Contents

1 General

1.1 General requirements

.1 The requirements of this section shall apply to all sections in Division 26 – Electrical.

.2 Conform to Division 1 General Conditions.

.3 All material, labour, equipment, and services required under this section shall be the full responsibility of the Contractor including any material, labour, equipment, and services provided by their sub-contractors.

.4 Refer to front end tender documents and electrical specifications for approved sub-trade lists

1.2 Definitions

.1 “Supply” shall mean supply only.

.2 “Install” shall mean install and connect.

.3 “Provide” shall mean supply, install, connect and test.

.4 “Drawings and Specifications” shall mean Contract Documents.

.5 “Authorities” or Authorities having jurisdiction” shall mean all agencies that enforce the applicable laws, ordinances, rules, regulations, or codes of the Place of Work.

.6 “Work” shall mean all equipment, materials, labour, and permits to provide a complete and operational electrical system as detailed in the drawings and specifications.

.7 “Owner” shall mean Action Car and Truck.

1.3 Related work

.1 Division 1 – General

.2 Division 22 and 23 – Mechanical

.3 Division 26 specifications form a part of the Contract Documents and shall be read, interpreted, and coordinated with all other Divisions. The Instructions to Bidders, General Conditions, General Requirements, Supplementary General Conditions and Amendments and Supplements thereto form a part of this Division and contain items related to the electrical work.

.4 Division 27 – Communications

.5 Division 28 – Fire Alarm

1.4 Intent

.1 The drawings and specifications are not a detailed set of installation instructions. Drawings and specifications are complementary to one another and that which is shown on one is as binding as that which is shown on both.

.2 The Consultant shall be immediately informed of any discrepancies between drawings and specifications leaving in doubt the true intent of the work.

.3 Supply all labour, equipment, and materials necessary to install a complete and operational electrical system described herein and shown on the drawings.

.4 It is the intent of these drawings and specifications to provide for an electrical installation complete and in operating condition. The responsibility for supplying and installing all material necessary to accomplish this, except where specifically noted that such work or materials is not included, shall be part of this section.

.5 Assess and be familiar with existing site conditions prior to pricing and construction and allow for same in tender price.

.6 All work must be done by qualified and certified persons in such line of work. Trade certificates must be available on demand.

.7 All work shall be in accordance with standard industry practice accepted and recognized by the Consultant and the Trade.

.8 The Contractor shall coordinate with and cooperate with all other trades prior to installation. Where work interferes with other trades due to failure to coordinate or cooperate, the work shall be removed and relocated as approved by the Consultant at no extra cost to the Owner.

.9 The Consultant shall have the right to reject any work that does not conform to the Contract Documents and accepted standards of practice including but not limited to performance, quietness of operation, and finish.

.10 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.

1.5 Codes, bylaws, standards, and regulations

.1 The electrical system shall comply with the latest editions and revisions of applicable codes, bylaws, bulletins, standards, and regulations including but not limited to:

.1 Ontario Building Code

.2 Ontario Electrical Safety Code

.3 Canadian Standards Association

.4 Local Municipal Codes

.5 Local Building Bylaws

.6 Ontario Occupational Health and Safety Act

.7 IEEE

.2 Provide work in accordance with the requirements of all applicable government codes, local by-laws, underwriter’s regulations base building standards, contract documents, and all authorities having jurisdiction.

.3 Where discrepancies occur between contract drawings and specifications and above codes and standards referred to herein, the Contractor is to

notify the Consultant in writing and obtain clarification prior to proceeding with the work.

.4 Contractors shall not reduce the requirements on the contract drawings and specifications by applying any codes and standards referred to herein.

1.6 Permits and fees

.1 Apply for, obtain, and pay for all permits, fees, connections, inspections, licenses, certificates or charges necessary including all provincial and federal taxes including HST.

.2 Coordinate all required inspections and give necessary notice to all authorities.

.3 Upon completion of project, provide inspection certificates confirming acceptance by all authorities having jurisdiction.

1.7 Contract breakdown

.1 After the tenders close, submit a breakdown of the price into scope and trades to the satisfaction of the Consultant based on the sections of the specifications.

.2 Breakdown shall include but not be limited to:

.1 Mobilization and shop drawing submission
.2 Permits and Fees
.3 Panel boards and other miscellaneous distribution equipment
.4 Starters, contactors and control devices
.5 Feeder conduits
.6 Branch conduits
.7 Feeder cables
.8 Branch wiring
.9 Wiring for mechanical equipment
.10 Luminaires (interior/exterior)
.11 Fire Alarm System
.12 Voice & Data
.13 Security System
.14 Close-out Submittals – Manuals & Record Drawings

.3 Progress claims shall be based on the breakdown. Submit in table format showing contract amount, work complete to date as percentage, previous draw, amount this draw and balance for each line item.

1.8 Shop drawings

.1 Refer to 01 33 00.

1.9 Product delivery schedule

.1 Refer to 01 32 00 and 01 65 00.

1.10 Construction meetings

.1 The Electrical Contractor shall attend all site meetings unless otherwise pre-approved.

.2 Sub-trades shall attend site meetings as requested or as required.

.3 Refer to 01 31 19.

1.11 Record drawings

.1 Refer to Section 01 78 00.

1.12 ESA certificates

.1 Furnish an unconditional Certificate of Acceptance from Electrical Safety Authority on completion of work. Arrange for interim and rough-in inspections. Arrange and pay for Occupancy Inspections if required for partial occupancies.

.2 Incorporate a copy of the final ESA Certificate in the operating and maintenance manual.

1.13 Maintenance manuals

.1 Refer to Section 01 78 00.

1.14 Testing

.1 The installation shall be free of open circuits and grounds.

.2 On completion, measure insulation resistances and comply with Table 24 of Ontario Electrical Safety Code.

.3 Test all wiring and connections for continuity and grounds before equipment is energized.

.4 Before energizing system, check all connections and set and calibrate all relays and instruments for proper operation, obtain necessary clearances, approval and instructions from utility company.

.5 Carry out all tests and furnish all equipment required to demonstrate safe and proper completion of the work, without cost to the Owner.

.6 Check load balance on all feeders and make necessary adjustments to provide a "balanced" load.

.7 Fully coordinate all testing and commissioning with all trades, the Consultant, and authorities having jurisdiction.

.8 Provide a minimum of forty-eight (48) hours written notice to all parties.

1.15 Demonstration and training

.1 Refer to 01 79 00.

1.16 Substantial completion and performance

.1 Substantial completion and performance shall be determined and awarded by the Consultant.

.2 Complete the following to the satisfaction of the Consultant prior to request for substantial performance:

.1 Submit Electrical Safety Authority Certificate

.2 Submit reports as specified herein – fire alarm, emergency lighting

.3 Fire stopping

.4 Record drawings

.5 Demonstration and Training

1.17 Warranty

.1 Provide a full parts and labour warranty for the new system from date of substantial completion. Refer to 00 65 36 for details and terms.

.2 Submit warranty letter on Company letterhead signed by Company representative stating warranty terms including warranty period from date of substantial completion.

2 Products

2.1 General

.1 All material used shall be new, free from defects, of quality specified, and installed in accordance with manufacturer's instructions.

.2 Major components shall have nameplates on the exterior of the equipment in a visible location containing manufacturer's name, model number, serial number, performance data, and electrical characteristics.

.3 The same manufacturer shall be used for types of components used in similar applications.

.4 It is the responsibility of the Contractor to store and protect materials supplied by this scope.

.5 Materials must be stored in original containers.

.6 Remove and dispose of all redundant materials and garbage from site.

2.2 Selected products and equivalents

.1 Sections within Division 26 list "Acceptable Manufacturers" which must meet characteristics of the specified equipment and products for each section.

.2 Base specified products are specified and/or shown on the drawings, and identified by manufacturer's name, type and catalogue number.

.3 Any alternate manufacturers from base specified products and equipment must equal or exceed the quality, finish and performance of those base specified and/or shown, and not exceed the space requirements allotted on the drawings. Include costs for any associated work to accommodate such substitutions, including the Consultant's time and revisions to the work of other divisions.

.4 If item or material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after the Contract has been awarded.

.5 If item of size indicated is unobtainable, supply next larger size without additional charge.

2.3 Quality of product

.1 All products provided shall be CSA approved, approved by other relevant authorities.

.2 If supplied products are not CSA approved, obtain approval of provincial regulatory authority. Pay all applicable charges levied and make all modifications required for approval.

.3 All products provided shall be new including those not specified and shall be of a quality best suited to the purpose required and their use subject to approval by the Consultant.

2.4 Voltage ratings

.1 Operating Voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

2.5 Electric motors, equipment and controls

.1 Refer to Drawings for Contractor’s equipment wiring responsibility.

.2 Control wiring and conduit shall be covered under this Division except connections below 50V which are related to control systems specified under Division 23.

2.6 Product finishes

.1 Shop drawings shall include finishes.

.2 All cabinets, panelboards, switchboards, cable trays, etc. shall be finished in ANSI 61 grey enamel unless otherwise specified.

.3 Apply primer on all items which are to be finished on the job.

.4 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

2.7 Access doors

.1 Provide access doors/panels as required for access, adjustment, operation, service, and maintenance.

.2 Access doors shall be flush mounted 600mmx600mm (24”x24”) for body entry and 300mmx300mm (12”x12”) for hand entry. Doors to open 180 degrees, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

.3 Access doors/covers - flush access door – drywall area

.1 Acudor #DW-5040 Series flush to surface for drywall, satin coat steel with white baked enamel finish, formed door panel, flanged on four sides, 20 gauge. Galvanized frame with multiple bends and integral taping bead, 26 gauge. Concealed hinge, stainless steel screwdriver operated cam latch.

.4 Access doors/covers - flush access door - universal

.1 Acudor #UF-5000 Universal Access Doors, 14 GA. (1.7mm) steel, baked enamel prime coat, continuous concealed hinge, with positive and self-opening screwdriver operated lock.

.5 Acceptable Manufacturers:

.1 Acudor

.2 Zurn

.3 Nailor Industries

.4 Le Hage

2.8 Floor mounted equipment

.1 Mount Switchboards, Motor Control Centres and all other floor mounted electrical equipment on chamfered edge housekeeping pads, minimum of 100 mm (4”) high and 150 mm (6”) larger than equipment dimensions all around.

2.9 Sleeves

.1 Provide sleeves for all cables passing through masonry, concrete or fire rated assemblies unless run in conduit. Conduit shall be minimum 53mm.

.2 Sleeves shall be EMT conduit complete with bushing.

2.10 Fire stopping

.1 This Contractor shall work with all other Contractors on the project in providing one common method of fire stopping all penetrations made in the fire rated assemblies.

.2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.

.3 Do not use cementious or rigid seals around penetrations for pipe, ductwork, or other mechanical items.

.4 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.

.5 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.

.6 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide “fire wrap” blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.

.7 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.

.8 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.

.9 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.

.10 Firestopping shall be inspected and approved by local authority prior to concealment of enclosure.

.11 Install material and components in accordance with ULC certification, manufacturer’s instructions and local authority.

.12 Submit product literature and insulation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and Consultant.

.13 Acceptable Manufacturers:

.1 Fryesleeve Industries Inc.

.2 General Electric Pensiil Firestop Systems

.3 International Protective Coatings Corp.

.4 Rectorseal Corporation (Metacaulk)

.5 Proset Systems

.6 3M

.7 AD Systems

.8 Hilti

3 Execution

3.1 Site examination

.1 Examine the site of work and become familiar with all features and characteristics affecting this work before submitting tender.

.2 No additional compensation will be given for extra work due to existing conditions which such examination should have disclosed.

.3 Report to the Consultant any unsatisfactory conditions which may adversely affect the proper completion of this work.

3.2 Interference and coordination drawings

.1 Refer to 01 31 14.

3.3 Separation of services

.1 Maintain separation between electrical wiring system and building piping, ductwork, etc. so that wiring system is isolated (except at approved connections to such systems) to prevent galvanic corrosion.

.2 In particular, contact between dissimilar metals, such as copper and aluminum, in damp or wet locations is not permitted.

.3 Do not support wiring from pipes, ductwork, etc. Hangers for suspended ceilings may be used for the support of wiring only when approval is obtained from ceiling installer, and approved clips or hangers are used.

3.4 Workplace safety

.1 The workplace must be kept safe at all times.

.2 Conform to all ministries of labour, and health and safety regulations at all times.

.3 Use ladders and proper techniques as approved by the ministry of labour to perform all work.

.4 Cover all holes/openings and provide barriers around hazards, etc. to ensure occupants and workers are not at risk.

.5 Where work does not conform to such regulations, stop work immediately and report the situation to the Owner's representative or Consultant or rectify the situation immediately.

.6 Report any hazards or concerns to the Owner's representative immediately.

.7 Conform to the Owner's safety requirements and construction regulations.

3.5 Temporary requirements

.1 Provide grounded extension cords and temporary lights required for work.

.2 Any specific task lighting required on site is the responsibility of this Division.

3.6 Location of luminaires

.1 Locations may have to be revised to suit construction and equipment arrangements and it is expected that such changes will not result in additional cost to the Owner, provided that no additional labour or material is required and installation has not been completed.

3.7 Mounting heights

.1 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise. Coordinate with block coursing (if applicable).

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights (indicated to the center of device box) unless indicated otherwise in plans:

.1 Local switches or switch plate sensors: 1050mm (41”)

.2 Wall receptacles:

.1 General: 400mm (16”)

.2 Above top of continuous baseboard heater: 200mm (8”)

.3 Above top of counters or counter splash backs: 100 mm (4”)

.4 In mechanical rooms: 1200mm (48”)

.3 Panelboards: as required by Code or 1400mm (56”)

.4 Voice/Data outlets: At height of adjacent outlet or at 400mm (16”)

.5 Thermostat: 1150mm (46”)

3.8 Repairs, cutting and restoration

.1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.

.2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.

.3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

.4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

3.9 Painting

.1 Refer to other Divisions for Painting unless otherwise specified herein.

.2 Apply at least one (1) coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

.3 Prime and touch up marred finished paintwork to match original.

.4 Restore to new condition, or replace equipment at discretion of Consultant, finishes which have been damaged too extensively to be merely primed, painted and touched up.

3.10 Concealment

.1 All equipment, components, piping, and conduit shall be concealed in ceiling spaces, bulkheads or walls where possible unless otherwise noted on the drawings or approved by the Owner or Consultant.

.2 Exposed equipment, components, piping, and conduit installed in unfinished areas, shall be installed as high as possible. Run piping and conduit tight to roof deck and down columns.

3.11 Clearances and accessibility

.1 Install all work for easy access for adjustment, operation, and maintenance.

.2 Maintain clearances for all components as per code and manufacturer's instructions.

.3 Provide access panels of adequate size as required to access components in concealed areas. Do not install access doors in specialty walls or ceilings.

.4 Provide fire rated access doors shall be installed in fire separations and match rating of separation.

3.12 Equipment and system protection

.1 Protect components and materials from damage in storage and on site before, during, and after installation until final acceptance.

.2 Protect inside and outside of components from dust and debris with appropriate covers that will withstand through the construction.

.3 Where equipment and system components become dirty or damaged, clean and repair to new condition to the satisfaction of the Consultant at the expense of this Contractor.

3.13 Supports

.1 Provide all miscellaneous metals and materials as required for support, hanging, anchoring, and guiding of all components.

.2 All supports must be securely mounted to structures.

3.14 Concrete pads

.1 Provide 100mm (4”) high concrete pads under all floor mounted electrical equipment including but not limited to MCCs, switchboards and transformers. Concrete pad shall extend 100mm (4”) beyond footprint of equipment.

.2 Paint top and all sides of pad with two (2) coats of yellow paint.

3.15 Location of outlets

.1 Do not install outlets back-to-back in wall. Allow minimum 150mm (6”) horizontal clearance between boxes.

.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3m (10’) and information is given before installation.

.3 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

3.16 Fire stopping

.1 Refer to Part 2 herein.

3.17 Cleaning

.1 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

3.18 Owner supplied equipment

.1 Connect to equipment supplied by the Owner and make operable.

3.19 Equipment identification

.1 Identify electrical equipment with nameplates as follows:

.2 Nameplates:

.1 Lamacoid 3mm (1/8”) thick plastic engraving sheet, black face, white core, mechanically attached with self-tapping screws.

Nameplate Sizes

Size 1	9mm x 50mm (3/8” xx 2”)	1 line	3mm (1/8”) high letters

Size 2	12mm x 70mm (1/2” x 2-1/2”)	1 line	5mm (3/16”) high letters
Size 3	12mm x 70mm (1/2” x 2-1/2”)	2 lines	3mm (1/8”) high letters
Size 4	20mm x 90mm (3/4” x 3-1/2”)	1 line	9mm (3/8”) high letters
Size 5	20mm x 90mm (3/4” x 3-1/2”)	2 lines	5mm (3/16”) high letters
Size 6	25mm x 100mm (1” x 4”)	1 line	12mm (1/2”) high letters
Size 7	25mm x 100mm (1” x 4”)	2 lines	6mm (1/4”) high letters

.3 Wording on nameplates labels to be approved by Consultant prior to manufacture.

.4 Allow for average of twenty-five (25) letters per nameplate.

.5 Identification to be English.

.6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.7 Nameplates for disconnects, starters and contactors must indicate equipment being controlled and voltage.

.8 Nameplates for transformers must indicate transformer label as indicated and capacity, primary, and secondary voltages.

.9 All equipment, whether supplied by the Electrical trade for by other trades, shall be labelled with panel and circuit number. Labels shall be lamacoid nameplates.

3.20 Wiring identification

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

3.21 Conduit and cable identification

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15m (45') intervals.

.3 Colour bands must be 25mm (1") wide.

	Prime
Up to 208V	yellow
Voice system	green
Data system	orange
Security	brown
Public address	black
Fire alarm	red

.4 This Contractor must paint all system junction boxes and covers in conformance with the above schedule.

3.22 Wiring terminations

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

3.23 Warning signs

.1 Meet requirements of Electrical Safety Authority and Consultant.

.2 Provide porcelain enamel signs, with a minimum size of 175mm x 250mm (7" x 10").

3.24 Load balance

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage equipment.

.3 Submit at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

3.25 Field quality control

.1 Conduct and pay for following tests:

.1 Power distribution system including phasing, voltage, grounding, and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Lighting and its control.

.4 Motors, heaters and associated control equipment including sequenced operating systems where applicable.

.5 Systems: fire alarm system.

.2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.3 Insulation resistance testing.

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.4 Carry out tests in presence of Consultant.

.5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.6 Submit test results for Consultant's review.

3.26 Coordination of protective devices

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as indicated on drawings or as determined from coordination study.

3.27 Demonstration and training

.1 Refer to 1.15 herein.

3.28 Field review and deficiencies

.1 The Contractor shall notify the Consultant when the job is ready for field review at various stages including rough-in stages.

.2 During the course of construction, the Consultants will monitor construction and provide written reports of work progress, discussions and deficiencies.

.3 The Contractor shall correct all deficiencies within the work period prior to the next review.

.4 The Contractor shall not conceal any work until inspected. Where work was concealed, the Contractor shall remove and replace tiles, coverings or other obstructions to allow proper inspection at the Contractor's expense.

.5 Upon completion of the project the Consultant will do a final review. Upon receiving the final inspection report, the Contractor must correct and sign back the inspection report indicated all deficiencies are completed. A re-inspection will only be done once the Consultant receives this in writing. Where the Consultant performs the re-inspection and the work is not complete, the Contractor is responsible for reimbursing the Consultant for the field review. The fee for

.6 Additional reviews will be at the Consultant's hourly rates plus mileage and applicable taxes to be paid directly to the Consultant prior to performing the next field review.

End of section

4 General

4.1 General

.1 The following specification represents the minimum standard required for installation of basic electrical components.

4.2 Work included

.1 Refer to Section 26 05 01.

.2 Work to be done under this Section includes labour, materials, and equipment required to install, test and operate Electrical and Communication Systems.

4.3 Codes and standards

.1 Ontario Electrical Safety Code – Current Edition.

.2 CSA

.3 ULC

.4 American Electronic/Telecommunication Industry Association

.5 Commercial Building for Telecommunications Pathways and Spaces

.6 Local Telephone Company requirements

.7 Local Codes and Requirements

4.4 Submittals

.1 Shop Drawings:

.1 Submit shop drawings to the Consultant for review prior to ordering or installation.

.2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.

.3 Contractor is responsible for reviewing and stamping all shop drawings to ensure equipment is as per specifications and match site conditions. Shop drawings will not be reviewed without contractor stamp indicating review.

.4 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

.2 Operation and Maintenance Data:

.1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.

.2 Operation and maintenance data shall be included in the maintenance manual.

4.5 Standard of materials

.1 Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.

.2 Materials required for performance of work shall be new and the best of their respective kinds and of uniform pattern throughout work.

.3 Equipment items shall be standard products of approved manufacture. Identical units of equipment shall be of same manufacture.

.4 Chemical and physical properties of materials and design performance characteristics and methods of construction and installation of items of equipment, specified herein, shall be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.

.5 Materials shall bear approval labels as required by Code and/or Inspection Authorities.

.6 Install materials in strict accordance with manufacturer’s recommendations.

.7 Include items of material and equipment not specifically noted on Drawings or mentioned in Specification but which are necessary to make a complete and operating installation.

.8 Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.

.9 Where a specific manufacturer is noted herein, other manufacturers may be considered where approved by the owner.

5 Products

5.1 General

.1 Provide all equipment as per the following description to complete the entire works as shown on drawings and as indicated in the specifications to provide a complete and operational system.

.2 Coordinate with other trades to provide the components required to make all systems operational – see mechanical schedules for details of equipment provided to make sure the works are complete.

5.2 Outlet boxes

.1 Outlet boxes shall conform to C.S.A. Standard C22.2 No. 18-1972.

.2 Ceiling boxes shall be 103 mm octagon or square, complete with fittings, where required to support fixtures.

.3 Switch and receptacle boxes shall be:

.1 103 mm square with plaster ring, where flush mounted in plaster walls.

.2 No. 1104, where flush mounted in wood or drywall, with stud fasteners as required.

.3 Masonry boxes in masonry walls.

.4 Where boxes are surface mounted in unfinished areas they shall be FS conduits.

.5 Standard outlet boxes shall be manufactured from code gauge galvanized steel.

.6 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.

.7 Boxes shall be of a size suitable for the number and size of conductors and the space requirements for the wiring device.

5.3 Conduit accessories, conduit and fittings

.1 Conduit accessories, conduit and fittings shall conform to C.S.A. Standard C22.2 No. 18-1972.

.2 Rigid conduit bushings shall be as manufactured by:

.1 Thomas & Betts Ltd. – Series 5031

.2 Efcor of Canada Ltd. – Series 720B

.3 Commander / Iberville

.3 EMT Connectors shall be steel set screw type as manufactured by:

.1 Thomas & Betts Ltd. – Steel City TC 121E Series

.2 Efcor of Canada Ltd. – Series 720B

.3 Commander / Iberville

.4 Ground Bushing shall be as manufactured by:

.1 Thomas & Betts – Blackjack or 1220 Series

.2 Efcor of Canada Ltd.

.3 Commander / Iberville

.5 Flexible conduit connectors shall be as manufactured by:

.1 Thomas & Betts Ltd. – Series 3110

.2 Efcor of Canada Ltd. – Series 1001B

.3 Commander / Iberville

.6 Conduit fittings shall be as manufactured by:

.1 Crouse-Hinds of Canada Ltd.

.2 Kondu Mfg. Co. Limited

.3 Thomas & Betts Ltd.

.4 Killark of Canada

.5 Efcor of Canada Ltd.

.6 Commander / Iberville

.7 Steel conduit shall be as manufactured by:

.1 Conduits National Co. Ltd.

.2 MBF Industries

.8 Aluminum conduits shall be as manufactured by:

.1 Alcan Canada Products Ltd.

.9 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.

.1 Thomas & Betts – 8125 Series

.10 Terminate EMT entering boxes or enclosures with nylon insulated steel threaded bushings.

.11 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.

.1 Thomas & Betts – 5332 Series

.12 Install wall entrance seals where conduits pass through exterior walls below grade.

.13 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.

.14 All cabling shall be run in EMT conduit unless otherwise approved.

.15 BX cable may only be used for short drops to light fixtures to a maximum length of 1500 mm. Any installations exceeding 1500 mm will be removed and replaced at the contractors expense. All installations of BX cable shall be complete with anti-short bushings at all stripped ends as per OEC #12-608(1)(a). Connectors for BX cable shall be Crouse Hinds #L16ST.

.16 Rigid PVC (unplasticized) conduit shall be CSA approved according to CSA Standard C22.2 No. 136. Ridgid PVC conduit may only be used under ground or when encased in concrete.

.17 Pull Cords/Strings

.1 Nylon twine

5.4 Conductors, wires and cables

.1 Wiring installed in conduit, unless otherwise noted, shall be copper 600 volt RW90XLPE, RWU90XLPE or T-90 nylon jacket as per the requirements on the plans. It is the responsibility of the contractor to verify all equipment termination temperature and adjust wire size/rating to suit.

.2 Lighting and power wiring shall be copper, minimum No. 12 gauge when protected by 15 amp breakers and 10 gauge when protected by 20 amp breakers. Size wires for 2% maximum voltage drop to farthest outlet on a maximum 80% loaded circuit. Increase wire size according to OESC section 4 when more than 3 current carrying conductors are installed in a single conduit.

.3 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case. Neutrals shall have white insulation over their entire length. Grounds or bonding conductors shall have green insulation over their entire length.

.4 Colour Coding for AC systems shall be as follows:

.1 Phase “A” – Red

.2 Phase “B” – Black

.3 Phase “C” – Blue

.4 Control – Orange

.5 Ground – Green

.6 Neutral – White

.5 Colour Coding for DC systems shall be as follows:

.1 Positive + – Red

.2 Negative - – Black

.3 Ground – Green

.6 Wire shall be as manufactured by:

.1 Canada Wire and Cable Co. Ltd.

.2 Industrial Wire and Cable (1970) Ltd.

.3 Phillips Cables Ltd.

.4 Pirelli Cables Ltd.

.7 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

.8 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.

.1 Thomas & Betts – Marr Max Series

.9 Splice large conductors using compression type connections insulated with heat shrink sleeves.

.1 Thomas & Betts – 5400 Series lugs and heat shrink type #s series

.10 Where colour coding tape is utilized, it shall be applied for a minimum of 2" at terminations, junction and pull boxes and condulet fittings. Do not paint conductors under any condition. Colour coding shall also apply to bussing in panels and, switchgear, disconnects, and metering cabinets.

.11 Single conductor cables shall be terminated using aluminum connectors and lock nuts. Provide and install all required non metallic and non ferrous entrance plates.

.12 Single conductor cables shall be fastened to cable tray and unistrut using aluminum "P" clamps.

5.5 Splitters

.1 Splitters must conform to CSA C22.2 No. 76 (latest edition).

.2 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.3 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.

.4 At least three spare terminals on each set of lugs in splitters less than 400A.

.5 Splitter length must match arrangement of equipment unless indicated otherwise.

5.6 Junction boxes and pull boxes

.1 Junction and pull boxes must conform to CSA C22.2 No. 40 (latest edition).

.2 Welded steel construction with screw-on flat covers for surface mounting.

.3 Covers with 25 mm (1") minimum extension all around, for flush-mounted pull and junction boxes.

5.7 Switches

.1 Local switches shall be 15A or 20A, single pole, double pole, three-way, four-way, keyed, or motor rated complete with pilot light. Switches to be silent, A.C. type and C.S.A. listed, specification grade. Provide switches rated to suit system voltage.

.2 Manually operated general purpose with the following features:

.1 Terminal holes approved for No. 10 AWG wire.

.2 Silver alloy contacts

.3 Urea or melamine molding for parts subject to carbon tracking

.4 Suitable for back and side wiring

.5 Toggle style

.3 Toggle operated fully rated for tungsten filament and LED lamps

.4 Up to 80% of rated capacity of motor loads.

.5 Switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.

.6 Provide white colour (to be confirmed at shop drawing review).

.7 Catalogue numbers listed below have been used to indicate quality standards.

.1	Single Pole	Hubbell 1221/18221 Series
.2	Double Pole	Hubbell 1222/18222 Series
.3	Three-Way	Hubbell 1223/18223 Series
.4	Four-Way	Hubbell 1224/18224 Series
.5	Keyed	Hubbell HBL1221L + 2 matching keys Hubbell HBL1209
.6	Motor rated	Hubbell HBL1221PL c/w pilot light (min 20A)

.8 Acceptable Manufacturers:

.1 Hubbell of Canada Ltd.

.2 Leviton

.3 Legrand

5.8 Dimmer control

.1 Dimmers to be provided with following features:

.1 Rating of 20A 120V

.2 Wattage to suit load as indicated. Minimum wattage to be 1000W.

.3 Linear slide control.

.4 Dimmer must be rated for LED control and provide full range control from zero to full intensity.

.5 On/Off switch

.6 Mountable in a single gang or multi-ganged box as required.

.7 Cover plate to match other wiring devices

5.9 Receptacles

.1 Receptacles shall conform to CSA 22.2 No. 42 (latest edition).

.2 Receptacles shall be specification grade of amperage and voltage indicated on the drawings.

.3 Manually operated general purpose with the following features:

.1 Terminal holes approved for No. 10 AWG wire.

.2 Break-off links for use as split receptacles

.3 Urea or melamine molding for parts subject to carbon tracking

.4 Suitable for back and side wiring (eight back wired entrances, four side wiring screws)

.5 Triple wipe contacts and riveted grounding contacts

.6 Tamper resistant where noted.

.4 Switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.

.5 Provide white colour (to be confirmed at shop drawing review).

.6 Receptacles shall be as listed below:

.1 15 ampere, 120V, single phase grounded duplex receptacle shall be NEMA-U-ground type CSA Configuration 5-15R.

.2 20 ampere, 120V, single phase grounded duplex receptacle shall be NEMA-U-ground type CSA Configuration 5-20RA.

.3 15 ampere, 120V, weatherproof receptacles shall be equal to those above but complete with gasketed cast plate and hinged covers.

.7 Other types of receptacles shall be provided as shown on Drawings.

.8 Catalogue numbers listed below have been used to indicate quality standards.

.1	Standard Duplex	Hubbell BR15WHI
.2	GFI T-Slot	Hubbell GF20WLA

.3	GFI	Hubbell GF15WLA
.4	GFI Tamper Resistant	Hubbell GFTR20W
.5	T-Slot	Hubbell BR20WHI
.6	Tamper Resistant	Hubbell BR15WHITR
.7	USB Tamper Resistant	Hubbell USB15X2W
.8	Dryer	Hubbell HBL9430A
.9	Range	Hubbell HBL9450A

.9 Acceptable Manufacturers:

.1 Hubbell

.2 Legrand

.3 Leviton

.4 Eaton

5.10 Cover plates

.1 Switch, receptacle, telephone and other plates shall be stainless steel 18-8 chrome nickel alloy, Hubbell Type 302/304, in finished areas and pressed steel in unfinished areas. Finish brush marks shall be run in a vertical direction.

.2 Cover plates shall be of the same manufacturer throughout.

.3 Cover plates shall be as manufactured by:

.1 Leviton

.2 Hubbell

.3 Legrand

5.11 Disconnect switches

.1 Fused or Un-fused disconnect or safety switches shall be Type “A”, quick-make, quick-break construction with provision for padlocking switches in either “ON” or “OFF” position.

.2 Switches throughout job shall be of same manufacture.

.3 Fused switches shall have fuse clips designed for Class “J” fuses and designed to reject standard N.E.C. fuses.

.4 Switches shall be as manufactured by:

.1 Cutler Hammer

.2 Siemens

.3 Schneider Electric

.5 Provide fused or un-fused safety or disconnect switches as shown and as required by Code.

.6 Disconnects feeding elevator controllers must be equipped with two auxiliary contacts approved by the elevator supplier.

5.12 Motor starters

.1 Starts shall conform to CSA C22.2 No. 14 (latest edition) and EEMAC E14-1.

.2 Single phase and manual motor starters shall be/have:

.1 Used for single phase motors up to 1HP

.2 On/Off Disconnect switch with recessed Hand/Auto Modes

.3 Single phase; 110V, 1/10HP – 1HP; 240V, 1/10HP – 1HP

.4 120~240VAC, 1-Phase, 60Hz, across the line, full-voltage non-reversing (1HP)

.5 Adjustable 1-16A Class 10 electronic overload

.6 NEMA Type 1 General Purpose Enclosure, surface mounting

.7 On/Off Switch, concealed Hand/Off/Auto switch

.8 Run Status Verification

.9 Voltage & Dry inputs for Auto Run Command

.10 System override mode

.11 Manual Overload Trip Reset

.12 Equal to Siemens SMFFG71P

.3 Magnetic motor starters shall be/have:

.1 Used for all 3 phase motor and single phase motors over 1HP

.2 Equal to Allen Bradley IEC type

.3 Contactor solenoid operated, rapid action type

.4 Motor overload protective device in each phase, manually reset from outside enclosure

.5 Hand/off/auto push button selector switches

.6 Indicating lights: standard duty, 1 red pilot light for “stop” or “off” and 1 green light for “start” or “on”.

.7 1-N/O and 1-N/C spare auxiliary contacts

.8 24V auxiliary contacts

.9 Wiring and schematic diagram inside starter enclosure in visible location

.4 Combination starters shall be/have:

.1 Used where fused switch and magnetic starter are in same location

.2 Equal to Allen Bradley IEC

.3 Include fused disconnect switch with operating lever on outside of enclosure to control disconnect

.4 Locking in “OFF” position

.5 Independent locking of enclosure door

.6 Provision for preventing switching to “ON” position while enclosure door is opened.

.7 Magnetic starter features as per above.

.5 Provide control transformers and auxiliary contacts as required for control connections.

.6 Provide push to test lights throughout.

.7 Half size and IEC starters will not be accepted.

.8 Acceptable Manufacturers:

.1 Allen Bradley

.2 Cutler Hammer

.3 Siemens

.4 Schneider Electric

5.13 Control transformers

.1 Control transformers shall conform to CSA C22.2 No. 66 (latest edition).

.2 Auto-transformers shall conform to CSA C22.2 No. 47 (latest edition).

.3 Single phase, dry type, control transformer with primary voltage as indicated and secondary voltage to suit remote control device, complete with secondary fuse, installed in with starter as indicated.

.4 Size control transformer for control circuit load plus 20% spare capacity.

5.14 Control relays

.1 Control relays shall be equal to Allen Bradley type P, electrically held. Confirm coil voltages for relays controlling mechanical equipment with controls contractor.

5.15 Surface raceway systems

.1 All surface mounted raceways shall be two cell compartment for power and data/voice with full separation between compartments.

.2 Surface raceway is to be utilized in dry interior locations only as covered in Article 352 Part B of the National Electrical Code, as adopted by the National Fire Protection Association and as approved by the American National Standards Institute.

.3 The surface raceway system specified herein for branch circuit wiring and/or data network, voice, video and other low-voltage wiring shall be steel system as manufactured by the Wiremold Company, V500 / V700 / 700WH Series.

.4 The raceway and all system components must be UL Listed.

.5 The raceway shall be a one-piece design with base and cover factory assembled.

.6 Manufacturer shall provide tools to cut, bend and install raceway.

.7 A full compliment of fittings must be available including, but not limited to flat, internal and external elbows, tees entrance fittings, cover clips and end caps. The fittings shall have a matte texture, in ivory or white colours to match the base and cover. They shall overlap the cover and base to hide uneven cuts. All fittings shall be supplied with a base where applicable to eliminate mitreing. A transition fitting shall be available to adapt to other Wiremold series raceways.

.8 Device brackets shall be available for mounting standard devices in-line with the raceway. Faceplates shall match and fit flush in the device plate.

.9 The raceway manufacturer will provide a complete line of connectivity outlets and modular inserts for UTP (including Category 5), STP (150 ohm) Fibre Optic, Coaxial and other cabling types with face plates and

bezels to facilitate mounting. This contractor is to provide brackets for faceplates to be provided by others.

.10 Acceptable Manufacturers:

.1 Wiremold Company

.2 Hubbell Base Trak

.3 Panduit Pan-Way

.4 Carlon Prestige Series 260

5.16 Hangers and supports

.1 Provide and correctly locate all hangers and inserts required for the installation of all work under this Contract.

.2 Hangers for electrical conduit shall be galvanized after fabrication.

.3 Conduit hangers shall be as manufactured by:

.1 Burndy Canada Ltd.

.2 Canadian Strut Products Ltd.

.3 E. Myatt & Co. Ltd.

.4 Steel City Electric Co.

.5 Pilgrim

.6 Thomas & Betts

.7 B-line

.4 Do not use perforated strapping (grappler bars).

5.17 Finishes and painting

.1 All factory supplied equipment shall have finish coating factory applied whether finish be painted, galvanized or other, as required and as specified.

.2 Repair dents and touch up all damaged finishes with matching finish, or if required by the Consultant or Owner, completely repaint or replace damaged surface at no extra cost to the Contract.

5.18 Feeds for roof mounted equipment

.1 Power shall be fed through base of roof mounted equipment wherever possible. Where not possible, supply 90 degree pitch pocket.

6 Execution

6.1 General

.1 All wiring to meet Ontario Electrical Safety Code and local authorities.

.2 All power, interlock and control wiring over 50V, and disconnects shall be supplied and installed by the Electrical Contractor. Coordinate with Division 22 and 23.

.3 Division 22 and 23 shall install all control and low voltage interlock wiring less 50V or less.

.4 All outdoor wiring to be run in liquidtight. All indoor wiring to be run in conduit. Last 1.5m (5') at final connection to equipment shall be run in flexible conduit only.

.5 Where wire size is not indicated, ampacity must match or exceed rating of protective device.

.6 Panels are specified as sequence bussed and all branch circuit wiring from these panels shall be such that where a common neutral is used for two or three circuits, these circuits shall be fed from adjacent breakers, so that single-pole breakers may be replaced with 2 or 3 pole breakers should this be required in the future. All circuits shall be balanced. All neutrals shall be sized to meet the requirements of Section 4-022 of the Ontario Electrical Safety code and in no case smaller than 12 awg.

.7 Feeders, sub-feeders, circuit wiring and ancillary items shall be colour coded for phase identification. Neutral conductors shall be full capacity with white covering and be continuous throughout the system without fuses, switches or breakers of any kind. All neutrals shall be sized to meet the requirements of Section 4-022 of the Ontario Electrical Safety code.

.8 Install wiring continuously within raceways, splices will be permitted only at outlets and junction boxes. Sufficient slack wire shall be left at these points to permit proper connection of fixtures, devices, equipment, etc.

.9 Any exposed conduits or cables shall be run parallel to or at right angles to building lines and in a neat manner. Conduits shall be thoroughly reamed and each threaded termination shall be provided with two lock nuts. Running threads for rigid conduit will not be accepted.

.10 Internal raceways in the building:

.1 Securely cap or plug all openings in conduit and ducts during the execution of the Work to prevent dust and debris from entering the openings.

.2 At completion of the installation, the service entry ducts and the conduit system in the building shall be fished to clear all blocks.

.11 Outlet and pull boxes shall be cleaned out and the system left free from water and moisture.

.12 Provide all conduit, wire, fittings, disconnect switches, line voltage, starters, disconnects, controls and auxiliary materials as previously defined to wire into service all 3 phase motors, single phase motors and equipment included in other Sections unless specified otherwise.

.13 Install pull boxes in conduit run where required to facilitate the pulling in of cable, and locate in inconspicuous accessible spaces.

.14 Provide flexible connections to mechanical equipment for vibration isolation. Connections to equipment roof mounted or in other damp or wet locations shall be liquid tight.

.15 Conduits and cables shall not be attached to mechanical units for support.

.16 All devices in General Purpose rooms (Gym), Mechanical and/or Electrical rooms and all exterior mounted devices shall have wire guards for protection from mechanical damage. Provide wire guards elsewhere as noted on drawings.

6.2 Wiring methods

.1 Install wiring in conduit unless otherwise specified. Final connections (1500mm maximum) shall be flexible conduit preferably liquidtight.

.2 Flexible conduit and armoured cable will be accepted for a maximum length of 1500 mm for final connection to lighting fixtures only. Do not connect from fixture to fixture.

.3 Use thin wall conduit (EMT), up to and including 78 mm conduit size, for branch circuit and feeder wiring in ceilings, furred spaces, and in hollow walls and partitions. Use rigid galvanized steel conduit for wiring in poured concrete, where exposed, and for conduit 91 mm or larger. Use rigid PVC conduit for wiring in slabs on grade and wiring below grade.

.4 Aluminum conduit may be used, in lieu of rigid steel conduit, in clean and dry locations, but shall not be used in poured concrete, or for signal and intercommunication systems wiring.

.5 Conduit manufacturer's touch-up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

.6 Single conductor cables shall be terminated using aluminum connectors and lock nuts. Provide and install all required non metallic and non ferrous entrance plates.

.7 Single conductor cables shall be fastened to cable tray and unistrut using aluminum "P" clamps.

.8 Power shall be fed through base of roof mounted equipment wherever possible. Where not possible, install 90 degree pitch pocket and coordinate roofing with General Contractor. Seal end of pitch pocket after feeder is installed.

6.3 Outlet boxes

.1 Where 103 mm square outlet boxes are installed in exposed concrete or cinder block finished areas, blocks will be cut under Masonry Division as instructed under this Section. Opening shall be cut to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Mortar shall not be used to patch up openings that are cut too large or to patch ragged edges.

.2 Ceiling boxes shall be 103 mm octagon or square, complete with fittings, where required to support fixtures.

.3 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.

.4 Support outlet boxes independently of conduit and cable.

.5 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.

.6 Offset outlet boxes, shown back to back in partitions, horizontally a min. 150mm to minimize noise transmission between adjacent rooms.

.7 Use gang boxes at locations where more than one device, of the same system only, is to be mounted. Each system shall utilize separate boxes.

.8 Use tile wall covers where 103 mm square outlet boxes are installed in exposed concrete or cinder block in finished areas.

.9 Flush mount boxes, panels, cabinets and electrical devices, which are installed in finished areas, shall be provided with suitable flush trims and doors or covers, unless specifically noted otherwise.

.10 Provide pre-formed polyethylene vapour barriers for all boxes located in walls with internal vapour barriers.

6.4 Floor boxes

.1 Equal to Hubbell Non-metallic floor box series S1PFB.

.2 At locations with receptacle and data shown, provide Hubbell Data Com and Duplex sub-plate equal to S1SPDU2IM with S1CFACL cover plate.

.3 At locations with two (2) receptacles, provide Hubbell sub-plate S1SPDU with cover plate S1TFCAL.

6.5 Conduit accessories, conduit and fittings

.1 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.

.1 Thomas & Betts – 8125 Series

.2 Terminate EMT entering boxes or enclosures with nylon insulated steel threaded bushings.

.3 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.

.1 Thomas & Betts – 5332 Series

.4 Install wall entrance seals where conduits pass through exterior walls below grade.

.5 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.

.6 BX cable is acceptable when fished in existing walls. BX cable may also be used for short drops to light fixtures to a MAXIMUM LENGTH OF 1500 mm. Any installations exceeding 1500 mm WILL BE REMOVED AND REPLACED AT THE CONTRACTORS EXPENSE. All installations of BX

cable shall be complete with anti-short bushings at all stripped ends as per OEC #12-608(1)(a). Connectors for BX cable shall be Crouse Hinds #L16ST.

6.6 Conductors, wires and cables

.1 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case. . Neutrals shall have white insulation over their entire length. Grounds or bonding conductors shall have green insulation over their entire length.

.2 Colour Coding for AC systems shall be as follows:

- .1 Phase “A” – Red
- .2 Phase “B” – Black
- .3 Phase “C” – Blue
- .4 Control – Orange
- .5 Ground – Green
- .6 Neutral – White

.3 Colour Coding for DC systems shall be as follows:

- .1 Positive + – Red
- .2 Negative - – Black
- .3 Ground – Green

.4 Lighting and power wiring shall be copper, minimum No. 12 gauge when protected by 15 amp breakers and a minimum of 10 gauge when protected by 20 amp breakers. Size wires for 2% maximum voltage drop to farthest outlet on a maximum 80% loaded circuit. Increase wire size according to OESC section 4 when more than 3 current carrying conductors are installed in a single conduit.

.5 All lighting circuits will have a dedicated neutral to each phase wire. Shared neutrals will not be accepted.

.6 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

.7 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.

.1 Thomas & Betts – Marr Max Series

.8 Splice large conductors using compression type connections insulated with heat shrink sleeves.

.1 Thomas & Betts – 5400 Series lugs and heat shrink type #s series

.9 Where colour coding tape is utilized, it shall be applied for a minimum of 2" at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition. Colour coding shall also apply to bussing in panels and, switchgear, disconnects, and metering cabinets.

6.7 Splitters

.1 Install splitters and mount plumb, true and square to the building lines on 19mm (3/4") painted plywood backboards.

.2 Provide equipment identification in conformance with Section 26 05 01.

6.8 Junction boxes and pull boxes

.1 Install pull boxes in inconspicuous but accessible locations. Provide access doors in all drywall areas.

.2 Install junction boxes and pull boxes so as not to exceed 30m (100') of conduit run between pull boxes and in conformance with the Electrical Safety Authority.

.3 Provide equipment identification in conformance with Section 26 05 01.

.4 Label all junction boxes with panel and circuit number.

6.9 Switches

.1 Install single throw switches with handle in the "up" position when switch is closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Confirm colour prior to ordering.

.4 Refer to Section 26 05 01 for mounting heights.

6.10 Receptacle

.1 Mount receptacles so long dimension is in the vertical.

.2 Exact locations shall be verified to suit furniture layout.

.3 Connect receptacle grounding terminal to the outlet box with an insulated green ground strap.

.4 Install receptacles in gang type outlet box when more than one switch is required in one location.

.5 Where split receptacle has one portion switched mount vertically and switch upper portion.

.6 Weatherproof receptacles shall be equal to 20A GFI and mounted in weatherproof enclosure complete with locking key. Enclosure shall be equivalent to Hubbell WPFS26 with locking device HBLWLC.

.7 Confirm colour prior to ordering.

.8 Refer to Section 26 05 01 for mounting heights.

6.11 Cover plates

.1 Do not install plates until final painting of room or area is completed. Remove protective covering.

6.12 Surface raceway systems

.1 Raceway is to be supplied and installed with all necessary fittings, hardware and device brackets for a complete functional system

.2 Install conduit system, wiring and devices as indicated.

.3 Install raceway as per manufacturer recommendations.

.4 Provide end caps where raceway ends.

6.13 Hangers and supports

.1 Provide and correctly locate all hangers and inserts required for the installation of all work under this Contract.

.2 Support outlet boxes, junction boxes, conduit and all electrical equipment independently with hangers and fastenings to building structural members.

.3 Hangers in general shall be supported from inserts in concrete construction or from building structure using beam clamps for steel structures. Provide all additional angle or channel steel members required between beams for support of conduits, cables, luminaires, etc.

.4 Use coach screws, lag screws or wood screws as appropriate in any wood construction.

.5 Feeders, conduits and power ducts running vertically in a building shall be supported at each floor and between each floor if necessary.

6.14 Mounting heights

.1 Refer to Section 26 05 01.

6.15 Conduit sleeves and curbs

.1 Provide conduit sleeves of galvanized steel for conduit and cable runs passing through concrete walls, beams, slabs and floor. Include for all power, communications and control wiring.

.2 Extend galvanized conduit sleeves for conduit rising through slabs 4” minimum above finished floors. Provide sleeves, passing through floors having a waterproof membrane, with an integral flashing clamp.

.3 Provide two 53mm conduit sleeves through corridor walls above the each door. The sleeves shall extend 53 mm beyond the wall on each side.

6.16 Supports and bases

.1 Mount Switchboards, Motor Control Centres and all other floor mounted electrical equipment on chamfered edge housekeeping pads, minimum of 100 mm (4”) high and 150 mm (6”) larger than equipment dimensions all around.

.2 Supply and erect special structural work required for installation of electrical equipment. Provide anchor bolts and other fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.

.3 Switches or other electrical equipment shall be complete with suitable bases or mounting brackets.

.4 Provide channel or other metal supports where necessary, to adequately support lighting fixtures. Do not use wood unless wood forms part of the building structure.

.5 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members, required between beams for supporting conduits and cables.

.6 Provide any additional supports required from existing concrete construction for any piping, cable tray or equipment, by drilling same and installing expansion bolt cinch anchors.

.7 Do not use explosive drive pins in any section of work without obtaining prior approval.

.8 Provide all required hangers and supports for cable tray and basket tray. All hangers and supports shall be rated for the installed load with a 100% safety factor.

6.17 Finishes and painting

.1 Primary and final painting for work, other than items specified as factory primed or finished, shall be performed by trades specializing in this type of work.

.2 Repair and finish factory finished equipment, damaged or scratched during installation, in an approved manner.

.3 Leave bare metal surfaces ready for painting by removing dirt, rust, grease or millscale to Consultant's approval.

.4 All structural steel including hangers, brackets, supports and other ferrous metals shall be shop or factory prime painted wherever practicable. Wherever structural steel including hangers, brackets, supports, and other ferrous metals cannot be shop or factory prime painted, wire brush to remove all traces of rust, clean of all traces of dirt, oil, and grease, and apply one coat of an approved rust inhibiting primer in accordance with CGSB-GB-40d and leave ready to receive finish paint.

6.18 Electrical connections for mechanical equipment

.1 Provide all required electrical connections to apparatus provided and/or supplied by Division 22 and 23, the Owner and as part of the work of other Divisions of the Specifications.

.2 All power and control wiring over 50V, and disconnects shall be installed by the Electrical Contractor.

.3 All control and low voltage wiring 50V and under shall be installed by the Mechanical Contractor. Coordinate all low voltage wiring with the Mechanical Contractor.

6.19 Motors and starters

.1 Division 26 shall supply and install all starters unless otherwise indicated.

.2 Coordinate with Division 22 and 23 as required.

.3 Install line voltage disconnect switches at each motor not within the required distance from its starter to meet code requirements.

.4 All motors shall be wired and connected under this Division. The drawings do not necessarily show the exact location of wiring to motors and it shall be the responsibility of this Division to fully coordinate this work with Division 22 and 23.

.5 Temperature Controls: Be responsible for the “line" side power connections to all control apparatus where detailed or required to make the system operational.

6.20 Equipment identification

.1 Refer to Section 26 05 01.

6.21 Testing

.1 Make tests of equipment and wiring at times requested.

.2 Tests shall include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load, and operation of each piece of equipment for correct operation.

.3 Supply meters, materials and personnel as required to carry out these tests.

.4 Test electrical work to standards and function of Specification and applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

.5 Before energizing system, check all connections and set and calibrate all relays and instruments for proper operation, obtain necessary clearances, approval and instructions from utility company.

.6 Connect single phase loads so that there is the least possible unbalance of the supply phases.

.7 Submit all test results in report format.

End of section

7 General

7.1 Work Included

.1 Commissioning shall be carried out by a Third Party Commissioning Agent retained by the Contractor under this contract.

.2 Commissioning Agent shall hold a currently valid certificate from one of the following organizations:

.1 ASHRAE

.2 Association of Energy Engineers (AEE)

.3 Building Commissioning Association (BCA)

.4 The Integrated Testing Coordinator, as described the CAN/ULC-S1001 standard, is to be an independent third-party contractor who has not completed any prior design, installation, or verification work on the project.

.3 The Contractor shall provide assistance throughout the commissioning process as needed.

8 Products

8.1 Equipment and products

.1 All equipment and products necessary to complete the commissioning shall be covered by the Agent and this Division at no cost to the Owner.

9 Execution

9.1 Commissioning

.1 Third Party Commissioning Plan shall be prepared by the Commissioning Agent and submitted to the Consultant for review at the start of the project.

.2 A copy of all electrical Shop Drawings shall be forwarded to the Commissioning Agent after review

.3 All equipment and systems shall be started, tested and reports submitted and accepted prior to start of commissioning.

.4 System tests shall include, but not be limited to:

.1 Fire Alarm Verification. Contractor to submit test forms in conformance with ULC. Final performance test to be witnessed by Commissioning Agent.

.2 Where fire protection and life safety systems, and systems with fire protection and life safety functions, are integrated with each other, the systems shall be tested as a whole in accordance with CAN/ULC-S1001, “Integrated Systems Testing of Fire Protection and Life Safety Systems,” to verify that the systems have been properly integrated, per Articles 3.2.10.1 and 9.10.18.10 of the Ontario Building Code.

.5 The Contractor shall submit all checklists included within the prepared Third Party Commissioning Plan.

9.2 Demonstration and Training

.1 Provide assistance during Demonstration and Training as detailed within Third Party Commissioning Plan and Section 01 79 00.

.2 Complete and accepted maintenance manuals and record drawings shall be submitted and available for use during the demonstration and training.

End of section

10 General

10.1 Codes and standards

.1 Ontario Electrical Safety Code-Current Edition

.2 CSA

.3 ULC

.4 Local Codes and Requirements

10.2 Submittals

.1 Shop Drawings:

.1 Submit shop drawings to the Consultant for review prior to ordering or installation.

.2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.

.3 One copy of all stamped approved shop drawings shall be included in maintenance manual.

.2 Operation and Maintenance Data:

.1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.

.2 Operation and maintenance data shall be included in the maintenance manual.

11 Products

11.1 Lighting and receptacle panels

.1 Panel boards shall be as manufactured by Eatons complete with molded case circuit breakers (10,000 AIC) and labeled with a CSA short circuit rating. Provide copper bus sized in accordance with the contract drawings and CSA standards.

.2 Electrical characteristics, main sizes, quantities of breakers and quantity of branch circuits shall be as indicated on the drawings.

.3 Where noted on the drawings, panel boards serving isolated ground circuits shall be complete with a separate ground bar isolated from the panel board box by an insulating plate. Connect this ground bar directly to the main building ground using AWG #6 copper minimum or larger as required by table 16 of the Ontario Electrical safety Code (unless otherwise noted).

.4 Panel boards shall be supplied with doors, concealed hinges, chromed locks and hardware. All locks shall be keyed alike. Doors shall be fitted with plastic covered panel directory, with circuits and areas served typed in. Doors shall be provided with spring latches and semi flush cylinder locks and catch assemblies. Provide two (2) keys per panel board.

.5 All panel boards to have sprinkler proof enclosures.

.6 Branch Breakers: Shall be of the heavy duty, bolt-on type, single, two or three pole as shown on the drawings and of the ampere ratings indicated. They shall be thermal magnetic, non interchangeable, moulded, case type with toggle mechanism, and be designed for use as switches. Two and three pole breakers shall be common trip type with single handle. Handle ties will not be permitted. Each breaker to be quick-make, quick break type. Shall be approved for use with CU/AL cables.

.7 Breakers 250 Amps and above shall have adjustable long delay pickup/time, adjustable short delay pickup/time and adjustable instantaneous pickup.

.8 Provide lock-on devices for fire alarm, stairway, exit and night light circuits.

.9 Ground fault circuit interrupters where required shall be C.S.A Class A with 5 mA tripping level and shall have push-to-test button on front.

.10 Provide new bolt-on breakers as required for new installation.

.11 Provide ground bus in each panel.

.12 Door and trim finish: grey enamel.

.13 Panel board depth is not to exceed 146mm.

.14 Cover plates shall be provided for all the blank spaces in the distribution section.

.15 Provide a nametag on the exterior of the enclosure. Nametag to indicate interrupting rating, voltage, service description, etc.

.16 Provide sequential phase bussing with odd numbered breakers on the left and even numbered on the right complete with each breaker identified by permanent marker identification as to circuit number and place.

.17 Main breaker to be mounted top or bottom of the panel to suit cable entry. When mounted vertically, down position shall trip the breaker.

.18 Branch circuit panel boards (250 AMP or smaller) must be equal to Eatons POW-R-Line-C PRL-1 or PRL-2 or approved alternate.

.19 Branch circuit panel boards indicated to be complete with transient voltage surge suppression filtering system integral to the panel tub must be equal to Eatons #CPSBXCH208YSD or approved alternate.

.20 Power distribution circuit breaker panel boards (400 AMP or larger) must be equal to Eatons POW-R-Line-C PRL-4a with bottom side entry wire way or approved alternate.

.21 Acceptable Manufacturers:

.1 Eaton

.2 Schneider

.3 Siemens

.4 Square D

11.2 Fuses

.1 Fuses: Shall be RK5 or HRC-I, Class J or L unless otherwise specified. Fuses in combination starters shall be HRC time delay type where specified.

.2 Motor fuses shall be sized according to the Drawings for the specified motor and starting cycle.

.3 Fuses shall be as manufactured by Buss, Gould, Little Fuse or approved equal.

.4 Provide three spare fuses of each type and size installed for maintenance.

12 Execution

12.1 Installation of service conduits and cables

.1 Run service entrance conduits as shown on the site plan and the trench section for primary and secondary duct bank.

.2 Supply and install CU RWU75 XLPE of size noted on drawings from secondary of pad mount transformer to service entrance switchboard located in the electrical room. Coordinate with Utility (Hydro One) for all final terminations.

.3 Final termination of primary cable to high voltage service and to transformer to be completed by Utility (Hydro One).

.4 Coordinate exact locations and installation with general contractor before installation commences.

.5 Do not pull spliced cable inside the duct.

.6 Install multiple conductors in duct simultaneously.

.7 Use CSA approved lubricants to reduce pulling tension.

.8 Perform insulation resistant test using a megger on each phase conductor before terminating installed cable.

.9 Provide any test(s) as required by Utility (Hydro One).

12.2 Grounding

.1 Verify the integrity of the existing water service bond / ground conductor and connection and replace is required. Provide two ground plates and connect to the service with 3/0 copper bare ground wire. If the existing vault ground system remains intact reconnect it to the new service.

.2 Make all required ground connections from water meter to all electrical apparatus. Ground conductors shall be minimum #2/0 copper wire connected with approved fittings.

.3 Where conduit systems are used for grounds, provide all necessary bushings, studs and jumpers as may be required to maintain effective continuity of ground. Provide separate ground conductors in all non-metallic conduits, concrete encased conduit and conduit below grade. Bond the ground wire to all boxes and luminaries.

.4 Install grounding connections to typical equipment included in but not necessarily limited to the following list. Service equipment transformers, switchgear, duct systems, frames of motors, motor control centres, starters control panels, building steel work, distribution panels, outdoor lighting.

.5 Test the resistance of the grounding system. Add additional ground wires and ground rods if required as directed by the Engineers and retest. Repeat this process until ground resistance is 2 ohms or less. Conduct all tests using Megger Null Balance or Megger Universal ground resistance test equipment.

.6 Test and log all ground connections at panels, switchboards and ground buses prior to and after the computer is put into operation. Trace and isolate all equipment causing current in ground wires to exceed one ampere. Replace such equipment if furnished as part of this contract.

.7 Test all receptacles for proper connections with a neon lamp type polarity tester. Check that ground resistance is less than 0.2 ohms with an Edgecumbe Peebles Ltd., ground loop impedance tester.

12.3 Electrical connections for mechanical equipment

.1 Provide all required electrical connections to apparatus provided and/or supplied by Division 22 and 23, the Owner and as part of the work of other Divisions of the Specifications.

.2 All power and control wiring over 50V, and disconnects shall be installed by the Electrical Contractor.

.3 All control and low voltage wiring 50V and under shall be installed by the Mechanical Contractor. Coordinate all low voltage wiring with the Mechanical Contractor.

End of section

13 General

13.1 Codes and standards

.1 Ontario Electrical Safety Code – Current Edition

.2 CSA

.3 ULC

.4 Local Codes and Requirements

13.2 Submittals

.1 Submit shop drawings to the Consultant for review prior to ordering or installation.

.2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.

14 Products

14.1 Fixtures

.1 Luminaires including fixtures and lamps shall conform to the luminaire schedule.

.2 Manufacturer:

.1 Acceptable Manufacturers:

.1 Refer to luminaire legend in drawings set for approved manufacturers.

.2 Alternate manufacturers must provide equal fixtures to the satisfaction of the Engineer. Any alternates that do not satisfy the specifications or the Engineer will be rejected.

.3 Alternate fixtures must be on approved DLC list if base spec fixtures is on approved list for applicable energy benefits.

.4 Where alternates alter functional or visual design, or change the space requirements or mounting details, all such information shall be clearly presented to the Consultant for consideration and any

costs associated with same shall be the responsibility of the Contractor.

.5 Once shop drawings are approved, no substitutions will be considered except for special circumstances such as delivery. Delivery reasons shall only be considered if at no fault to the Contractor. Contractor's failure to order fixtures within the schedule will not be acceptable.

.3 Similar luminaires shall be products of same manufacturer.

.4 Luminaires shall be completely factory assembled and delivered in cartons or in palletized form.

.5 All fixtures shall be recessed type in acoustic tile or drywall ceilings unless otherwise indicated. Provide drywall trim frame for recessed drywall applications.

.6 Troffers in ceiling shall be equipped with adjustable mounting brackets.

.7 All fixtures shall be provided with ballasts suitable for the fixture type and application. All ballasts shall be CSA approved and ULC listed and comply with CSA standard C22.2 No. 74. Ballasts shall be suitable for 120 volt application as noted.

.8 Protective wire guards shall be provided for all fixtures where indicated on the drawings and where subject to damage.

14.2 Lenses

.1 In general, lenses shall be K12 distribution acrylic 0.125" (32mm) thick, shall have a recessed prismatic pattern of 3/16" (5mm) square based female cones running 45 degrees to the parallel and perpendicular axis to the panel. Provide vandal lenses where specified.

.2 Panel shall be made of ultraviolet inhibited injection moulded clear virgin acrylic.

.3 Panels shall be strain free and uniform in production. There shall be no fade-outs or streaks to detract from job performance.

.4 Lenses shall be low brightness, sparkling crystal panel that provides maximum efficiency and good brightness control in the direct glare zone.

14.3 Solid state drivers

.1 Drivers shall be UL/CSA approved for application required and meet all applicable CEC, NEMA and ANSI Standards.

.2 Driver to provide full-range dimming, 0-10V, where indicated.

.3 Drivers shall comply with NEMA limits governing electromagnetic and radio frequency interference and shall not interfere with operation of other normal electrical equipment.

.4 Driver shall meet ANSI Spec C62.41 and IEEE standards regarding all applicable transient protection.

.5 Frequency of operation shall be 20 kHz or greater.

.6 Driver shall have an ‘A’ sound rating.

.7 Total harmonic distortions shall be less than 10%. Meet ANSI C82.77.

.8 Drivers shall have a power factor of 0.85 minimum.

.9 Driver warranty shall be minimum five (5) years

14.4 LEDs

.1 Shall conform to ANSI C78.377 (latest edition)

.2 LEDs shall be 4500K unless otherwise noted. Verify colour of LEDs before ordering.

.3 LEDs shall provide a minimum 80 CRI unless otherwise noted.

.4 LED life shall be minimum 50,000 hours. LEDs shall be rated for L70 life span.

.5 Warranty shall be minimum 5 years.

15 Execution

15.1 General

.1 Luminaires shall be stored in a dry and protected area. Confirm acceptable storage area prior to luminaire being delivered to site.

.2 Lenses for fixtures shall be stored on site and installed separately from the fixtures at a time to be directed by the Consultant.

15.2 Installation of lighting fixtures

.1 Provide all lighting fixtures and lamps as shown on the drawings and schedules.

.2 Include for assembly, and mounting of all fixtures, complete with all wiring, connections, fittings, hangers, aligners, box covers and accessories which may be required for any fixture to provide a complete, safe, fully operational assembly.

.3 Install fixtures in accordance with applicable reflected ceiling plans and/or as directed by the Consultant.

.4 In Equipment Rooms, shafts and similar secondary areas, install fixtures after the mechanical and other major work is roughed-in and adjust fixture locations as required at no cost to the Owner. Fixtures in these areas shall be installed at the same height unless otherwise directed.

.5 At the discretion of the Consultant, site test and demonstrate the operation of special application fixtures and adjust their locations within a reasonable distance to obtain the effects desired. Assist in the aligning and positioning of all adjustable fixtures, and ensure that fixtures with adjustable lamp holders are properly positioned to correspond with the lamps specified.

.6 Thoroughly review all ceiling types, construction details and mounting arrangements before placing fixture orders and ensure that all mounting assemblies, frames, rings and similar features are included for and match the required installation.

.7 Mount luminaires perfectly level and plumb. Luminaires shall fit tightly to ceiling without showing a space or light leak between frame and ceiling. Re-install improperly installed fixtures at no expense to the Owner.

.8 All fixtures and fixture assemblies shall be properly secured and supported. Support fixtures independent of the ceiling construction complete with all fasteners, framing and hangers as required. Do not secure fixtures to mechanical ductwork or other vibration producing apparatus.

.9 Where fixtures are suspended from the structure they shall utilize self aligning box covers with an additional ground wire from the outlet through the hanger for continuity of ground.

.10 Carefully co-ordinate the fixture installation with the work of other trades ensuring that the necessary depths and mounting spaces are provided. Do not alter fixture locations unless approved by the Consultant.

.11 All lamps shall be new and intact when the project is complete, and ready for acceptance. Replace lamps used for testing fixture assemblies at the discretion of the Consultant. Include a full lamp listing in the Operating and Maintenance Instructions.

.12 Provide safety chains on all surface mounted, T-bar mounted or suspended light fixtures. Light fixtures shall have two chains, each supporting two corners of the luminaire (all four corners supported). Chain shall be #10 tensile jack chain, bright inc coated, with a strength of 400 lbs (180 kg). Attachments shall be made using a No. 10 “S” hook. Caddy fasteners may be used where applicable. “S” hooks must be closed after installation.

.13 Industrial luminaires, where suspended, shall have ½” (12mm) conduit hangers and ARB cylinder ball aligners. Length and location shall clear equipment, ducts and pipes. Metal strut (Flexibar or equal) may be used for mounting of luminaires in mechanical areas or electrical rooms.

End of section

16 General

16.1 Codes and standards

.1 Ontario Electrical Safety Code – Current Edition

.2 CSA Z32

.3 ULC

.4 Local Codes and Requirements

16.2 Submittals

.1 Shop Drawings:

.1 Submit shop drawings to the Consultant for review prior to ordering or installation.

.2 Shop drawings shall include manufacturer, model numbers, electrical data, wiring diagrams, and indicate conformance to above reference standards.

.3 One copy of all stamped reviewed shop drawings shall be included in maintenance manual.

.2 Operation and Maintenance Data:

.1 Provide operation and maintenance literature for all equipment indicating manufacturer and model of equipment, instructions for operation and maintenance of same, and parts list.

.2 Operation and maintenance data shall be included in the maintenance manual.

16.3 Acceptable manufacturers

.1 EmergiLite

.2 Lumacell

.3 Beghelli

.4 AimLite

17 Products

17.1 Battery units

.1 New batteries shall be 12 volt D.C. and shall be designed to supply all units and all connected remote heads for a period of one half hour to an end voltage of 91%. The fully automatic charger shall regulate the charging current according to battery need and provide full recharge in 12 hours or less after full discharge.

.2 Battery units shall be complete with long life lead batteries, 10-year warranty and type integral heads as indicated on the drawings. Capacities shall be as noted on the drawings. Provide white finish.

.3 Battery units shall provide the required operating time for all connected lights and signs under emergency conditions in conformance with the OBC.

.4 Battery Units shall be have line cord kit.

17.2 Remote emergency lights

.1 Lamp head and stem shall be injection molded, impact resistant, flame retardant thermoplastic, factory white.

.2 Lamp type to be LED. Provide wattage as indicated on drawings.

.3 The lens shall be inverse concave design and fully adjustable for aisle or area distribution during installation without the need to energize the lamp.

.4 Visual identification of distribution shall be provided through position of adjustment pins.

.5 Fixture shall be supplied with a canopy for installation on any four inch octagon box.

.6 Housing shall be so designed to allow for lamp replacement if required.

.7 Provide protective cages over lights in gymnasiums and other areas where they would susceptible to damage.

17.3 Exit signs

.1 Exit signs shall be CSA 22.2 No.141-10 listed.

.2 Exit signs shall have pictogram style faceplates, refer to drawings.

.3 Exit signs shall operate with universal AC input voltage as per site conditions at less than 2.5 watts and universal two-wire DC input voltage from 6VDC to 24VDC at less than 1 watt for single and double face signs.

.4 The exit sign shall be suitable for wall, end or ceiling mount.

.5 The frame and back plate shall each be of one-piece steel construction.

.6 The frame shall be of a one-piece steel construction painted factory white.

.7 The light source shall be light emitting diodes (LED). The LED lamps shall provide illumination in normal and emergency operation and shall be mounted inside the exit housing, no on the face.

.8 An LED sensitive diffuser shall be mounted behind the legend to provide the letters with even illumination.

.9 Provide protective cages over lights in gymnasiums and other areas where they would susceptible to damage.

18 Execution

18.1 General

.1 Installation of system equipment shall be in accordance with Canadian Electrical Code and Ontario Building Code.

18.2 Battery units

.1 Provide 120V receptacle for each battery unit mounted adjacent and at height of battery unit.

18.3 Emergency lights

.1 Provide emergency lighting on battery back-up as indicated on the drawings.

.2 Emergency lighting is required to provide an average level of illumination of not less than 10 lux at floor level and a minimum level of 1 lux.

.3 Emergency Lights shall be mounted 2.45m (8') above finished floor to the underside of the fixture. Where the ceiling height does not permit this mounting height the minimum acceptable height is 2.13m (7)'.

.4 Provide protective cages over lights in gymnasiums and other areas where they would susceptible to damage.

18.4 Exit lights

.1 Every Exit Sign shall be visible from the exit approach. Provide suitable arrows or chevrons indicating direction of egress as required.

.2 Exit signs shall be illuminated continuously.

.3 Exit lights shall be mounted 2.45m (8') above finished floor to the underside of the fixture. Where the ceiling height does not permit this mounting height the minimum acceptable height is 2.13m (7)'.

.4 Exit lights at doors shall be mounted above the door where space permits otherwise it can be mounted directly adjacent to it but ensuring it is visible from the exit approach.

.5 Provide protective cages over lights in gymnasiums and other areas where they would susceptible to damage.

18.5 Installation

.1 Include all necessary conduits, wiring and lamps for a complete operating system.

.2 Panel breakers feeding emergency lighting and exit lights shall be complete with circuit breaker lock-off device.

.3 Wiring to remote heads and exit light DC sockets shall be sized for a maximum voltage drop of 5%. In no case shall wiring be less than #10 AWG. Provide separate circuits for all exit lighting using separate raceways from non-emergency wiring.

18.6 Verification

.1 Following completion of the exit and emergency lighting installation, conduct tests of each system component and confirm battery operation life under emergency conditions.

.2 Conduct light level tests in upgraded areas upon completion of emergency lighting system installation.

.3 Upon completion of the tests, issue to the Consultant and Building Inspector a report for each test. Reports shall include:

.1 As-built location of each component

.2 Confirmation that it will remain operational for minimum required time in conformance with OBC

.3 Light level readings

.4 Technician’s name and signature that performed the tests

.5 Owner Representative’s name and signature that witnessed the tests.

.4 Verify all emergency lighting systems in area of work to the Consultant and Building Inspector as requested by them.

End of section

19 General

19.1 References

.1 CAN/ULC-S524 (latest edition), Installation of Fire Alarm Systems.

.2 ULC-S525 (latest edition), Audible Signal Appliances for Fire Alarm Systems.

.3 CAN/ULC-S526 (latest edition), Visual Signal Appliances, Fire Alarm.

.4 CAN/ULC-S527 (latest edition), Control Units, Fire Alarm.

.5 CAN/ULC-S528 (latest edition), Manual Pull Stations.

.6 CAN/ULC-S529 (latest edition), Smoke Detectors.

.7 CAN/ULC-S530 (latest edition), Heated Actuated Fire Detectors, Fire Alarm.

.8 CAN/ULC-S531 (latest edition), Smoke Alarms.

.9 CAN/ULC-S536 (latest edition), Inspection and Testing of Fire Alarm Systems.

.10 CAN/ULC-S537 (latest edition), Verification of Fire Alarm Systems.

.11 OBC-2006, Ontario Building Code.

19.2 Description of system

.1 System includes:

.1 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.

.2 Trouble signal devices.

.3 Power supply facilities.

.4 Addressable manual alarm stations.

.5 Addressable automatic alarm initiating devices.

.6 Audible and visual signal devices.

.7 End-of-line devices.

.8 Annunciators.

.9 Ancillary devices.

.10 Interface and zone modules.

19.3 Requirements of regulatory agencies

.1 This system is subject to review by local building department officials, local fire department officials. Therefore, submission of verification certificate and field technical device verification sheets is required prior to inspection by these officials. Schedule accordingly.

19.4 Shop drawings

.1 Submit shop drawings in accordance with Section 26 05 01.

.2 Include:

.1 Device specification sheet

.2 Complete wiring diagram

19.5 Operation and maintenance data

.1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual specified in Section 26 05 01.

.2 Include:

.1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data – illustrated parts list with parts catalogue numbers.

.3 Copy of approved shop drawings.

.4 List of recommended spare parts for system.

19.6 Maintenance materials

.1 10% spare glass rods for total number of manual pull box stations if applicable.

19.7 System operation

.1 Operation of any alarm initiating device to:

.1 Cause audible and visual signal devices to sound throughout building.

.2 Transmit signal to fire department via monitoring station.

.3 Cause zone of alarm device to be indicated on control panel and remote annunciator(s).

.4 Cause air conditioning and ventilating fans to shut down and to function so as to provide required control of smoke movement.

.5 Cause fire doors and smoke control doors of normally held open, to close automatically.

.6 Log the alarm in the historical alarm log file.

.2 System Reset

.1 It shall be possible to reset the fire alarm system until all the alarm zones have been properly reset or cleared.

.3 System Trouble Operation

.1 A trouble initiated by the actuation of a sprinkler system supervisory trouble switch shall cause the following to occur:

.1 An audible and visual trouble signal shall sound at the main control panel only until acknowledge by an operator.

.2 Annunciate the Supervisory Trouble Alarm at the main control panel LCD Display and all remote annunciator(s).

.3 Log the Supervisory Trouble Alarm in the Historical Trouble Log File.

.4 Cause the remote trouble indicator to activate.

.2 Any system trouble shall cause the following to occur:

.1 An audible and visual trouble signal shall sound at the main control panel LCD Display Only until acknowledged by an operator.

.2 Log the trouble condition in the separate Historical Trouble Log File.

19.8 Performance criteria

.1 These specifications describe the minimum functional requirements for an electronically supervised, microprocessor based, fully integrated system. The initial installation shall include all the necessary electronic hardware, software and memory for a completely operable system in accordance with these specifications.

19.9 Quality assurance

.1 Each and all items of the fire alarm system shall be listed as the products of a single manufacturer under the appropriate category by the Underwriter’s Laboratories of Canada and shall bear the “ULC” label.

.2 Each and all items of the fire alarm system shall be covered by a one year parts and labour warranty covering defects resulting from faulty workmanship and materials. The warranty shall be deemed to begin on the date the system is accepted by the Project Manager on issuance of the substantial performance certificate for the project.

.3 All control equipment must have Transient Protection Devices to comply with ULC requirements.

20 Products

20.1 Existing fire alarm system

.1 Not applicable.

20.2 Devices

.1 Provide all new materials, devices and wiring required for contract work in conformance with all codes. Coordinate all requirements with fire alarm manufacturer prior to pricing and rough-in.

.2 Each and all items of the Fire Alarm System shall be compatible with the existing system and listed as a product of a SINGLE fire alarm system manufacturer under the appropriate category by the Underwriters' Laboratories of Canada Inc. (ULC) and listed as Underwriters' Laboratories of Canada Inc. (ULC), and shall bear the "ULC" label.

20.3 Addressable manual alarm stations

.1 Manual alarm stations shall be addressable, single action, non-coded, semi-flush mounted type. Pull stations shall be break-glass style. Contacts are to activate when handle is pulled down.

.2 Addressable pull station electronics shall be mounted to the back plate of the station. The station's address will be set at the time of installation. Device addressing shall be accomplished by either an electrical or mechanical means.

.3 Where noted on drawings, stations are to be equipped with tamperproof guard equal to Stopper II Cat. # STI-1100.

20.4 Intelligent detectors – general operation

.1 Addressable devices shall use simple to install and maintain decade, numbered 0 to 9, address switches. Detectors that have expanded addressing will have decade switch numbered from 0 to 15 for the most significant digit to allow detector addressing from 1 to 250.

.2 Device addressing shall be accomplished by either an electrical or mechanical means.

.3 Detectors shall be in Telligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel signaling line circuits.

.4 Addressable smoke detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alar condition has been detected, if required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.

.5 The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.

.6 Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance.

.7 The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.

.8 The detectors shall provide at test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.

.9 Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).

.10 Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-tie measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.

.11 Detectors shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LEDs shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.

.12 Addressable devices shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.

.13 The sensors shall be of a low profile design and ULC listed for both ceiling and wall mount applications.

.14 Automatic smoke sensors shall be equipped with a dust cover, which shall be removed at the time of verification to prevent dust and dirt entering the smoke chamber during construction.

.15 A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

20.5 Intelligent multi-detector

.1 The intelligent multi-detector shall be an addressable device, which is designed to monitor photoelectric, ionization, and thermal technologies in a single sensing device. This detector shall utilize advanced electronics which react to smaller products of combustion found in fast flaming fires (ionization), slow smoldering fires (photoelectric), and heat (thermal) all within a single sensing device.

.2 The multi-detector shall include two bicolour LEDs, which flash green in normal operation and turn on steady red in alarm.

.3 Detectors are to be provided with relay base where noted on the drawings.

.4 Separately mounted photoelectric ionization and heat detectors in the same location are not acceptable alternatives.

20.6 Fixed temperature heat detector

.1 These heat detectors shall have a low mass thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. The heat detector shall have a nominal

.2 Alarm point rating of 57°C (135°F). The heat detector shall be rated for ceiling installation at a minimum of 21.3m (70’) centres and be suitable for wall mount applications.

20.7 Fixed temperature / rate of rise heat detector

.1 These heat detectors shall have a low mass thermistor heat sensor and operate in a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central

intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 57°C (135°F) and a rate-of-rise alarm point of 9°C (15°F) per minute. The heat detector shall be rated for ceiling installation at a minimum of 21.3m (70') centres and be suitable for wall mount applications.

20.8 Photoelectric smoke detectors

.1 The intelligent photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values form the sensor and initiate an alarm based on the analysis of data. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging, and humidity. The photo detector shall be rated for ceiling installation at a minimum of Soft (Olin) centres and be suitable for wall mount applications.

.2 The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3%. The photo detector shall be suitable for operation in the following environment:

.1 Temperature: 0°C to 49°C (32°F to 120°F)

.2 Humidity: 0-93% RH, no-condensing

.3 Elevation: no limit

.3 Detectors are to be provided with relay base where noted on the drawings.

20.9 Standard detector mounting bases

.1 Provide standard detector mounting bases suitable for mounting on North American 1-gang, 85mm (3-1/2") or 100mm (4") square box. The base shall, contain no electronics, suppo0rt all detector types and have the following minimum requirements:

.1 Removal of the respective detector shall not affect communications with other detectors.

.2 Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.

20.10 Audible/visual signal devices

.1 Mini Horns: flush mounted temporal mini horn, 24 Vdc operation, selectable HIGH/LOW setting 94.5 dBA (high) / 89.8 dBA (low) at 3 m (10'), white or red coverplate, FM and ULC listed. Suitable for mounting on a single gang box.

.2 Strobe: semi-recessed, 24 Vdc operation, complete with selectable 15/30/110 candela output (unless otherwise noted set at 75 cd), synchronized strobe, red finish, FM and ULC listed. Suitable for mounting on a single gang box.

.3 Mini Horn/Strobe: flush mounted temporal combination mini horn/strobe, 24 Vdc operation, selectable HIGH/LOW setting 94.5 dBA (high) / 89.8 dBA (low) at 3 m (10') selectable 15/30/75/110 candela output (unless otherwise noted set at75 cd), synchronized strobe white or red coverplate, FM and ULC listed. Suitable for mounting on a single gang box.

.4 Notes:

.1 Any surface mounted signal devices must be provided with suitable backboxes supplied by the manufacturer.

.2 Provide synchronization modules to suit signal devices (if required by manufacturer).

.3 Set signal devices in classrooms to LOW setting.

20.11 Monitor module

.1 The monitor modules shall have the following operating characteristics:

.1 A flashing LED indicates that the module is in communication with the control panel. The LED latches stead on alarm (subject to current limitations on the loop).

.2 The monitor modules shall have the following features:

.1 Nominal operating voltage: 15 to 32 VDC

.2 Maximum current draw: 5.1 mA (LED on)

.3 Average operating current: 400uA (LED flashing)

.4 EOL resistance: 47K ohms.

.5 Temperature range: 0°C to 49°C (32°F to 120°F)

.6 Humidity range: 10% to 93% noncondensing

.7 Dimensions: 114.3mm (4.5”) high x 101.6 mm (4”) wide x 31.75 mm (1.25”) deep. Mounts to a 101.6 mm (4”) square x 53.975 mm (2-1/8”) deep box.

20.12 Isolator module

.1 Fault isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC loop. The fault isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop. If a wire-to-wire short occurs, the fault isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the fault isolator module shall automatically reconnect the isolated section of the SLC loop.

.2 The fault isolator module shall not require any address-setting, and its’ operations shall be totally automatic. It shall not be necessary to replace or reset a fault isolator module after its normal operation. The fault isolator module shall mount in a standard 10.16 cm (4”) deep electrical box, in a surface-mounted backbox, or in the fire alarm control panel. It shall provide a single LED which shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

20.13 Control module

.1 Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contact relay.

.2 The control module NACs may be wired for Style Z or Style Y (Class A/B) with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% or all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

.3 The control module shall be suitable for pilot duty applications and rate for minimum of 0.6 Amps at 30 VDC.

20.14 System wiring

.1 The system wiring must be FSA rated in conformance with the Electrical Safety code to suit the type of installation.

.2 Wiring shall be minimum #18 AWG twisted shielded pair in conduit. “Securex 2” armoured cable will be permitted to be used for “drops” to devices on accessible ceilings.

.3 As indicated on system riser diagram initiating device wiring shall be run in a loop with a home run from the last device to the control panel (Class ‘A’ configuration).

.4 Signal wiring is to be cross connected in a Class ‘A’ configuration.

.5 Install isolator modules and end of line resistors in service rooms no higher than 2.4 m AFF. Provide location of these devices at the time of shop drawing submission.

.6 These are the basic wiring requirements for system operation. Prior to tender close manufacturer and contractor are to confirm all necessary wiring specifications and requirements.

21 Execution

21.1 Installation

.1 The entire system shall be installed in accordance with CAN/ULC-S524 (latest edition) and approved manufacturers manuals and wiring diagrams. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the Electrical Safety Code, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout.

.2 Disconnect and remove any existing devices and retain for reinstallation to suit construction work. Reinstall in accordance with system requirements and verify in accordance to applicable standards noted herein.

.3 Locate and install manual alarm stations and connect to alarm circuit wiring.

.4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1m (39”) of air outlets. Maintain at least 600 mm (24”) radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.

.5 Locate and install signal devices and connect to signalling circuits. Allow for any additional signal circuits from main fire alarm control panel as required to suit new devices. Confirm loading requirements with fire alarm manufacturer.

.6 Install end-of-line devices at end of applicable alarm and signalling circuits.

.7 The manufacturer and electrical contractor are to allow in their tender the cost of five (5) additional signalling devices to be installed and verified in locations as directed by the Consultant.

.8 Note: This installation and verification will be occurring after the audibility testing is complete.

.9 Locate and install remote relay units to control fan shut down. All new and existing are handling units are to be tied into the fire alarm control panel for fan shut down.

21.2 Device mounting heights

.1 Pull stations to be mounted 47” above finished floor to center of device.

.2 Wall mounted audible signal devices to be mounted minimum 6” (150mm) below ceiling and no less than 90” (2300mm) above finished floor to top of device.

.3 Visual signal devices to be mounted so that entire lens is 78”-94” (2000-2400mm) above finished floor

.4 Combination audible/visual signal devices shall conform to both 3.2.2 and 3.2.3.

.5 End of line resistors to be mounted less than 70” (1800mm) above finished floor

21.3 Fire detectors mounting

.1 Fire detectors shall not be located closer than 1000mm horizontally from tip of suspended ceiling fan (paddle) or ceiling mounted unit heater measured to end of the detector.

.2 Fire detectors shall be located closer than 450mm from any supply outlet or exhaust outlet as measured to the edge of the detector.

21.4 Field quality control

.1 The system shall be installed and fully tested under the supervision of trained manufacturer's representative. The system shall be demonstrated to perform all the functions as specified.

21.5 Acceptable installer

.1 The fire alarm/life safety system specified herein shall be installed by an Authorized Electrical Contractor who is CFAA Certified.

21.6 Examination

.1 Prior to the commencement of any of the work detailed herein, an examination and analysis of the area(s) where the Fire Alarm/Life Safety System and all associated components are to be installed shall be made.

.2 Any of these area(s) which are found to be outside the manufacturer's recommended environments for the particular specified products shall be noted on a Site Examination Report which shall be given to the Building Owner's Representative, and the Consultant.

.3 Any shorts, opens, or grounds found on existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.

21.7 Demonstration

.1 Each of the intended operations of the installed Fire Alarm/Life Safety System shall be demonstrated to the Building Owner's Representative and the Consultant.

21.8 System test

.1 Perform tests in accordance with Section 26 05 01 and CAN/ULC-S537 (latest edition) Standard for the Verification of Fire Alarm Systems.

.2 Fire Alarm System:

.1 Test each device and alarm circuit to ensure noted devices transmit alarm to control panel and actuate general alarm ancillary devices.

.2 Check annunciator panels to ensure zones are show correctly.

.3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.

.4 Class A Circuits:

.1 Test each conductor on all circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on all circuits for capability of proving alarm signals during ground-fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.5 Class B Circuits:

.1 Test each conductor on all circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on all circuits for capability of proving alarm signals during ground-fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.3 The sensor’s average analogue value is the average of the last 2000 recorded analogue entries of its chamber.

.4 Any sensor that fails this test shall indicated a ‘self-test abnormal’ trouble condition with the sensor’s address at the control panel.

21.9 Audibility testing

.1 Audibility Testing:

.1 The contractor is to coordinate an audibility test prior to occupancy of the facility. The test is to be performed by the representatives of the fire alarm manufacturer in the presence of the Consultant. The test report is to be in chart form indicating:

.1 Project

.2 Date of test

.3 Room name and number

.4 Ambient dB level

.5 Alarm dB level

.6 Name of testing technician

.2 The test results are to be submitted to the Consultant for review prior to issuing to Owner’s representatives and/or authorities having jurisdiction.

End of section