

Part I General

I.1 RELATED REQUIREMENTS

- .1 Note Used

I.2 REFERENCES

- .1 Refer to section 27 05 00 for references applicable to this project.

I.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for communications equipment and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Construction/Demolition Waste Management and Disposal in accordance with Section 10 74 21

I.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect communications equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section
Packaging Waste Management: remove for reuse and return by manufacturer of.
packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 GROUNDING CONDUCTOR

- .1 Ground wire: No. 6 AWG stranded annealed copper conductor with colour Green polyvinyl chloride insulation designed for ground connections to protect cable terminals and protectors.

2.2 2-POST TELECOM RACK

- .1 EIA compliant 483mm 2-post telecom rack.
- .2 Complete with double sided 10/32 tapped holes and EIA universal standard hole pattern.
- .3 44 rack units 2.1m high complete with 2 hinged vertical cable management.
- .4 Floor mounted ultra heavy welded steel construction.
- .5 Black powder coat finish.
- .6 Acceptable manufacturers: Middle Atlantic, Electron Metal, Cable Talk

2.3 SMALL EQUIPMENT RACK FOR ROOM 110

- .1 EIA compliant 483mm rotating slide-out equipment rack.
- .2 Overall dimensions of rack shall be 483mm W x 697 mm H x 588 D with 14 useable rack spaces and a 300 lb. weight capacity.
- .3 Rack shall put out 584mm on integrated ball bearing slides and rotate 90° for equipment servicing.
- .4 Detachable rack allows for off-site integration.
- .5 Front mounted tab shall be used to rotate rack and lock into position.
- .6 Front mounted level shall lock rack in extended position.
- .7 When rotating rack, locking detent shall allow rack to lock in place at 0°, 60° and 90°.
- .8 Rack rail shall be 11-gauge steel with tapped 10-32 holes in universal EIA spacing.
- .9 Rack rail shall be finished in black e-coat with marked rack spaces.
- .10 rough-in pan shall be 14-gauge steel.
- .11 Finish on assembly shall be a durable flat black powder coat.
- .12 Trim/locking panel shall lock cabinet in closed position and be 11-gauge aluminum with a black brushed and anodized finish. Equipment cabinet shall be warrantied to be free from defects in material or workmanship under normal use and conditions for a period of 3 years.
- .13 Locking trim panel in silver brushed and anodized finish.
- .14 Acceptable manufacturers: Middle Atlantic, Electron Metal, Hammond

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for communications equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install grounding conductor between new telecom room 104 grounding bus bar and existing telecom room 206.
- .2 Install 2-post rack in telecom room 104
- .3 Install Small equipment rack in room 110, coordinate with millwork supplier the installation of rack and with Departmental Representative.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

2.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by communications equipment installation.

END OF SECTION

Part I General

I.1 REFERENCES

- .1 American National Standards Institute
 - .1 ANSI J-STD-607-B-2011, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-606-B-2012, Administration Standard for the Commercial Telecommunications Infrastructure.
- .3 U.S. Department of Labor/Occupational Safety and Health Administration (OSHA)
 - .1 Nationally Recognized Testing Laboratory (NRTL).
- .4 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-15, Canadian Electrical Code 23rd Ed.
- .5 Building Industry Consulting Services International (BICSI)
 - .1 BICSI Telecommunications Distribution Methods Manual 13th Edition

I.2 SYSTEM DESCRIPTION

- .1 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.
- .2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

I.3 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

I.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
- .2 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- .1 A Pre-drilled electroplated copper Busbar with holes for use with standard 2 hole lugs with standard NEMA bolt hole sizing and spacing..
- .2 Shall be sized accordance with the immediate connection requirements with a minimum of 4 extra sets of holes.
- .3 Shall be a minimum size of 6mm thick, 53mm high and variable in length.
- .4 Shall include Insulated supports with a minimum of 50mm separation from mount.
- .5 Shall be listed by a nationally recognized testing laboratory.
- .6 Acceptable Products: Cable-Talk CT-BIBB 2X10-12, Panduit GB2B0306TPI-I, Erico TGB-A14L06PT.

2.2 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

- .1 3/0 AWG stranded copper conductor, green insulated marked to: ANSI J-STD-607-B.

2.3 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

- .1 3/0 AWG stranded copper conductor, green insulated marked to: ANSI J-STD-607-B.

2.4 GROUNDING EQUALIZER (GE)

- .1 3/0 AWG stranded copper conductor, green insulated marked to: ANSI J-STD-607-B.

2.5 EQUIPMENT BONDING CONDUCTOR (EC)

- .1 6 AWG stranded copper conductor, green insulated marked to: ANSI J-STD-607-B.

2.6 RACEWAY BONDING CONDUCTOR (RBC)

- .1 6 AWG stranded copper conductor, green insulated marked to: ANSI J-STD-607-B.

2.7 BONDING CONDUCTOR TERMINATION

- .1 Two-Hole compression lugs, long barrel type, sized as per AWG of cable.
- .2 High conductivity wrought copper.
- .3 Electro tin plated
- .4 Hole spacing as per TMGB and TGB.

2.8 INSULATED CONDUIT GROUND BUSHINGS

- .1 Each Metal Conduit originating in the Telecom Entrance Facility, Telecom Room or Equipment Room shall be directly connected to the TMGB or TGB via a compression lug.
- .2 Ground bushing shall be insulated.

2.9 BONDING AND GROUNDING CLAMPS

- .1 All ground wires originating at the TMGB or TGB shall be clamped to the plywood backboard "B" ground wire clamps.
- .2 Shall be mechanically galvanized ASTM B695
- .3 5.6mm hole diameter

2.10 CABLE TRAY BONDING CLAMPS

- .1 Shall be constructed of malleable iron
- .2 Zinc plated
- .3 Shall allow for clamping of ground wire of multiple gauges.

2.11 WARNING LABELS

- .1 Non-metallic warning labels in English and French to: ANSI J-STD-607-B.
- .2 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

Part 3 Execution

3.1 GENERAL INSTALLATION REQUIREMENTS

- .1 Install all Bonding Conductors as per CEC. And manufacturers recommended installation procedures.

3.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- .1 Install TGB in main terminal/equipment room and each telecommunications room.
- .2 Install 3/0 AWG copper bonding conductor from TGB to alternating current equipment ground (ACEG) of serving electrical power panel (panelboard) or main electrical grounding bus bar.

3.3 BONDING CONDUCTORS GENERAL

- .1 When placed in ferrous metallic conduit or EMT longer than 1 m, bond to each end of conduit or EMT using grounding bushing and #6 AWG copper conductor.

3.4 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

- .1 Install bonding conductor for telecommunications from TMGB to service equipment (power) ground.
- .2 Use approved 2-hole compression lugs for connection to TMGB.

3.5 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

- .1 Install TBB from TMGB to each TGB as indicated.
- .2 Use approved 2-hole compression lugs for connection to TMGB and TGBs.

3.6 GROUNDING EQUALIZER (GE)

- .1 Install GE between TBBs in multi-storey building by bonding TGBs with GE on top floor and every third floor in between top and bottom floors.

3.7 BONDING TO TGB

- .1 Bond metallic raceways in telecommunications room to TGB using #6 AWG green insulated copper conductor.
- .2 For cables within telecommunications room having shield or metallic member, bond shield or metallic member to TGB using #12 AWG green insulated copper conductor.
- .3 Bond equipment rack and cabinet located in telecommunications room to TGB using #6 AWG green insulated copper conductor.

3.8 LABELLING

- .1 Apply warning labels to telecommunications bonding and grounding conductors.
- .2 Apply additional administrative labels to: TIA/EIA-606-B.

END OF SECTION

Part I General

I.1 REFERENCES

- .1 American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA)
 - .1 ANSI/TIA-569-C-2012, Telecommunications Pathways and Spaces
- .2 Building Industry Consulting Services International (BICSI)
 - .1 BICSI Telecommunications Distribution Methods Manual 13th Edition
- .3 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code

I.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for communication raceway systems and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit Construction/Demolition Waste Management and Disposal in accordance with Section 01 74 21.

I.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect communication raceway systems from [nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

- .5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Empty telecommunications raceways system consists of outlet boxes, cover plates, single gang raise plaster adapter ring, distribution cabinets, conduits, cable trays, pull boxes, sleeves and caps, fish wires, service poles, service fittings, surface raceways, floor boxes.
- .2 Overhead main cable tray distribution system and combination J-hook/conduit to device outlet installed in accessible ceiling space.
- .3 Voice and data cabling installation is not in contract. Shared Service Canada (SSC) is responsible for the installation, termination and testing of voice and data cabling.

2.2 CABLE TRAYS: BASKET STYLE CABLE TRAY

- .1 Shall be a pre-fabricated structure, minimum 300 mm wide by 103mm tall consisting of a Basket bottom within basket two side rails.
- .2 Shall be supported as per manufacturer's instruction and applicable codes.
- .3 Use proper manufactured fittings; accessories and fittings such as cable drop-out fitting, elbow, reducers, crossovers, tees and risers will be used for any change of direction, height or size of the basket cable tray.
- .4 Acceptable Manufacturers: Cablofil, Hubbell, Thomas and Betts

2.3 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

- .1 Cable tray shall be supported by Cantilever brackets, Trapeze Brackets, or individual rod suspension. Supports shall be approved types of wall brackets or trapeze hangers. Additional bracing may be required for seismic restraints.
- .2 Conduits entering a room shall be appropriately racked on a trapeze support suspended from the structure.
- .3 Cable tray shall be supported via Manufactures brackets, or supports manufactured on site using Unistrut or B-line channel, meeting all the manufacturers' requirements for loading.
- .4 Conduits should be independently supported, free from any other mechanical system.
- .5 Conduit and cable tray support systems shall be securely and adequately installed to preclude movement of conduit and cable tray during pulling operations.
- .6 J-hooks are authorized for Communications Distribution installed in T-bar ceiling space.

2.4 CONDUIT, PULL BOXES AND OUTLET BOXES FOR COMMUNICATIONS AND SECURITY SYSTEMS

- .1 Metallic Conduit
 - .1 Thin Wall EMT, reamed and bushed at both ends.
 - .2 Minimum Size for communications is 27mm inside diameter.
 - .3 Installed above ceilings, under access floors and in walls only; not acceptable for in floor use.
 - .4 Conduits, conduit fittings, hanger and supports: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings, Section 26 05 29 Hangers and Support for Electrical Systems, Section 26 05 33 Raceway and Boxes for Electrical System
 - .5 Fish wire: polypropylene type.
- .2 Pull Boxes
 - .1 Shall be made of code gauge steel and shall have a rust resistant finish.
 - .2 Shall be constructed in accordance with Canadian Standards Association.
 - .3 Shall be sized in accordance with ANSI/TIA/EIA-569B, Table 12.
 - .4 Pull Boxes for Security systems shall not have pre-punched knockouts.
 - .5 Junction boxes, cabinets type: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .3 Outlet Boxes for communications systems
 - .1 Shall be a minimum size of 100mm x 100mm x 65mm deep.
 - .2 Shall have a raised Plaster adapter ring sized for a single gang opening for communications Outlets.
 - .3 Shall have raised plaster adapter ring sized for Access Control devices.
 - .4 Shall have raised plaster adapter ring sized for Digital Wall clock.
 - .5 Shall have raised plaster adapter ring sized for Intrusion Alarm devices.
 - .6 Outlet boxes 2-gang type with single gang plaster ring, conduit, and fittings: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for communication raceway systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install empty raceway system, including underfloor overhead distribution system, pull wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service poles, miscellaneous and positioning material to constitute complete system.
- .1 Install all systems as per the CEC and manufacturers recommended installation procedures.
- .2 Ground and bond all conduits and cable tray in accordance with section 27 05 26 and CEC.
- .3 Provide separate conduit/cable tray system for the following systems:
 - .1 Intrusion Alarm System
 - .2 Audio Video Systems
 - .3 Public Address / Audio system
 - .4 Sound Masking System
 - .5 Video Surveillance and Access Control
- .4 Electrical Metallic Tubing (EMT) conduits for all Voice Data Systems, Audio/Video system,. Access Control and Video Surveillance systems minimum size to be 27mm unless specified otherwise.
- .5 Electrical Metallic Tubing (EMT) conduits for all Intrusion Alarm and Public Address/Audio systems minimum size to be 21mm unless specified otherwise.
- .6 Provide the following separation from Electrical Power systems installed in conduits:
 - .1 300mm from circuits of 300Volt and less.
 - .2 600mm from circuits 300Volt and higher.
 - .3 2 Metres from Circuits between 600V and 15KV.
 - .4 3 Metres for circuits above 15KV.
 - .5 Electrical or Mechanical systems cannot share the same cable tray or be racked on the same support structure.
- .7 Heights of Communications system Outlet Boxes:
 - .1 Telecommunications outlets, 400mm Above Finished Floor (AFF) (the same height as adjacent receptacles)
 - .2 Wall Mounted Telephones or Intercom, 1220mm AFF.
 - .3 Access control Card readers, 1100mm AFF.
 - .4 Intrusion alarm keypads, 1400mm AFF
 - .5 Barrier Free Buttons, 900mm AFF
 - .6 Door Contacts, on leading edge of door frame at top of frame.

3.3 INSTALLATION OF HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS.

- .1 Support Cable tray of approved types of wall brackets, trapeze supports. Plumbers perforated straps are not permitted means of supports.
- .2 Centre hung cable tray is not acceptable for communications cabling.
- .3 Conduits and equipment shall be independently supported, free from any other mechanical system.
- .4 Conduit and Cable Tray support systems shall be securely and adequately installed to preclude movement of conduit and cable tray during pulling operations.
- .5 Communications outlet boxes shall not be placed back to back with another communications outlet box or any other box.
- .6 Maximum Height for installed communications systems is 11 ft.
- .7 Only communications system can be attached to the trapeze supports of the cable tray.
- .8 Power or mechanical controls shall not be attached to communications racking.

3.4 INSTALLATION OF CONDUIT, PULL BOXES AND OUTLET BOXES FOR COMMUNICATIONS SYSTEMS.

- .1 Conduit Installation Requirements
 - .1 All Communications systems shall be installed in conduit or cable tray unless otherwise indicated.
 - .2 The inside radius of a bend in conduit shall be not less than 10 times the internal diameter of the conduit.
 - .3 All Conduits shall be identified and labelled at both ends. Tags shall identify start and finish of conduit.
 - .4 A Maximum of one communications outlet per 27mm conduit run.
 - .5 Back to back or offset outlets shall not be used.
 - .6 All Conduits shall originate in the communications room, pull box or cable tray.
 - .7 Conduits shall be rigidly and adequately fastened to withstand pulling tensions as per manufacturer's recommendations.
 - .8 Conduits must follow building lines.
 - .9 90-degree LB, LL, LR, or condulets shall not be used in any instance for communications cabling.
 - .10 A pull box shall be installed in conduit runs where:
 - .1 The length of conduit is over 30 metres
 - .2 There are more than two 90-degree bends
 - .11 Offsets or kicks are to be considered 90 degree bend for communications
 - .12 Conduits protruding through the floor shall be terminated 25-50 mm above the finished floor.
 - .13 Riser sleeves protruding through the floor shall be terminated 25-75mm above the finished floor, including sleeve and bonding bushing.

- .14 Conduits entering and exiting through the ceiling of a communications Room (TR) shall protrude into the room 25-50mm above the 2400mm level.
 - .15 All zone conduits entering a TR (unless otherwise stipulated will protrude into the TR from 25-50 mm without a bend.
 - .16 The maximum fill rate authorized for conduits is 40 percent.
 - .17 Pull boxes shall not be installed higher than 3353mm above finished floor. Approval of this deviation is on a case by case basis.
 - .18 Communications conduits shall NEVER be run over:
 - .1 Boilers
 - .2 Incinerators
 - .3 Hot Water lines
 - .4 Steam lines
 - .5 Electrical rooms and Closets
 - .6 Washrooms
 - .19 All Conduits shall be bonded in accordance with section 27 05 26 and the CEC.
 - .20 All Conduits shall use the trapeze hanger method to support the conduits, shall use threaded rod not less than 3/8" diameter.
 - .21 Install pull string in all conduits and cable tray tied at both ends for installation by Voice data system contractor.
- .2 PULL BOX INSTALLATION REQUIREMENTS
- .1 In all instances pull boxes shall be placed in straight sections of a conduit run and shall NOT be used in lieu of a bend. Corresponding ends of the conduit are to be aligned with each other. Conduit fittings shall not be used in place of pull boxes. Conduits shall always protrude in the direction of pull. Conduits shall not exit the sides bottom or back of the pull box.
 - .2 All Communications system conduits including Intrusion Alarm, Sound Masking, Public Address and Access control shall follow the requirements of this section.
 - .3 Pull boxes shall be placed in an exposed location, and readily accessible. Pull boxes shall not be placed in a fixed false ceiling space, unless immediately above a suitably marked and hinged panel. If the pull box is installed above a suspended type ceiling a green indicator dot shall be placed on ceiling t-rail to indicate the location of pull box.
 - .4 All Boxes shall be adequately secured. They shall not be supported by the conduits entering the box.
 - .5 Riser cables and Communications outlet cannot share the same conduit system or pull boxes.
- .3 OUTLET BOX INSTALLATION REQUIREMENTS
- .1 Install communications Outlet boxes for voice data systems same level as adjacent receptacles and flush to the wall wherever possible.
 - .2 Where communications Outlets are installed in steel stud type systems, provide additional cross bracing and or straps to make the installation completely rigid prior to the application of the wall facing material.
 - .3 Back to back and offset outlets shall not be used.

- .4 Apply appropriate acoustic sealing as necessary on back of communications outlet boxes to ensure the STC rating is maintained.
- .5 Ensure conduits are installed not to de-rate the STC rating of the wall.
- .6 Ensure Outlet Box is mechanically bonded to the Conduit system.
- .7 Conduits must enter the outlet box from the top or bottom.

3.5 **CABLE TRAY FOR COMMUNICATIONS SYSTEMS**

- .1 Cable tray shall be installed above false ceilings or below access floors. Under no circumstances should cable tray be installed above a fixed ceiling. Provide a minimum of two 103mm conduits to transition the fixed ceiling portions. Install additional conduits if the fill rating of the cable requires additional conduits.
- .2 Cable Trays installed 150mm above a false ceiling with 300mm clear access above. Cable tray shall be installed with separation from sources of EMI and electrical power system as indicated.
- .3 Communications Cable Tray shall NEVER be run over:
 - .1 Boilers
 - .2 Incinerators
 - .3 Hot Water lines
 - .4 Steam lines
 - .5 Electrical rooms and Closets
 - .6 Washrooms.
- .4 Support Cable Tray to suit loading and recommended support requirements in the Canadian Electrical Code, Part I, for the applicable class. A support shall be placed within a maximum of 610mm on either side of any connection to a fitting and 1524mm on centre as recommended by the cable tray manufacturer. Cable Tray shall be adequately fastened to withstand pulling tensions as per manufacturer's recommendations.
- .5 Remove any burrs, sharp edges, or projections that may damage cables.
- .6 Install proper manufactured accessories and fittings such as elbows, reducers, crossovers, tees and risers for any change of direction, height or change of direction of the cable tray. Vented accessories shall be used.
- .7 Install cable tray a minimum of 300mm from fluorescent luminaries, Power cables shall cross at right angles to communications cables with the separation distances as indicated.
- .8 Install Cable tray either using angle brackets or trapeze, ensure only communications systems can be racked to the bottom of the tray. Electrical power or Mechanical controls shall not be racked or installed using communications equipment supports or hangers.
- .9 Install Grounding and Bonding in accordance with section 27 05 26 and CEC.
- .10 Ensure other building components, i.e.: mechanical ducts, sprinkler pipes, luminaries, etc do not restrict access to Communications cable tray.
- .11 Mark Cable Tray at each transition or connection.
- .12 Provide cable water fall down to 2-post rack.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse, recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by pathways for communications systems installation.

END OF SECTION

Part I General

I.1 RELATED REQUIREMENTS

- .1 Not Used

I.2 REFERENCES

- .1 Industry Canada - Terminal Attachment Program
 - .1 CS-03-2010, Compliance Specification.
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA72-2010, National Fire Alarm and Signaling Code.

I.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for audio system and wireless microphones and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.
 - .2 Indicate on drawings:
 - .1 Riser diagram, block diagram of complete public address system.
 - .2 Audio system and wireless microphones system design criteria.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit Construction/Demolition Waste Management and Disposal in accordance with Section 01 74 21.

I.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for audio system and wireless microphones for incorporation into manual.
- .3 Include in manual:
 - .1 Operation instructions.

- .2 Description of system operation.
- .3 Description of each subsystem operation.
- .4 List showing each piece of equipment in system or subsystem by its original manufacturer name and model number.
- .5 Part list showing parts used in equipment by identification numbers that are standard to electronics industry.

I.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Include: Part numbers.

I.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect amplifiers, speakers, wireless microphone and wireless microphone transmitters and controllers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction/Demolition Waste Management and Disposal in accordance with Section 01 74 21.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 Classroom Audio loudspeaker system to incorporate:
 - .1 The audio room controller shall be programmed to be able to deliver Voice announcement, music or audio input from PC etc for individual classroom Rooms 107A, 107B and 107C. The control panel located in the room shall also be able to select the input and control the volume of the amplifier.
 - .2 The audio room controller for classroom 107A shall be programmed to be able to send voice announcement, music or audio input from PC etc. and send the output to speakers located in classroom 107A, 107B, 107C and multi-purpose

- room. The control panel located in the room shall also be able to select the input and control the volume of the amplifiers.
- .3 Audio room controller to be wall mounted in individual classroom to control sound system in the classroom as well as to converge other classroom in to one system.
 - .4 Audio input to be mounted on the floor box located by the teacher's desk in front of the classrooms. The audio input shall be able to accommodate input from Recorded music from CD player, digital audio - MP3 player, IPOD, computer etc.
- .2 Operations:
- .1 Paging:
 - .1 Voice announcements from the microphone overrides broadcast or recorded music reproductions.
 - .2 Announcement to individual classrooms.
 - .3 Announcements to all areas.
 - .2 Music:
 - .1 Music from CD player and other external source.
 - .2 Speaker selection made via soft-switches and wall mounted multiplexed assembly.
- .3 Amplifiers, wireless microphone receiver and audio input receiver to be rack mounted.

2.2 MATERIALS

- .1 Conduits: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings and Section 27 05 28 – Pathways for Communications System.
- .2 Communication conductors: as indicated, in accordance with this Section.

2.3 COMPONENTS

- .1 Continuous duty cycle.
- .2 Modular system design.
- .3 Solid state, and suitable for rack mounting.
- .4 Maximum operating temperature: 65 degrees C.
- .5 Grounding conductor for system components.

2.4 EQUIPMENT RACK

- .1 Rack, to accommodate system components, enclosed type, steel construction with internal mounting rails, wire and cable entrances with smooth edges protected by rubber edging, four adjustable rack levelling feet.
- .2 Metal outlet raceway with colour coded outlets wired to 120 V, 60 Hz supply controlled by key type locking switch.

- .3 Rotating design allows enhanced access to rear equipment connections simplifying wiring. Rotation angle 60°, maximum rollout 635mm.
- .4 660mm useable depth, rack frame is housed in a 835mm deep host enclosure.
- .5 1956mm Useable height and rack frame height is 2165mm.
- .6 Host enclosure can be pre-installed on site while detachable rack frame is integrated with equipment off-site.
- .7 Louvres and ventilation apertures in sides and front of the rack complete with forced air cooling system mounted on top of the rack.
- .8 Racks to contain but not necessarily limited to following components:
 - .1 Monitor panel.
 - .2 Relay assembly.
 - .3 Page/music selection panel.
 - .4 Pre-amplifier mixer.
 - .5 Power amplifiers.
 - .6 Power supplies.
 - .7 Installation and service connections to various panels by plug-in type terminal blocks with barriers and screw type terminals.
 - .8 Acceptable manufacturers: Hammond, Middle Atlantic, Electron Metal

2.5 WIRELESS MICROPHONE AND WIRELESS MICROPHONE RECEIVER

- .1 Wireless Microphone: omni-directional, noise cancellation, dynamic type, complete with cradle and battery charger
- .2 24-bit/48 kHz digital audio that delivers incredibly clear and accurate reproduction of the source material.
- .3 20 Hz – 20 kHz frequency range with flat response.
- .4 Greater than 120 dB dynamic range through the analog outputs.
- .5 Built-in limiter circuitry prevents digital audio clipping from excessive signal levels.
- .6 130 dB dynamic range (typical) using Dante™ digital networked audio.
- .7 60 dB of adjustable system gain easily accessible from the receiver front panel.
- .8 No transmitter gain adjustments needed - optimized for any input source
- .9 Up to 72 MHz overall tuning range (region dependent)
- .10 Up to 17 active transmitters in one 6 MHz TV channel (22 on an 8 MHz TV channel).
- .11 High Density mode enables up to 47 active transmitters in one 6 MHz TV channel (63 in one 8 MHz TV channel), with no audio quality degradation.
- .12 Rock-solid signal stability with no audio artifacts over the entire 100 meter line-of-sight range using standard supplied ½ wave antennas.
- .13 Selectable 1, 10, and 20 mW transmitter RF output power.

- .14 Optimized scanning automatically finds, prioritizes, and selects the cleanest frequencies available.
- .15 Wireless microphone receiver shall be the same manufacturer as the wireless microphone. Shall be complete with ceiling mounted antenna, cable, power supply and wireless microphone battery charger.

2.6 DIGITAL MATRIX MIXER/AMPLIFIER

- .1 Modular design.
- .2 Power Source: 120 V AC, 60 Hz
- .3 Power Consumption: 100 W
- .4 Audio Input: Max.
 - .1 8 channels, modular construction (modules optional)
 - .2 Power amplifier input: 0 dB(*I), 10 k Ω , RCA pin jack
- .5 Audio Output
 - .1 Preamplifier output 1: 0 dB(*I), 300 Ω , unbalanced, RCA pin jack
 - .2 Preamplifier output 2: 0 dB(*I), 600 Ω , balanced, removable terminal block (3 pins)
 - .3 Speaker output: Removable terminal block (7 pins) (Direct) 60 W, 4 Ω , unbalanced (Transformer) 60 W, 8 Ω 25 V & 70 V, balanced
- .6 Module Slot
 - .1 Analog input (slot 1 - 8): -10 dB(*I), 10 k Ω , unbalanced
 - .2 Digital input (slot 1 - 4): 24 bit/48 kHz
 - .3 MIX output (slot 1 - 8): -14 dB(*I), 330 Ω (CH 1 prefader output), unbalanced
 - .4 Digital output (slot 5 - 7): 24 bit/48 kHz
 - .5 Power supply (slot 1 - 8): +24 V, -24 V, +6 V DC
- .7 Digital Audio Signal Reference Level: -20 dBFS
- .8 Power Bandwidth
 - .1 (Direct) 20 - 20k Hz, 0.02% THD
 - .2 (Transformer) 50 - 20k Hz, 0.5% THD
- .9 Frequency Response
 - .1 Power amplifier section: 20 - 20k Hz, +0, -1 dB
 - .2 Analog input module to speaker output: 20 - 20,000 Hz, +1, -3 dB
- .10 Total Harmonic Distortion
 - .1 Power amplifier section: 0.008% (22 kHz LPF, 1 kHz, rated power)
 - .2 Analog input module to speaker output: 0.008% (22 kHz LPF, 1 kHz, rated power)
- .11 S/N Ratio

- .1 At Input short, 20 - 20,000 Hz, set to ALL FLAT or OFF setting
- .2 Output volume min.: 90 dB (preamplifier output)
- .3 Output volume max.: 61 dB
- .4 (preamplifier output, Input 1 volume: 0 dB, Other Inputs: OFF)
- .5 Power amplifier section: 110 dB
- .12 Cross Talk: Over 64 dB (at 20 kHz)
- .13 Tone Control
 - .1 Bass: ± 12 dB (at 100 Hz)
 - .2 Treble: ± 12 dB (at 10 kHz)
- .14 Parametric Equalizer: 10 bands, Frequency: 20 - 20k Hz, 31 steps, Variable range: ± 12 dB, Q: 0.3 - 5
- .15 Speaker Equalizer: 15 (compatible with TOA speakers only)
- .16 High-pass Filter: -12 dB/oct, Variable frequency range: 20 - 400 Hz, 14 steps
- .17 Low-pass Filter: -12 dB/oct, Variable frequency range: 4k - 20k Hz, 8 steps
- .18 Compressor: Depth: 1 - 5
- .19 Delay: 0 - 40 ms (1 ms steps), maximum 40 ms (CH 1 + CH 2), mixer mode only
- .20 Scene/Event Memory: 32
- .21 Operation Mode: Matrix mode/Mixer mode (selector switch)
- .22 Auxiliary Function: Key lock function
- .23 Control Input/Output
 - .1 RS-232C, D-sub connector (9 P, female)
 - .2 Control input: 4 inputs, no-voltage make contact input, open voltage: 3.3 V DC,
 - .3 Short-circuit current: Under 1 mA, removable terminal block (14 pins)
 - .4 Control output: 4 outputs, open collector output, withstand voltage: 27 V DC, control current: 50 mA, removable terminal block (14 pins)
 - .5 Remote volume: 2 channels, connect a 10 k Ω /linear taper variable resistor or
 - .6 Input the DC voltage of 0 to +10 V, removable terminal block (14 pins)
- .24 Operating Temperature: -10°C to +40°C
- .25 Operating Humidity: 35% to 80% RH (no condensation)
- .26 Finish
 - .1 Panel: Aluminum, hair-line, black
 - .2 Case: Surface-treated steel plate, black, paint
- .27 Dimensions: 420 (W) \times 107.6 (H) \times 355 (D) mm
- .28 Shall be complete with all modules to interface with other amplifiers, wireless microphone receiver and control module, input and output device modules. Provide

audio input complete with faceplate in the classrooms as well as all the wiring back to the equipment cabinet located in telecom room 104.

2.7 POWER AMPLIFIER

- .1 Overload and output short circuit protection.
- .2 Power output: 60 W stated in RMS power at 1% harmonic distortion
- .3 Frequency response 20 to 20,000 Hz, ± 1 dB
- .4 Signal and noise level: 90 - 108 dB below rated output.
- .5 Maximum gain: 75 dB.
- .6 Outputs: 70 V balanced or unbalanced line.
- .7 Peak power: 60 W.
- .8 Controls and indicators:
 - .1 Volume control.
 - .2 AC power switch.
 - .3 Fused primary.
 - .4 'On' indicator light.

2.8 AUDIO ROOM CONTROLLER

- .1 Remote Control Panel.
 - .1 Wall mounted remote control panel having 4 buttons and 1 volume control knob.
 - .2 Power Source: 24 VDC
 - .3 Consumption: 50 mA or less
 - .4 Terminal Blocks: Removable terminal block (10 pins)
 - .5 Indicator: 4 function indicators (Green LED), Level indicators (Green LED)
 - .6 Connection Cable: Shielded CPEV cable (paired data line and pair power line) or Category 5e twisted pair cable for LAN (CAT5e-STP)
 - .7 Operating Section: 4 function button, 1 volume control

2.9 VOLUME CONTROL

- .1 Wall mounted remote control panel having volume control knob.
- .2 Power Source: 24 VDC
- .3 Consumption: 50 mA or less
- .4 Terminal Blocks: Removable terminal block (10 pins)
- .5 Indicator: Level indicator (Green LED)
- .6 Connection Cable: Shielded CPEV cable (paired data line and pair power line) or Category 5e twisted pair cable for LAN (CAT5e-STP)
- .7 Operating Section: 4 function button, 1 volume control

2.10 AUDIO INPUT OVER CAT5E CABLE

- .1 Two-pair audio sending modules compatible with manufacturer's twisted pair products. These modules are designed to be mounted in wall boxes, cabinets or other enclosures that allow users to connect audio sources.
- .2 Features a white front-panel laminate with gray lettering that matches Decora®-style remote controls.
- .3 Shall be complete with transmitting and receiving device module.
- .4 Unbalanced -10 dBV Mini Jack Audio Input
- .5 Rear-panel RJ45 Input for Connecting Additional -TPS8A Senders
- .6 Left (L) Input Feeds Pair B; Right (R) Feeds Pair C
- .7 Signal and Power Pair Pass-Through on RJ45 Jacks
- .8 Remote Powering through Twisted Pair Cable
- .9 Daisy-Chain with Single-Pair Sender
- .10 Studio-Quality Precision Active Balanced Circuitry
- .11 Decora® Design with All Steel Panel and Rear enclosure.
- .12 Inputs (2): 10 kΩ Unbalanced, stereo; Format-A
- .13 Input Connection: Mini jack (front panel); RJ45 (rear panel)
- .14 Input Level: -10 dBV; +10 dBV Maximum
- .15 Format-A Signal Pairs Used (2): B (Left); C (Right)
- .16 Gain: 12 dB
- .17 Output: RDL TP Format-A
- .18 Output Connection: RJ45
- .19 Frequency Response: 20 Hz to 50 kHz (+/- 0.5 dB)
- .20 THD+N: < 0.1% (20 Hz to 50 kHz); <0.01% (1 kHz)
- .21 Noise below +4 dBu: < -85 dB; < -75 dB with up to 10 -TPS8A modules connected
- .22 Crosstalk: < 85 dB (1 kHz); < 75 dB (20 Hz to 20 kHz)
- .23 Headroom above +4 dBu: > 20 dB
- .24 Power Connection: RJ45
- .25 Power Requirement: 24 Vdc @ 30 mA
- .26 Dimensions: 1.33" (3.37 cm) D; 1.72" (4.37 cm) W; 4.11" (10.44 cm) H
- .27 Ambient Operating Environment: 0° C to 55° C
- .28 Complete with power supply

2.11 SPEAKERS (TYPE I)

- .1 8" Ceiling speaker complete with speaker baffle, speaker grill and T-bar/drywall kit.

- .2 Rated input: 10W, 70V line
- .3 Transformer tap: 0.25, 0.5, 1, 1.5, 2, 2.5, 5, 10W
- .4 Sensitivity: 97dB
- .5 Speaker component: Dual cone type 8"
- .6 Frequency response 50 – 16.5 KHz
- .7 Magnet size: Dia.80 K (3.15") × dia.32 (1.26") × 12 (0.47 ") mm
- .8 Magnet Weight 272 g (10 oz)
- .9 Flux density 11,900 gauss
- .10 Finish Baffle : Steel plate, white; Grille : Surface-treated steel plate net, white
- .11 Potentiometer - Type : Screw-driver adjust Wire wound, resistance 50Ω

2.12 COAXIAL CABLES FOR WIRELESS MICROPHONE SYSTEMS

- .1 Coaxial antenna wire: centre conductor No. 16 AWG copper, polypropylene foam insulation, medium density polyethylene skin, two longitudinal drain wires for shielding continuity, outer conductor and shield of polyolefin-coated aluminum tape, and outer jacket of polyvinyl chloride, designed for use between wireless microphone receiver and ceiling mounted antenna.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for public address systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install equipment in accordance with manufacturer's instructions, and as indicated.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conduct intelligibility test.

3.4 CLOSEOUT ACTIVITIES

- .1 Manufacturer's factory service engineer to instruct:
 - .1 Maintenance personnel in maintenance of system.
 - .2 Operating personnel in use of system.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse, recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by public address and mass notification systems installation.

END OF SECTION

Part I General

I.1 REFERENCES

- .1 ASTM E1374-06 (11) – Standard Guide for Open Office Acoustics and Applicable ASTM Standards
- .2 ASTM E1573-09 – Standard Test Method for Evaluating Masking Sound in Open Office Using A-Weighted and One-Third Octave Band Sound Pressure Levels
- .3 ASTM E1130-08 – Standard Test Method for Objective Measurement of Speech Privacy in Open Offices Using Articulation Index
- .4 ASTM E2638 – Standard Test Method for Objective Measurement of Speech Privacy Provide by Closed Rooms
- .5 Acoustical Design of Conventional Open Plan Offices, Canadian Acoustics, vol 27, no. 3, 2003 (NRCC-46274)

I.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for Sound Masking systems and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Include single line diagram, sound masking speaker layout of complete Sound Masking system.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

I.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for Sound Masking systems for incorporation into manual.
- .3 Include parts list using component identification numbers standard to electronics industry.

I.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address. Inspect manufacturer's packages upon receipt.
- .2 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect Sound Masking systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .4 Protect from moisture during shipping, storage and handling.
 - .5 Handle packages carefully.
- .3 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal

Part 2 Products

2.1 MATERIALS

- .1 Conduits: size as indicated, in accordance with Section 26 05 00 - Common Work Results for Electrical and in accordance with Section 27 05 28 - Pathways for Communications Systems.
- .2 Communication conductors: type and size as indicated, in accordance with manufacturer's cable type and sizes, to be CMP or FT6 rated.

2.2 SYSTEM DESCRIPTION

- .1 The contractor shall supply and install a complete and operational Sound Masking System for Classroom 107A, Classroom 107B, Classroom 107C and Workstations room 111 as indicated in the plan.
- .2 The sound masking speaker shall either be direct field, radiating directly into space or radiating upwards in the ceiling space.
- .3 The sound masking system shall automatically adjust based on the room's ambient noise level or timer based system or has wall mounted volume control system.
- .4 System Architecture
 - 1. The system shall be of a networked decentralized architecture with addressable masking devices distributed throughout the installation area.
 - 2. The sound masking system shall be arranged into zones from 1 to 6 speakers.

- .1 Each zone shall be individually addressable and controllable for both volume and spectrum for fine tuning of the system.

.5 Sound masking generating system

- 1. The system shall use digital signal processing (DSP) technology for masking sound generation and output adjustment of masking signals.
- 2. Sound masking generator shall include an automatic calibration process on 340 narrow bands or third-octave bands from 100Hz to 6.3kHz based on DSP technology.
- 3. The masking sound shall be generated via a truly-random, non-deterministic digital process with no repeat cycle.
- 4. The system shall provide independently controllable masking zones that efficiently allow the ability to control and monitor the operation of each zone and provide:
 - .1 A third-octave equalizer per zone with minimum 18 bands, ranging from 100Hz to 6 300Hz
 - .2 Possibility to select specific spectrum for each masking zone.
 - .3 Definition of the sound masking spectrum by increment of 0,1 dB in each 1/3 octave band.
 - .4 An independent masking volume control providing minimum 0.1 dBA volume increments and an output range of 35 to 85 dBA @ 1m from the loudspeaker
 - .5 A temporary mute function for the masking output
 - .6 The ability to completely disable the masking output
 - .7 Possibility to provide a masking volume ramp-up function of up to 4 weeks to facilitate the introduction of the system in the buildings that are already occupied.
 - .8 The system shall provide a function to allow a gradual ramp up of masking volume each time power is applied

.6 System control and software

- 1. The configuration and the adjustment of the system shall be made with a PC or a tablet connected by a wireless connection. The wireless connection is required only during the configuration of the system.
- 2. The sound masking system shall include graphical software interface that integrates the design, setup, and calibration stages directly on the office layout plan.
- 3. When adjustment needs to be made on the sound masking system, the operator shall be able to make the changes directly from the area that needs modification. The operator control PC or tablet shall be able to communicate with the system by wireless.

.7 Sound Masking Systems Acoustical Performance

- I. The preferred target sound masking frequency spectrum to be used shall be the one shown in Table I and in Acoustical Design of Conventional Open Plan Offices, Canadian Acoustics, vol 27, no. 3, 2003 (NRCC-46274) for each zone
 - .I The frequency contour provided shall be maintained at different dBA target levels by equally applying the positive or negative difference, between the nominal 45 dBA level and the target dBA level, to each of the one-third octave frequency band's dB level, so as to equally shift the entire contour. (e.g. A target level of 42 dBA, will required shifting the entire 45 dBA spectrum down equally by 3 dB in each of the 1/3 octave frequency bands)

Table I: Optimal Sound Masking Spectrum (ref. Bradley, NRCC-46274 report)

– Nominal 45 dBA Contour

1/3 Octave Band Center Frequency	1/3 Octave dB Sound Levels (overall = 45 dBA nominal)
Hz	dB
100	42.5
125	42
160	41.5
200	41.5
250	41
315	40.5
400	39.5
500	38.5
630	37.5
800	37
1,000	35.5
1,250	33.5
1,600	31
2,000	28.5
2,500	26.5
3,150	23.5
4,000	21.5
5,000	19.5

2. Provide Adaptive volume control adjustment Workstations room III
3. Masking sound levels for each location type shall be as follows:
 - .1 45 dBA in open plan areas.
 - .2 45 +/- 2 dBA in open areas with the adaptive volume control adjustment option.

- .3 42 dBA in enclosed rooms
- 4. The supplier shall setup the sound masking system to meet acoustical performance requirements when HVAC systems are functioning under what is considered a "normal" mode of operation for occupied periods.
 - .1 It is the Departmental Representative's responsibility to ensure HVAC systems are operating as required during sound masking system's scheduled commissioning.
 - .2 The supplier shall not be responsible to meet acoustical performance requirements in locations where, existing background noise exceeds sound masking spectrum levels, and/or where building design details or other constraints prevent its proper installation, setup and operation.
- 5. The spectrum should be verified and adjust to match target spectrum for every 100 to 150 square meters in open area and in 20% of enclosed rooms. The measurement shall be performed at representative locations 1.5m above floor level 1m away from demising partitions and walls or large reflecting surfaces, in concordance with ASTM E1573 measurement procedures.
- 6. After adjustment, the system shall provide spatial uniformity within the tolerances provide below.
 - .1 Overall dBA levels measured within zones and in enclosed rooms shall be within +/- 1 dBA, of the specified target level for the combined mechanical and sound masking level.
 - .2 Uniformity in any third-octave band shall vary no more than +/- 2 dBA, from the 1/3 octave band contour levels indicated in Table 1.
 - .3 In the situation where building background noise exceeds the target spectrum, special attention should be taken to identify the source.
- 7. To meet the above requirement, and allow flexible adjustments of the masking level, each 100 to 150 square meters of an open area should have an independent adjustment capability.
- 8. Upon completion of installation, and final setup the supplier shall provide a report to Departmental Representative of the sound masking systems acoustical performance.
- .8 Adaptive volume control adjustment in open areas
 - 1. The adaptive volume control system provides a real-time volume adjustment of the masking sound level based on the level of distracting noise in a zone.
 - 2. The ambient noise shall be measured with sensors installed in the ceiling.
 - 3. The adaptive adjustment system shall be based on the latest DSP technology
 - 4. Sensitivity of the active volume control shall be programmable to adapt masking level with ambient noise increase.
 - 5. Level variations rates shall be adjustable with 0.1 dB steps, update every 15s.

6. The minimum and maximum sound masking level and the sensitivity of the active volume control shall be programmable.
 7. It should be possible to control the masking sound volume in each zone independently.
 8. History of the active volume control shall be recorded on a 7 days period to allow the performance of the system to be analysed.
- .9 Timer Performance
1. The system shall provide a timer function allowing masking volume levels to be automatically adjusted according to a programmed schedule
 2. The system shall provide a calendar-based programmable timer function. Timer schedules shall be assigned to an individual or group of sound masking zones.
- .10 In-Room occupant Control for all the classrooms
1. Provide 1 wall mounted, in-room controls for each classroom giving the user's manual controls over the loudspeaker volume in designated room or zone.
 2. Electrical contractor to provide boxes and conduit complete with pull string as indicated in the plan.
- .11 Security Performance
1. The system shall provide:
 - .1 Password-protected access to the project manager software.
 - .2 storage of settings in memory in each networked masking device, which shall be maintained during power outages

2.3. SUBMITTALS

- .1 Product Data: Manufacturer's specifications and installation instructions.
- .2 System Design: Schematics of the system showing quantity and location of components, related cabling and accessories.
- .3 Warranty Documents: Warranty documents covering the system components.

2.4. QUALITY ASSURANCE

- .1 System Design: Performed by an approved manufacturer representative.
- .2 Installer Qualifications: Approved by manufacturer representative and are trained with the specified components or have demonstrated experience with the installation of similar products to those specified.
- .3 System Adjustment: Done by an approved manufacturer representative or trained contractor.

2.5. REGULATORY TESTING AND CERTIFICATIONS

- .1 The relevant system components shall conform to:

1. UL 60065 / ULC 60065 – Standard for Audio/Video and Musical Instrument Apparatus for Household, Commercial and Similar General
2. FCC – EN 55103-1&2 – Audio, Video and Entertainment Lighting Control

2.6. WARRANTY AND MAINTENANCE

- .1 Provide a written warranty that the system components installed shall be free from defects in parts or assembly for a 5-year period from date of first use (the date of system initialization).

Part 3 Execution

3.1 SYSTEM DESIGN

- .1 Design system according to manufacturer's specifications.

3.2 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for intercommunications systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of .
 - .2 Inform of unacceptable conditions immediately upon discovery.
 - .3 Ensure that facility build out is at a stage suitable for the system installation.
 - .4 Ensure that facility is constructed according to plans, including wall locations, ceiling types and plenum barriers.
 - .5 Ensure that the plenum height is appropriate as per manufacturer's recommendations and as per plan.
 - .6 Ensure power requirements have been provided as per plan.
 - .7 Ensure sufficient space for centrally located components is available as per plan and manufacturer's specifications.
 - .8 Ensure any third-party components required to be interfaced with the system have been provided.
 - .9 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from .

3.3 PERMITS

- .1 Obtain necessary permits for installation work.

3.4 INSTALLATION

- .1 Install equipment as indicated and in accordance with manufacturer's instructions.
- .2 Interconnect system components.

- .3 Follow all applicable codes and standards for the area.
- .4 Follow manufacturer's recommendations regarding installation.
- .5 Follow the system design for location of loudspeakers and wiring.
- .6 Record any necessary changes to the system design on the plan.
- .7 Ensure that supplementary materials used meet applicable safety standards.

3.5 FIELD QUALITY CONTROL

- .1 Ensure that loudspeakers are suspended in a level manner.
- .2 Minimize obstructions to loudspeakers, to the extent possible.
- .3 Ensure cables are properly supported in the ceiling.
- .4 Ensure cables are securely terminated.
- .5 Ensure cables are Plenum rated

3.6 SYSTEM CONFIGURATION AND ADJUSTMENT

- .1 Follow manufacturer's recommendations for system settings as found in the User Manual.

3.7 DEMONSTRATION AND TRAINING

- .1 Demonstrate operational system to the Departmental Representative by walking the space.
- .2 Demonstrate functionality of the system to the Departmental Representative.
- .3 Provide any training to the Departmental Representative that may be required under the terms of the contract to maintain and/or operate the system or any optional devices (e.g., in room controls)
- .4 Provide 2 hour training for users and 2 hour training for maintenance personnel.

3.8 TESTS

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conduct intelligibility performance test.

3.9 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.10 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by intercommunications and program systems installation.

END OF SECTION

Part I General

I.1 REFERENCES

- .1 Note used

I.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for Intercommunications systems and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Include riser diagram, talk paths of complete intercom system.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
 - .2 Submit Construction/Demolition Waste Management and Disposal in accordance with Section 01 74 21.

I.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for intercommunications systems for incorporation into manual.
- .3 Include parts list using component identification numbers standard to electronics industry.

I.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect intercommunications systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management

Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

2.1 MATERIALS

- .1 Conduits: size as indicated, in accordance with Section 26 05 00 - Common Work Results for Electrical and in accordance with Section 27 05 28 - Pathways for Communications Systems.
- .2 Communication conductors: type and size as indicated, in accordance manufacturer's recommended cable type and sizes.

2.2 INTERCOM DOOR STATION

- .1 Intercom Door Station
 - .1 Modular type, suitable for indoor or outdoor installation, minimum IP54 rating. The system shall Internet Protocol (IP) based permit the use of push button type of panels.
 - .2 Panels shall be vandal resistant. Led illumination, stainless steel face plate frames with concealed fasteners.
 - .3 Door station shall be complete with relay for use with remote door release of electronic door operator.
 - .4 1/4 in. CCD Color Camera with high-brightness LED and Up/down and left/right manual adjustment for perfect vision.
 - .5 Pre-amplified speaker unit with trimmers for audio adjustment.
 - .6 Clean contact NO-NC relay for lock operation.
 - .7 Operating conditions will be -10 to +50 °C and up to 90% RH Humidity.
 - .8 Power supply: PoE
- .2 Intercom Master Station
 - .1 Interchangeable front mask to match a variety of interior decor. Hands-free version with touch sensitive buttons, or full touch screen. Each unit shall be of attractive modern design, suitable for flush or wall-mounting.
 - .2 The Master controller shall be Inter Protocol (IP) based suitable for the installation of Sub-master station using smart phone, tablet and PC.
 - .3 3.5 inch screen version:
 - .1 Hands-free version with touch sensitive buttons (capacitive touch), no mechanical buttons
 - .2 Each unit shall be of attractive modern design, suitable for flush or wall-mounting
 - .3 Monitor shall be aesthetically flexible with changeable front-mask so to match apartment design (Black and White options required)

- .4 Connection of internal monitors will be realized with Cat.5E cable and RJ45 plug (PoE).
- .5 3.5 inch High Resolution graphic LCD with User Friendly icons for simple use or 7 inch touch screen LCD.
- .6 SD card slot available to increase monitor's memory and upload customized ringtones /melodies.
- .7 Dedicated Key and Speech button, for lock release and audio function.
- .8 Menu buttons to navigate into the User Menu
- .9 Programmable buttons for different services (Intercom Calls to other monitors/apartments, call to CPS, Self Trigger to CCTV camera or Entrance Panels, other functions)
- .10 Dedicated button and LED indication for Privacy/Do not Disturb function
- .11 All-call audio intercom function between an individual or group of internal stations
- .12 Integrated video recording function. Automatic in case of unanswered call
- .13 Programmable inputs for Alarms sensors (at least 4) for use as; Panic button, Fire/Smoke detectors or other similar device with the possibility to program these inputs in order to send different type of Alarm signals to CPS
- .14 Monitors can provide function as a simple Burglar Alarm control unit, with Arm/Disarm function and programmable Exit/Entry time and Password
- .4 Network POE Switch: Use network switch provided by Shared Service Canada/Landlord.
- .5 Remote Video Input Module: Remote video input module shall have the following:
 - .1 Ability to connect to the network via Cat.5E cable and RJ45 plug (PoE).
 - .2 Able to have 4 analog CCTV cameras connect to it via composite 2 wire connection.
 - .3 Able to have any internal monitor bring up any of the cameras or sequence of cameras
 - .4 Allow for unlimited number of video input modules on each system.
 - .5 Individually addressable through the system.
- .6 Software and Apps:
 - .1 Intercall application (App) - (iOS/Android):
 - .1 App to be used on any apple iOS or Android mobile device or tablet.

- .2 App to be downloaded from the Apple itunes store or the Google Play store.
 - .3 App to be used as a expansion monitor only.
 - .4 To be able to provide full functions as a standard monitor such as two way audio and video communication, door release, intercom between internal stations, remote triggers of devices such as relays and cameras on the LAN.
 - .5 App to be connected through Wifi on the same LAN network as the other intercom devices.
 - .6 IP address for the app to be determined by DHCP.
 - .7 Individually addressable through the set up on the mobile device itself.
- .2 PC software Monitor- (Loaded on a USB Stick)
 - .1 Software Monitor used as a master or expansion monitor in the system.
 - .2 Must be easy to install directly on a PC or MAC via the provided USB stick
 - .3 USB stick used as the registration encoding device; requires that USB remain on the PC in order for the software to function.
 - .4 Each Software monitor shall be installed on computers.
- .7 Video Output Module:
 - .1 Module for video output in standard analog format for use with a DVR, or any other video distribution equipment.
 - .2 Single output in NTSC Video format.
 - .3 Individually addressable through the system.
 - .4 Connection of device will be realized with Cat.5E cable and RJ45 plug (PoE).
 - .5 Product: Video output device I 446, or equal.
- .8 VIP to SIP module:
 - .1 Module allows for the conversion of the proprietary IP Intercom signal to be translated into standard SIP format.
 - .2 Gives the system the ability to talk to can SIP device, Audio or Video.
 - .3 Module shall be installed on the same LAN as the rest of the IP intercom system.
 - .4 Individually addressable through the system.
 - .5 Connection of device will be realized with Cat.5E cable and RJ45 plug (PoE).
- .9 I/O module (relay):

- .1 Module to control a normally open or closed relay to be located on the same LAN network as the other Intercom devices
- .2 The ability to trigger and control the device from any of the inside or outside devices on the network.
- .3 Unlimited I/O modules can be added to the system.
- .4 I/O module can be used for door release, gate release, lift/elevator control, or any other dry contact trigger.
- .5 Individually addressable through the system.
- .6 Connection of device will be realized with Cat.5E cable and RJ45 plug (PoE).
- .7 Product: Relay 1443, or equal.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for intercommunications systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install equipment as indicated and in accordance with manufacturer's instructions.
- .2 Interconnect system components.

3.3 TESTS

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Conduct intelligibility performance test.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by intercommunications and program systems installation.

END OF SECTION

Part 1 General

I.1 REFERENCES

- .1 Not Used.

I.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for clock systems and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Diagram of proposed system showing Owner's Network Time Protocol server, communication pathway, and schedule of individual clock locations.
 - .3 Indicate integration with the Owner's network and servers. Include a line diagram of network relationships. Show system power requirements.
 - .4 Sample Warranty: Manufacturer's standard form.
 - .5 Sample System Maintenance Proposal.

I.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect clock systems from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal Section.

Part 2 Products

2.1 SYSTEM DESCRIPTION

- .1 The synchronized clock system utilizes the Owner's 10/100 Base-T Ethernet. Time signals emanate from the Departmental Representatives Network Time Protocol (NTP) server.

- .2 Remotely-hosted system receives diagnostics and firmware upgrades from and backs up to vendor's central server.
- .3 Locally-hosted system managed through licensed firmware and software maintenance agreement.

2.2 SYSTEM COMPONENTS

- .1 Clocks: IP addressable digital NTP synchronized clocks with automated monitoring, alerting, and reporting firmware. The clock firmware performs self-diagnostics on battery life, time accuracy, and strength of network connection, and sends diagnostics to the gateway server. Clocks maintain internal reference so that failure of the master NTP system will not cause clocks to fail. Clocks will continue indicating accurate time within plus or minus 0.35 seconds in 24-hours.
 - .1 Clocks systems that rely on low frequency AM or FM signals or power line frequency for synchronization do not meet the requirements of this specification.
- .2 NTP Server: Owner's server to be utilized that synchronizes clocks over the network with signals from the NTP server, stores and forwards system information from the clocks, and communicates with the vendor's central server for firmware upgrades.

2.3 QUALITY ASSURANCE

- .1 Manufacturer's Qualifications: Manufacturer of wireless and Ethernet connected synchronized clock systems with a minimum of five years record of satisfactory manufacturing and support of systems comparable to basis of design system.
- .2 Electrical Components, Devices, and Accessories: Listed and labeled per NFPA 70.
- .3 Regulatory Requirements: System design and installation shall comply with the following:
 - .1 National Electric Code (NEC).
 - .2 Underwriters Laboratory (UL) standards for wired devices.
 - .3 Local codes and regulations.

2.4 COORDINATION

- .1 Integrate design of network synchronized clock system with Departmental Representative's wireless or wired network.
- .2 Coordinate installation of cable with Shared Services Canada.
- .3 Departmental Representative/SSC to provide IP address for the network clocks.

2.5 POWER OVER ETHERNET CLOCKS:

- .1 4-Digit Green 7-Segment LEDs
- .2 103mm high numerals

- .3 Dimensions: 30cm x 15cm x 5.6cm
- .4 Cabinet Brushed Stainless Steel
- .5 Weight: 1.7kg
- .6 Viewing Distance: 50+ meters
- .7 Accuracy: +/- approximately 200 milliseconds
- .8 Operating Temperature: 0° to 40° C
- .9 Operating Humidity: 95% maximum, non-condensing
- .10 Mounting Options: Surface, Pendant, Cantilever, Flush Inset, Double Sided
- .11 Certifications: UL 1950, ETL Listed, CE Marked, RoHS Compliant
- .12 Acceptable Product: Primex Wireless SNS5X20ISS, On-Time ONT4SS (Green Numerals), BRG Precision PENM440G

2.6 POWER OVER ETHERNET NETWORK SWITCH

- .1 Utilize Departmental Representative's Power over Ethernet Network switch.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for clock systems installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Locate Digital clock as indicated in the drawing and connect to Departmental Representative's NTP server.
- .2 Provide necessary mounting hardware, coordinate any openings and provide any rough in boxes.
- .3 Provide category 5e patch cables for patching between patch panel and PoE switch.

- .4 Coordinate with Shared Services Canada (SSC) the installation of category 5e cables for all clock locations.
- .5 Confirm with Owner the Time Zone settings. Configure and provide test report for clocks.

3.3 SITE TESTS

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by clock systems installation.

END OF SECTION