall be taken into account in calculating the maximum load of the fire alarm system power supply.

Faults in equipment for other functions shall not affect the performance of the fire alarm system.

Software to generate the signals to the interfaced equipment shall be arranged such that the signals are not transmitted during fire alarm test routine, but only in the event of actual fire detection in the building.

4.6.1.12 System Requirements

All signals to and from ancillary systems shall be via volt-free relay contacts (where appropriate) located in the fire alarm panels and remote equipment, the connecting cables being monitored by the fire alarm panel(s).

The layout of control panels in integrated systems shall be arranged so that fire alarm controls cannot be confused with other controls.

4.6.1.13 M&E Equipment Controls

On registering a fire alarm, signals shall be automatically transmitted to operate mechanical and electrical equipment.

Manual override controls shall be provided to operate mechanical and electrical equipment.

In the event of power failure in the communications to mechanical and electrical equipment, the equipment shall operate in a fail-safe mode.

Fire alarm systems incorporating M&E control facilities shall comply in addition with the associated separate M&E controls specification.

4.6.2 Execution

The Contractor shall submit proposals to the Architect for the installation of the repeater panel which shall be fully co-ordinated with the building fabrics and finishes provided by others. The proposals shall include methods of fixing, mounting heights and the method of connecting incoming and outgoing cables.

The installation and method of fixing of all devices shall be co-ordinated with the building fabrics and finishes to which they are fixed.

All control panels and devices shall be fixed true and level to the surfaces on which they are mounted with a tolerance of ± 0.5 mm.

Under no circumstances shall any device be fixed to temporary or movable parts of the building fabric, including doors and furniture.

4.6.2.1 Cable Support

Fire alarm cables shall be run in cable ducts. Single or dual cables may be clipped direct for runs of up to 2 metres using cable manufacturer's fire-resistant fixings. Sleeving with conduit is required for runs over 2 metres.

Methods of cable support shall be non-combustible and such that circuit integrity will not be reduced below that afforded by the cable used, and should withstand a similar temperature and duration to that of the cable, while maintaining adequate support. The use of plastic cable clips, cable ties or plastic conduit/ trunking/ cableways are not acceptable where these products are the sole means of cable support.

The cable support system shall comply with all requirements of the Cable Support Systems for Life Safety and Fire-Fighting Applications section of this specification.

Overhead lines shall not be used for any fire alarm system interconnections.

4.6.2.2 Junction Boxes

Fire alarm junction boxes shall be coloured red, fire resistant, galvanised steel or die-cast alloy, sealed to IP 54, fitted with rail mounted, numbered terminals and a permanently fixed engraved traffolyte label, white script on a red background, reading '**Fire Alarm – Detection Circuit / Sounder Circuit**' as appropriate.

Ceramic heat resistant connectors shall be used (plastic terminal blocks are not acceptable).

Sounder circuits and detection circuits shall have separate junction boxes.

4.6.3 Control

No samples required.

The Contractor shall submit a technical submittal complete with all manufacturer information to the Engineer for final approval of the material prior to any orders being placed.

4.7 Public Address & Voice Alarm Systems

4.7.1 Materials and Products

The Contractor shall supply, install, test, commission and demonstrate an extension of the public address system within the corridor and changing rooms.

This shall include wiring, speakers and auxiliary input equipment etc. to serve areas as outlined on the drawings and shall maintain the exact same number of speakers as are currently installed.

4.7.1.1 System Description and Requirements

The public address system shall generally be used for the broadcast of routine public address messages and shall be capable of delivering high intelligibility messages to all areas in the corridor and changing rooms.

The system shall be supplied, installed and tested, in its entirety, in accordance with DS/EN 60268.

The public address system shall also be used as a voice alarm system in conjunction with the fire alarm system and shall comply with the relevant requirements of DS/EN 60849, DS/EN 54-16, in line with the main UN City building.

The system shall consist of the following:

- Internal recessed ceiling mounted speakers.
- Cabling between the UN City building amplifier and the speakers.

Generally, ceiling mounted speakers shall be 6W, flush mounting, white circular speakers. Speakers shall be IP65.

4.7.1.2 Specialist Manufacturer

The Contractor shall engage with the Sound Systems Contractor to supply, test, commission and certify the system and to co-ordinate all elements of the installation in order to provide a complete system in accordance with the intent of this specification and to the satisfaction of the Engineer.

The specialist Contractor shall be Autronica.

Equipment and components of the public address system shall be manufactured by Autronica. All equipment for each system shall, be designed and provided by the identified manufacturer.

4.7.1.3 Standards and Regulations

- DS/EN 54-16 '*Fire Detection and Fire Alarm Systems - Part 16: Voice Alarm Control and Indicating Equipment*'
- DS/EN 60268 '*Sound System Equipment*'
- DS/EN 61672 '*Electroacoustics - Sound Level Meters*'
- DS/EN 60849 '*Sound Systems for Emergency Purposes*'
- ISO 7240-16:2007 *Fire detection and alarm systems -.Part 16: Sound system control and indicating equipment*

4.7.1.4 General Requirements

Voice reproduction shall be of good quality and natural sounding, excepting those areas with average noise levels in excess of 80 dB(A).

The system shall be free from audible distortion hum and noise and all switching shall be inaudible.

The system shall be capable of producing good overall sound levels with a pink noise signal limited to the operating bandwidth of the system.

Sound levels shall be a minimum of 5 dB(A) above any ambient noise level which exists or is likely to occur for 30 seconds or more.

The specialist Contractor shall be responsible for checking the location and quantity of speakers shown in conjunction with the type of equipment proposed and ensuring that this requirement is met.

4.7.1.5 Power Amplifier

It is anticipated that the existing power amplifier is sufficient to provide the requirements of the corridor and changing rooms.

4.7.1.6 Speakers

All speakers shall be suitable for public address and shall give a very high level of vocal clarity. Recessed ceiling mounted speakers shall be 6W ABS white circular speakers.

The assembly shall comprise of a bass/mid-range 215mm diameter coned loudspeaker and a 25mm Mylar dome tweeter complete with 12.5mm moving coil and neodymium magnet.

The speaker baffle shall be a round two-part bezel comprising of an inner metal mesh grille and chassis with integral speaker having no visible fixings.

The unit shall be fitted with a 6W / 100V line factory fitted transformer.

Transformer shall be 100V line with 3dB power taps of 6, 3, 1.5 and 0.75W to be clearly marked on the assembly.

The speaker shall have wide angle dispersion of 160° @ 1kHz. Cone shall be a damped, high compliance type with a smooth extended frequency response over a range of 50Hz ~ 20 kHz. Sensitivity shall be a minimum of 94dB @ 1m, 1W test signal bandwidth 100Hz ~10 kHz.

4.7.1.7 Installation and Cables

All speaker circuits shall be wired in 2 core fire resistant cables with attention being paid to the table below:

Cable Size	Loudspeaker Circuit Loads						
	4 W	10 W	20 W	40 W	100 W	200 W	400 W
1.00mm ²	8,000	3,200	1,600	800	320	160	80
1.50mm ²	12,000	4,800	2,400	1,200	480	240	120
2.50mm ²	20,000	8,000	4,000	2,000	800	400	200
4.00mm ²	32,000	12,800	6,400	3,200	1,280	640	320
6.00mm ²	48,000	19,200	9,600	4,800	1,920	960	480

4.7.2 Execution

4.7.2.1 Testing & Commissioning

On completion of the installation the Contractor shall have the entire system tested, commissioned and certified by the specialist Contractor in accordance with BR18.

The Contractor shall include for attendances on the specialist supplier during testing and commissioning of the system.

Sound levels shall be measured and recorded. They shall be measured at 1.5m above floor level (1m above floor level in seating areas) in all normally accessible areas, using a sound level meter complying with DS/EN 61672 Type 1 or 2, set to "S" (slow) response and calibrated immediately before the measurements.

The calibration procedure and the measurements may be witnessed by the Engineer who shall be provided with a written set of results.

4.7.2.2 Documentation

The Contractor shall include for supplying full Operation and Maintenance Manuals including as installed drawings and commissioning certificates signed by all relevant parties shall be submitted to the Engineer at the practical completion stage.

4.7.3 Control

No samples required.

The Contractor shall submit a technical submittal complete with all manufacturer information to the Engineer for final approval of the material prior to any orders being placed.

4.8 Earthing and Bonding

4.8.1 Materials and Products

4.8.1.1 General

The Contractor shall supply, install, test and commission a complete earthing and bonding system, in full compliance with all requirements of the relevant standards and regulations.

4.8.1.2 Standards & Regulations

- DS/EN 50173 '*Low Voltage Electrical Installations*'
- DS/EN 50310 '*Application of equipotential bonding and earthing at premises with information technology present*'

4.8.1.3 System Description and Requirements

The entire installation shall be properly and effectively earthed and bonded, with protective earthing and main and supplementary equipotential bonding provided throughout, except where detailed otherwise in the specification and drawings.

The Main Earthing Terminal (MET) of the installation is located in the main LV switchroom located in the basement of the UN City building. The Contractor shall ensure that additional earthing is provided at the distribution board serving this area and shall connect all points to this distribution board.

4.8.1.4 Earth Electrode System

The electrode system shall be connected by means of insulated single core copper cables to the main earth bar(s) for the installation.

All conductors forming part of the earthing system shall be of stranded copper, insulated to 450/750V standards with green/yellow LSF sheath except where detailed otherwise in this specification or on the drawings.

All clamps shall be purpose-made earthing clamps.

4.8.1.5 Execution

4.8.1.6 Installation Requirements

The cross-sectional area of all earthing, bonding and protective conductors shall be as required in the regulations or listed in the specifications.

Contact between dissimilar metals shall be avoided wherever possible. Precautions shall be taken to prevent long-term corrosion. Corrosion inhibiting compounds shall be used in accordance with the manufacturer's recommendations

Where conduits, or small glands for mineral insulated or armoured cables, terminate on switchgear, distribution boards, starter panels or other apparatus, brass compression washers shall be used to ensure an effective earth connection.

Where connections are made between sections of trunking, the manufacturer's earth continuity links shall be installed across the joint. Connections made between trunking sections crossing a building expansion joint shall be made with a flexible copper braid.

The earth terminal of all socket outlets shall be connected to the main protective conductor of the final sub-circuit. Where the protective conductor is formed by conduit, trunking or the metal sheath and/or armouring of cables, the earth terminal of the socket outlet shall be connected to an earth terminal in the box or enclosure associated with the conduit, trunking or cable.

Connections between earth bars, equipment frames etc. and stranded copper cables and/or copper strip shall be made with the appropriate compression lug, bolt, washers, nut and lock nut. With copper strip, the washers shall be of sufficient size to prevent any distortion of the strip.

All contact surfaces shall be thoroughly cleaned prior to connection.

Connections to pipework and cable sheath/armour shall be made with clamps

Joints shall only be used where unavoidable.

4.8.1.7 Equipotential Bonding

Main bonding conductors shall be installed to connect the extraneous conductive parts of the main engineering services (gas & water pipes, HVAC ductwork, tanks, structural steel parts etc.) to the earthing terminal at the distribution board. Conductors shall be minimum 25mm² earth cable.

Supplementary bonding conductors shall be installed to connect all extraneous and exposed conductive parts throughout the installation. These shall be sized in accordance with the regulations but shall not be less than 2.5mm².

Metallic ductwork and pipework shall be bonded across insulating joint with 25mm² copper braid bonding conductor.

All instruments shall be bonded using minimum 4mm² earth cable bolted to the lug provided by the manufacturer and linked to the associated tray or bonded tube.

Suspended ceilings shall be bonded to luminaire earth terminals. Minimum one bond per 20m² with 2.5mm² earth cable.

4.8.1.8 Testing & Commissioning

Tests shall be made both during and upon completion of the works.

Resistance tests shall be carried out on each section of the earthing system and on the complete system at the completion of the works.

Tests made on the earth electrode system shall include details of the prevailing weather and ground conditions.

Where building elements are to be used as the earth electrodes they shall be tested during construction to ensure that the resistance is low enough to make suitable electrodes. A formal record will be kept of the resistance readings taken.

Earth fault loop impedances shall be measured at all distribution boards, motor control centres, miscellaneous plant and equipment, etc. and on all final circuits. All results shall be recorded on the schedules of sub-circuit and final circuit insulation resistance, which shall be provided by the Contractor.

All plant and equipment supplied, installed and connected to the installation and/or existing plant and equipment connected to the installation shall also be tested.

4.8.2 Control

No samples required.

The Contractor shall submit a technical submittal complete with all manufacturer information to the Engineer for final approval of the material prior to any orders being placed.

Appendix A

Luminaire Schedule

Job Title: **UN City Refurbishment Changing Rooms**

Luminaire Reference: **A**

Job Number: **279110-00** Purpose of Issue: **Issue**

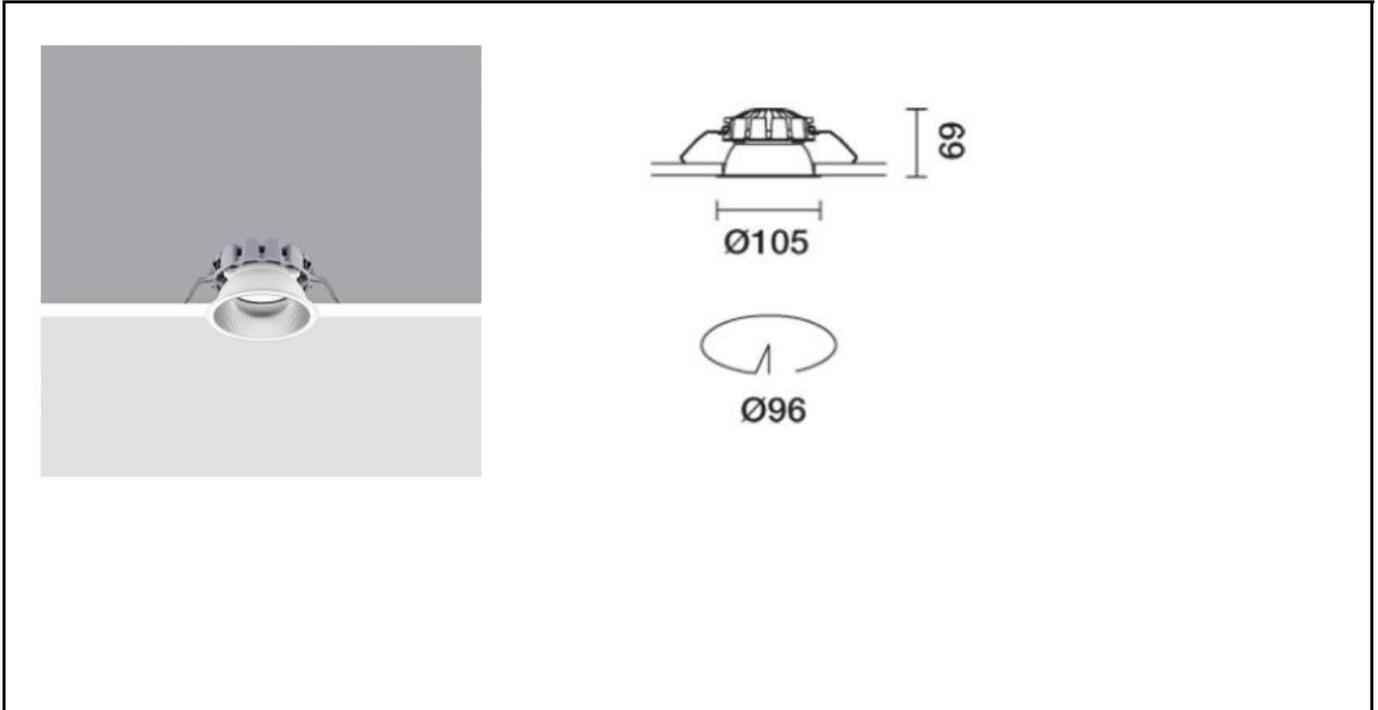
Revision: **0**

Date: **27-Nov-20**

General Description

Round fixed luminaire designed to use LED lamps with C.o.B. technology. Version with rim for surface-mounting. Prismatic thermoplastic reflector complete with flux enhancer. Dissipater made of painted grey die-cast aluminium. Product complete with LED lamp in warm white colour tone (3000K). General lighting beam.

General Appearance



Luminaire

Manufacturer	iGuzzini or equal or approved
Manufacturing standard	White
Catalogue number	QV79.D8
Finish	

Light Source

No. & Type	LED
Wattage	13.2W
IP Rating	IP54
Colour / Beam	3000K

Control Gear / Transformer

Type	DALI
Dimming	Yes
Location	Integral

Accessories

Lens	Yes
Baffle	n/a
Other	n/a

Fixture Location(s) Corridor and Changing Rooms

Equipment supplied to be as specified or equal approved

Additional Information

1. _____
2. _____
3. _____
4. _____
5. _____

Job Title: **UN City Refurbishment Changing Rooms**

Luminaire Reference: **B**

Job Number: **279110-00** Purpose of Issue: **Issue**

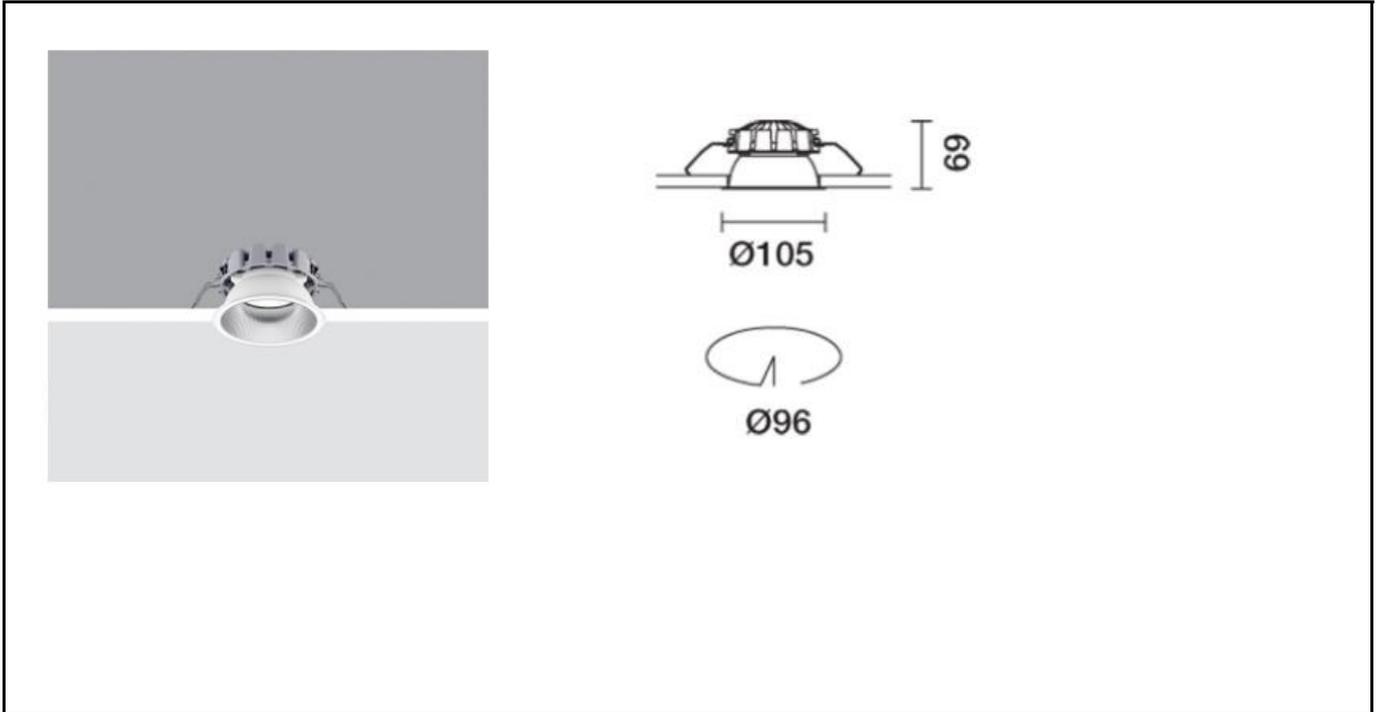
Revision: **0**

Date: **27-Nov-20**

General Description

Round fixed luminaire designed to use LED lamps with C.o.B. technology. Version with rim for surface-mounting. Prismatic thermoplastic reflector complete with flux enhancer. Dissipater made of painted grey die-cast aluminium. Product complete with LED lamp in warm white colour tone (3000K). General lighting beam.

General Appearance



Luminaire

Manufacturer	iGuzzini or equal or approved
Manufacturing standard	White
Catalogue number	QV79.D8
Finish	

Light Source

No. & Type	LED
Wattage	13.2W
IP Rating	IP54
Colour / Beam	3000K

Control Gear / Transformer

Type	DALI
Dimming	Yes
Location	Integral

Accessories

Lens	Yes
Baffle	n/a
Other	n/a

Fixture Location(s) Corridor and Changing Rooms

Equipment supplied to be as specified or equal approved

Additional Information

1. Emergency luminaires to come complete with interface units as necessary for connection to the central battery system.

2.

3.

4.

5.

Job Title: **UN City Refurbishment Changing Rooms**

Luminaire Reference: **EXIT**

Job Number: **279110-00** Purpose of Issue: **Issue**

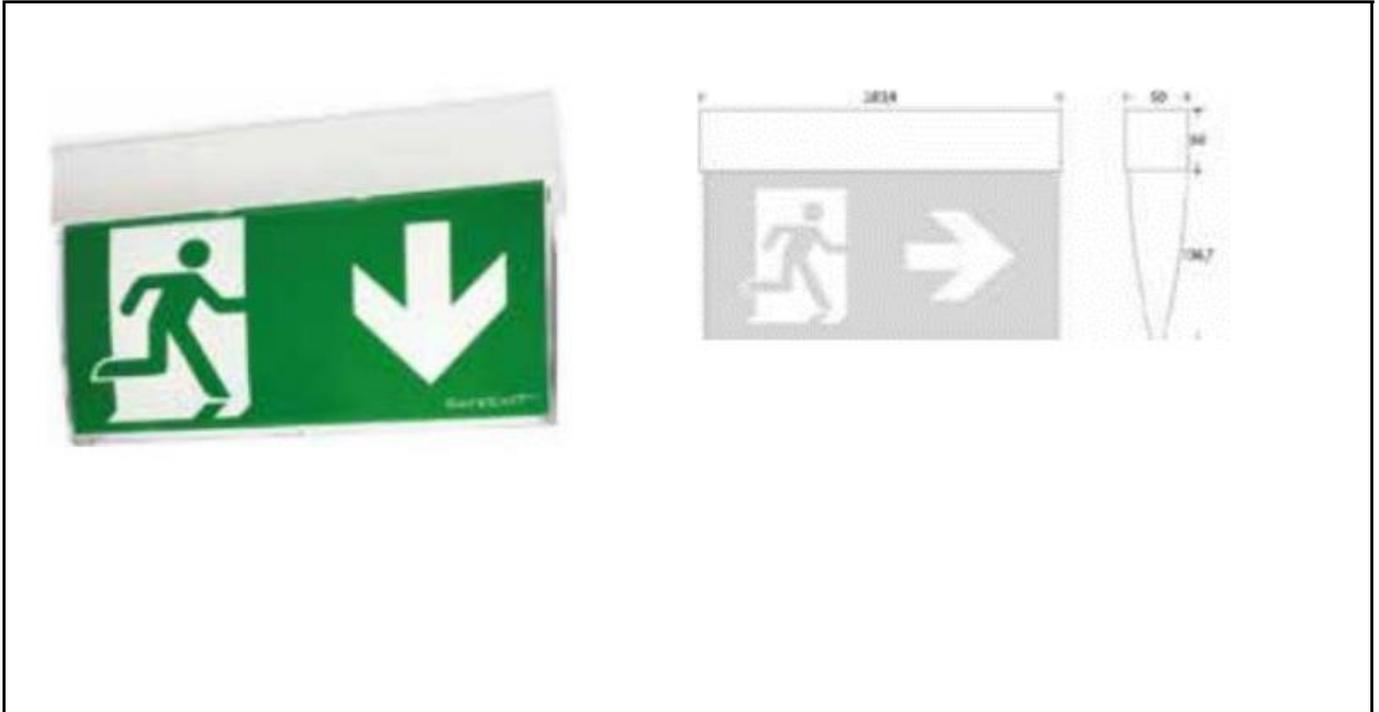
Revision: **0**

Date: **27-Nov-20**

General Description

Luminaires to be connected to central battery system, reading distance 27m

General Appearance



Luminaire

Manufacturer	SafeExit 1234 or equal or approved
Manufacturing standard	Series F1 230V AC / DC LED
Catalogue number	60131015
Finish	Standard

Light Source

No. & Type	LED
Wattage	2W
IP Rating	IP54
Colour / Beam	4000k

Control Gear / Transformer

Type	DALI
Dimming	Yes
Location	Integral

Accessories

Lens	NO
Baffle	n/a
Other	n/a

Fixture Location(s)

Throughout

Equipment supplied to be as specified or equal approved

Additional Information

1. Connected to central monitoring panel. Refer to specifications.

2.

3.

4.

5.

Appendix B

Definitions and common terms

Term	Meaning
Employer	The Employer is the party responsible for coordinating the input of the Employer and the Employer's appointed consultants including Consultants involved in preparing the design intent information for the Works and others as necessary in relation to the Works. It includes any of these parties when directed and instructed by the Employer .
Contractor	Includes all sub-consultants, sub- Contractors , and suppliers working under the Contractor either directly or indirectly with respect to the Works. References to 'he' and 'his' in this Specification refer to the Contractor unless the context of the clause indicates otherwise.
Detailed Design Submissions	Design information produced by the Employer .
Project Plan	Information supplied by the Contractor including, models, samples, prototypes, mock-ups, digital mock-ups, 3d surface models, tests, reports, certificates, permissions and approvals, method statements that are to be submitted to the Employer for review and approval.
Visual Mock Up Drawings	Information supplied by the Contractor including, project design, testing, fabrication, shipping and installation, that are to be submitted to the Employer for review and approval.
Performance Mock Up Drawings	Drawings produced by the Contractor illustrating his detail design proposals for the Visual Mock Up (VMU). These are to be submitted to the Employer for review and approval.
Fabrication drawings	Drawings produced by the Contractor illustrating his detail design proposals for the Performance Mock Up (PMU). These are to be submitted to the Employer for review and approval.
Installation drawings	Drawings produced by the Contractor containing fabrication and process information for use in the manufacture and factory assembly of components for the Works, all in accordance with the approved Construction drawings. These are not required for review and approval, but should be available for inspection and audit if requested.
	Drawings produced by the Contractor containing installation and process information for use in the manufacture and site assembly of components for the Works, all in accordance with the approved Construction drawings. These are not required for review and approval, but should be available for inspection and audit if requested.

Term	Meaning
As-built information	Information supplied by the Contractor as part of the O&M manual including drawings, photographs, descriptions, tests and reports. These are to be submitted to the Employer for review and approval.