Mechanical and Electrical Specifications

Issued for Owner Review

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PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

End of Document

1 General

1.01 SECTION INCLUDES

.1 This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Sections of Mechanical Divisions. It is intended as a supplement to each Section and is to be read accordingly.

1.02 REFERENCES

.1 Division 00 and Division 01 apply to and are a part of each Mechanical Division:

.1 Division 20 – Common Mechanical Requirements;

.2 Division 23 – Heating, Ventilating, and Air Conditioning;

.3 Division 25 – Integrated Automation.

1.03 SUBMITTALS

.1 Submit shop drawings/product data sheets for:

.1 electric motors (submit with equipment they are associated with).

.2 Submit weight loads for selected equipment (upon request).

.3 Submit copy of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations.

.4 Submit a list of equipment identification nameplates indicating proposed wording and sizes.

.5 Submit drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.

.6 Submit any other submittals specified in this Section or other Sections of Mechanical Divisions.

1.04 MAINTENANCE MATERIAL SUBMITTALS

.1 As specified in Part 2 of this Section, submit a spare belt set, tagged and identified, for each belt driven piece of equipment.

2 Products

2.01 FIRESTOPPING AND SMOKE SEAL MATERIALS

.1 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in Section 20 05 17 - Sleeves and Sleeve Seals for Mechanical Piping, and work is to be done as part of mechanical work unless otherwise specified in Division 07.

2.02 ACCESS DOORS

.1 Provide all access doors required for Mechanical work unless otherwise specified in Division 08. Coordinate consistency of look and finish of access doors on project with each Division of Work. Coordinate exact requirements with General Trades Contractor.

.2 Access doors to be rust resistant steel door panels, with concealed hinges and positive locking and self-opening screwdriver operated lock. Wall type frame to be suitable for wall installation and have integral keys for plaster walls. Doors in tile wall to be stainless steel and in ceilings to be suitable for plaster covering with only frame joint showing. Other doors to be prime painted steel.

.3 Size access doors to suit the concealed work for which they are supplied, and wherever possible they are to be of standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.

.4 Lay-in type tiles, properly marked, may serve as access panels. Coordinate marking of ceiling tiles with the Consultant. Panels in glazed tile walls to be 12 gauge, 304 alloy stainless steel, No. 4 finish, with recessed frame secured with stainless steel counter-sunk flush head screws.

.5 Panels in plaster surfaces to have dish-shaped door and welded metal lath, ready to take plaster. Provide a plastic grommet for door key access.

.6 Other access doors to be welded 12 gauge steel, flush type with concealed hinges, lock and anchor straps, complete with factory prime coat. Submit to Consultant for review, details of non-standard door construction details.

.7 Access doors in fire rated ceilings, walls, partitions, structures, etc., to be ULC listed and labelled and of a rating to maintain fire separation integrity.

.8 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting finish in which they are to be installed so as to maintain final building surface appearance throughout.

.9 Manufacturers:

.1 SMS.

.2 Bauco.

.3 Acudor.

3 Execution

3.01 GENERAL PIPING AND DUCTWORK INSTALLATION REQUIREMENTS

.1 Unless otherwise specified, locate and arrange horizontal pipes and ducts above or at ceiling on floors, arranged so that under consideration of all other work in area, maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, with Consultant’s approval.

.2 Unless otherwise specified, install work concealed in finished spaces, and concealed to degree possible in partially finished and unfinished spaces. Refer to and examine Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Walls which are painted are considered finished.

.3 Install pipes and ducts parallel to building lines and to each other.

.4 Neatly group and arrange exposed work.

.5 Locate work to permit easy access for service or maintenance as required and/or applicable. Locate valves, dampers and any other equipment which will or may need maintenance or repairs and which are to be installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate accessories at floor level.

.6 Make connections between pipes of different materials using adapters suitable for application. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.

.7 Comply with equipment and material manufacturer's installation instructions unless otherwise specified herein or on drawings, and unless such instructions contradict governing codes and regulations.

.8 Carefully clean ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.

.9 Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around pipe or duct, except for ductwork at fire barriers, in which case insulation will be terminated at each side of the duct fire damper.

.10 Inspect surfaces and structure prepared by other trades before performing work. Verify surfaces or structure to receive work has no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of work will constitute acceptance of such surfaces as being satisfactory.

.11 Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both, is to be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean piping prior to being concealed.

.12 For factory applied finishes, repaint or refinish surfaces damaged during shipment and installation. Quality of repair work is to match original finish. This requirement also applies to galvanized finishes.

.13 Where mechanical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminium ductwork, copper or stainless steel pipe, etc.

.14 Provide screwed unions or flanges in piping connections to equipment and in regular intervals in long (in excess of 12 m (40')) piping runs to permit removal of sections of piping.

.15 Unless otherwise specified and except where space limitations do not permit, piping elbows are to be long radius. Eccentric reducers are to be installed with straight side at top of piping.

3.02 DUCT OPENINGS

.1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by trade responsible for particular construction in which opening is required.

.2 Size openings for fire dampers to suit damper arrangement with folding blade out of air stream.

.3 For duct openings except where fire dampers are required, pack and seal space between duct or duct insulation and duct opening as specified above for pipe openings in non-fire rated construction.

3.03 SUPPLY OF ACCESS DOORS

.1 Supply access doors to give access to mechanical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on drawings.

.2 Before commencing installation of mechanical work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant’s review and show exact sizes and locations of such access doors. Locate and arrange mechanical work to suit.

.3 Access doors will be installed by trade responsible for particular type of construction in which doors are required. Supply access doors to trade installing same at proper time.

.4 Wherever possible, access doors to be of a standard size for each application. Confirm exact dimensions and minimum size restrictions with the Consultant prior to ordering.

.5 Group piping and ductwork to ensure minimum number of access doors is required.

.6 Coordinate with Electrical Contractor and General Trades Contractor to ensure access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and work involving both mechanical and electrical services should, where possible, be accessible from common access door. Coordinate work to ensure common location access doors are not supplied by both Mechanical Divisions and Electrical Divisions.

3.04 FINISH PAINTING OF MECHANICAL WORK

.1 Finish paint exposed mechanical work as specified and/or scheduled in accordance with requirements of Division 09.

.2 Touch-up paint damaged factory applied finishes on mechanical work products.

3.05 INTERRUPTION TO AND SHUT-DOWN OF MECHANICAL SERVICES AND SYSTEMS

.1 Coordinate shut-down and interruption to existing mechanical systems with Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning, unless otherwise specified in Division 01. Include for costs of premium time to perform work during nights, weekends or other times outside of normal working hours, which may be necessary to comply with stipulations specified herein this Article. Services for operation of existing non-renovated areas of building are to be maintained.

.2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.

.3 Prior to each shut-down or interruption, inform Owner and the Consultant in writing 5 working days in advance of proposed shut-down or interruption and obtain written consent to proceed. Do not shut-down or interrupt any system or service without such written consent. Shutdowns of some essential services may require additional advance notification time.

.4 Perform work associated with shut-downs and interruptions as continuous operations to minimize shut-down time and to reinstate systems as soon as possible, and, prior to any shut-down, ensure materials and labour required to complete the work for which shut-down is required are available at site.

.5 Pipe freezing shall be used to connect new piping to existing piping. Alternative methods may be proposed, if site conditions are evaluated and permit, and are approved by the Consultant.

.6 Where existing isolation valves do not hold, pipe freezing shall be used to connect new piping to existing piping.

3.06 MECHANICAL SERVICE REQUIREMENTS FOR FLOATING FLOOR SLABS

.1 Where mechanical services are required to be installed in or through a vibration isolated floating slab, install such services so as not to transmit any vibration to base slab on which floating floor slab is placed.

.2 Wherever possible, arrange mechanical work to avoid penetrating a floating floor slab.

3.07 CUTTING, PATCHING AND CORE DRILLING

.1 Unless otherwise provided by General Trades, perform cutting, patching, and core drilling of existing building required for installation of mechanical work. Perform cutting in a neat and true fashion, with proper tools and equipment to Consultant’s approval. Patching is to exactly match existing finishes and be performed by tradesmen skilled in particular trade or application. Work is subject to review and acceptance by the Consultant.

.2 Criteria for cutting holes for additional services:

.1 cut holes through slabs only; no holes to be cut through beams;

.2 cut holes 150 mm (6") diameter or smaller only; obtain approval from Structural Consultant for larger holes;

.3 keep at least 100 mm (4") clear from beam faces;

.4 space at least 3 hole diameters on centre;

.5 for holes that are required closer than 25% of slab span from supporting beam face, use cover meter above slab to clear slab top bars;

.6 for holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars;

.7 submit sleeving drawings indicating holes and their locations for Structural Consultant's review.

.3 Do not cut or drill any existing work without approval from Owner and Consultant. Be responsible for damage done to building and services caused by cutting or drilling.

.4 Where pipes pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around pipes or pipe insulation.

.5 Prior to drilling or cutting an opening, determine, in consultation with Consultant and Owner, and by use of non-destructive radar scan (magnetic scan) of slab or wall, presence of any existing services and reinforcement bars concealed behind building surface to be cut and locate openings to suit. Coring is not permitted through concrete beams or girders.

.6 Where drilling is required in waterproof slabs, size opening to permit snug and tight installation of a pipe sleeve sized to leave 12 mm (½") clearance around pipe or pipe insulation. Provide a pipe sleeve, constructed of Schedule 40 galvanized steel pipe with a flange at one end and of a length to extend 100 mm (4") above slab, in opening. Secure flange to the underside of slab and caulk void between sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.

.7 Firestop and seal openings in fire rated construction. Do not leave openings open overnight unless approved by Owner and Consultant.

3.08 PACKING AND SEALING CORE DRILLED PIPE OPENINGS

.1 Pack and seal void between pipe opening and pipe or pipe insulation for length of opening as follows:

.1 non-fire rated interior construction – pack with mineral wool and seal both ends of opening with non-hardening silicone base caulking compound to produce a water-tight seal;

.2 exterior walls above grade – pack with mineral wool and seal both ends of sleeves water-tight with non-hardening silicone base caulking compound unless mechanical type seals have been specified;

.3 exterior walls below grade (and any other wall where water leakage may be a problem) – seal with link type mechanical seals as specified.

3.09 FLASHING FOR MECHANICAL WORK PENETRATING ROOF

.1 Unless otherwise specified in Division 07, perform required flashing work, including counter-flashing, for mechanical work penetrating and/or set in roof.

.2 Perform flashing work in accordance with requirements of drawing details and/or requirements specified in Division 07.

3.10 CLEANING MECHANICAL WORK

.1 Refer to cleaning requirements specified in Division 01.

.2 Clean mechanical work prior to application for Substantial Performance of the Work.

.3 Include for vacuum cleaning interior of air handling units and ductwork systems.

3.11 CONNECTIONS TO OTHER EQUIPMENT

.1 Carefully examine Contract Documents during bidding period and include for mechanical work piping and/or ductwork connections to equipment requiring such connections.

3.12 INSTALLATION OF FLEXIBLE CONNECTORS

.1 Provide flexible connectors in piping connections to seismically restrained equipment, where applicable, and wherever else shown.

.2 Provide flexible connectors in piping connections to vibration isolated equipment.

3.13 FAN NOISE LEVELS

.1 Submit sound power levels with fan shop drawings/product data, with levels measured to AMCA 300 and calculated to AMCA 301.

3.14 EQUIPMENT AND SYSTEM MANUFACTURER'S CERTIFICATION

.1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for equipment/system manufacturer's authorized representative to visit site to examine installation, and after any required corrective measures have been made, to certify in writing to the Consultant that equipment/system installation is complete and in accordance with equipment/system manufacturer's instructions.

3.15 SYSTEM STARTUP

.1 When installation of equipment/systems is complete but prior to commissioning, perform start-up for equipment/systems as specified in mechanical work Sections in accordance with following requirements:

.1 submit a copy of each equipment/system manufacturer's start-up report sheet to the Consultant for review, and incorporate any comments made by the Consultant;

.2 under direct on-site supervision and involvement of equipment/system manufacturer's representative, start-up equipment/systems, make any required adjustments, document procedures, leave equipment/systems in proper operating condition, and submit to the Consultant complete set of start-up documentation sheets signed by manufacturer/supplier and Contractor;

.3 commission interconnected life safety systems in accordance with CAN/ULC-S1001-11 and provide written report for Consultant's review.

End of Section

1 General

1.01 SECTION INCLUDES

.1 This Section specifies requirements, criteria, methods and execution for mechanical demolition work that are common to one or more mechanical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

2 Products – Not Used

3 Execution

3.01 DISCONNECTION AND REMOVAL OF EXISTING MECHANICAL WORK

.1 Where indicated on drawings, disconnect and remove existing mechanical work, including hangers, supports, insulation, etc. Disconnect at point of supply, remove obsolete connecting services and make system safe. Cut back obsolete piping behind finishes and cap water-tight unless otherwise specified.

.2 Scope and extent of demolition or revision work is only generally indicated on drawings. Estimate scope, extent and cost of work at site during bidding period site visit(s). Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at site during bidding period site visits will not be allowed.

.3 If any re-design is required due to discrepancies between mechanical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between mechanical drawings and actual site conditions are of a minor nature, required modifications are to be done at no additional cost.

.4 Where existing mechanical services extend through, or are in an area to serve items which are to remain, maintain services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during renovation work, so as to be concealed behind new or existing finishes.

.5 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused.

3.02 ROOFING WORK

.1 Where roof revisions and/or replacements are part of project, include for disconnecting, lifting, or temporarily removing mechanical equipment on roof as required to permit completion of roofing work, and for re-installing equipment when roofing work is complete.

End of Section

1 General

1.01 SECTION INCLUDES

.1 This Section specifies requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. Where requirements of this Section contradict requirements of Division 00 or Division 01, conditions of Division 00 or Division 01 to take precedence.

.2 Be responsible for advising product vendors of requirements of this Section.

1.02 RELATED REQUIREMENTS

.1 Division 00 and Division 01 apply to and are a part of this Section.

1.03 DEFINITIONS

.1 "concealed" – means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.

.2 "exposed" – means work normally visible, including work in equipment rooms, service tunnels, and similar spaces.

.3 "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished.

.4 “provision” or "provide" (and tenses of "provide") – means supply and install complete.

.5 "install" (and tenses of "install") – means secure in position, connect complete, test, adjust, verify, and certify.

.6 "supply" – means to procure, arrange for delivery to site, inspect, accept delivery and administer supply of products; distribute to areas; and include manufacturer’s supply of any special materials, standard on site testing, initial start-up, programming, basic commissioning, warranties and manufacturers’ assistance to Contractor.

.7 "delete" or "remove" (and tenses of "delete" or “remove”) – means to disconnect, make safe, and remove obsolete materials; patch and repair/finish surfaces to match adjoining similar construction; include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Owner and reviewed with the Consultant.

.8 "BAS" – means building automation system; "BMS" – means building management system; "FMS" – means facility management system; and “DDC” means direct digital controls; references to "BAS", "BMS", "FMS" and “DDC” generally mean same.

.9 "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" – means government departments, agencies, standards, rules and regulations that apply to and govern work and to which work must adhere.

.10 "OSHA" and "OHSA" – stands for Occupational Safety and Health Administration and Occupational Health and Safety Act, and wherever either one is used, they are to be read to mean local governing occupational health and safety regulations that apply to and govern work and to which work must adhere, regardless if Project falls within either authority's jurisdiction.

.11 "Mechanical Divisions" – refers to Division 20, Division 21, Division 22, Division 23, Division 25, and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Mechanical Contractor, unless otherwise noted.

.12 "Electrical Divisions" – refers to Division 26, Division 27, Division 28, and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Electrical Contractor, unless otherwise noted.

.13 "Consultant" – means person, firm or corporation identified as such in Agreement or Documents, and is licensed to practice in Place of the Work, and has been appointed by Owner to act for Owner in a professional capacity in relation to the Work.

.14 Wherever words "indicated", "shown", "noted", "listed", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean product referred to is "indicated", "shown", "listed", or "noted" on Contract Documents.

.15 Wherever words "reviewed", "satisfactory", "as directed", "submit", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "to the satisfaction of", "submitted to", etc., Consultant.

1.04 DOCUMENTS

.1 Documents for bidding include but are not limited to issued Drawings, Specifications and Addenda.

.2 Specification is arranged in accordance with CSI/CSC 49 Divisions of MasterFormat.

.3 Drawings and Specifications are portions of Contract Documents and identify labour, products and services necessary for performance of work and form a basis for determining pricing. They are intended to be cooperative. Perform work that is shown, specified, or reasonably implied on the drawings but not mentioned in Specification, or vice-versa, as though fully covered by both.

.4 Review Drawings and Specifications in conjunction with documents of other Divisions and, where applicable, Code Consultant’s report.

.5 Unless otherwise specifically noted in Specifications and/or on Drawings, Sections of Mechanical Divisions are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and Sections are to be read as a whole.

.6 Drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of building is to be taken on site. Do not scale Drawings, and do not use Drawings for prefabrication work.

.7 Drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, offsets, fittings, transformations and similar products required as a result of obstructions and other architectural and/or structural details but not shown on Drawings.

.8 Locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of equipment and/or materials, other equipment or systems being installed, and of building, all at no additional cost to Contract.

.9 Specification does not generally indicate specific number of items or amounts of material required. Specification is intended to provide product data and installation requirements. Refer to schedules, Drawings (layouts, riser diagrams, schematics, details) and Specification to provide correct quantities. Singular may be read as plural and vice versa.

.10 Starter/motor control centre (MCC)/variable frequency drive (VFD) schedule drawings are both mechanical and electrical, and apply to work of Mechanical Divisions and Electrical Divisions. Be responsible for reviewing starter, MCC, VFD, and motor specification requirements prior to Bid submission. Confirm and coordinate exact scope of work and responsibility of work between Mechanical Divisions and Electrical Divisions.

.11 Drawings and Specifications have been prepared solely for use by party with whom Consultant has entered into a contract and there are no representations of any kind made by the Consultant to any other party.

.12 In the case of discrepancies between the drawings and specifications, documents will govern in order specified in “General Conditions”, however, when scale and date of drawings are same, or where discrepancy exists within specification, most costly arrangement will take precedence.

1.05 METRIC AND IMPERIAL MEASUREMENTS

.1 Generally, both metric and imperial units of measurement are given in Sections of Specification governed by this section. Measurement conversions may be generally "soft" and rounded off. Confirm exact measurements based on application. Where measurements are related to installation and onsite applications, confirm issued document measurements with applicable local code requirements, and/or as applicable, make accurate measurements onsite. Where significant discrepancies are found, immediately notify Consultant for direction.

1.06 EXAMINATION OF DOCUMENTS AND SITE

.1 Carefully examine Documents and visit site to determine and review existing site conditions that will or may affect work, and include for such conditions in Bid Price.

.2 Report to Consultant, prior to Bid Submittal, any existing site condition that will or may affect performance of work as per Documents. Failure to do so will not be grounds for additional costs.

.3 Upon finding discrepancies in, or omissions from Documents, or having doubt as to their meaning or intent, immediately notify Consultant, in writing.

1.07 WORK STANDARDS

.1 Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of submission of Bids adopted by and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.

.2 Where regulatory codes, standards and regulations are at variance with Drawings and Specification, more stringent requirement will apply unless otherwise directed by Owner and reviewed with the Consultant.

.3 Supplementary mandatory specification and requirements to be used in conjunction with project include but are not limited to following:

.1 Air-Conditioning, Heating and Refrigeration Institute (AHRI);

.2 Air Movement and Control Association (AMCA);

.3 American Iron and Steel Institute (AISI);

.4 American National Standards Institute (ANSI);

.5 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE);

.6 American Society of Mechanical Engineers (ASME);

.7 American Society of Testing and Materials (ASTM);

.8 American Water Works Association (AWWA);

.9 Associated Air Balance Council (AABC);

.10 Building Industry Consulting Services, International (BICSI);

.11 Canadian Gas Association (CGA);

.12 Canadian General Standards Board (CGSB);

.13 Canadian Standards Association (CSA);

.14 Electrical and Electronic Manufacturers Association of Canada (EEMAC);

.15 Electrical Safety Authority (ESA);

.16 Electronic Industries Association (EIA);

.17 Factory Mutual Systems (FM);

.18 Illuminating Engineering Society (IES);

.19 Institute of Electrical and Electronic Engineers (IEEE);

.20 International Standards Organization (ISO);

.21 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS);

.22 National Building Code of Canada (NBC);

.23 National Electrical Manufacturers Association (NEMA);

.24 National Environmental Balancing Bureau (NEBB);

.25 National Fire Protection Association (NFPA);

.26 National Standards of Canada;

.27 NSF International;

.28 Occupational Health and Safety Act (OHSA);

.29 Ontario Building Code (OBC);

.30 Ontario Electrical Safety Code (OESC);

.31 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA);

.32 Technical Standards and Safety Authority (TSSA);

.33 Thermal Insulation Association of Canada (TIAC);

.34 Underwriters’ Laboratories of Canada (ULC);

.35 Workplace Hazardous Materials Information System (WHMIS);

.36 Material Safety Data Sheets by product manufacturers;

.37 Local utility inspection permits;

.38 Codes, standards, and regulations of local governing authorities having jurisdiction;

.39 Additional codes and standards listed in Trade Sections;

.40 Owner’s standards.

.4 Provide applicable requirements for barrier free access in accordance with latest edition of local governing building code.

.5 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted to appropriate authorities. Be responsible for costs associated with these submittals.

.6 Unless otherwise specified, install equipment in accordance with equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.

.7 Work is to be performed by journeyperson tradesmen who perform only work that their certificates permit, or by apprentice tradesmen under direct on site supervision of experienced journeyperson tradesman. Journeyperson to apprentice ratio is not to exceed ratio determined by the Board as stated in Ontario College of Trades and Apprenticeship Act or local equivalent governing body in Place of the Work.

.8 Journeyperson tradesmen are to have a copy of valid trade certificates available at site for review with the Consultant at any time.

.9 Experienced and qualified superintendent is to be on-site at times when work is being performed.

.10 Coordinate work inspection reviews and approvals with governing inspection department to ensure that construction schedule is not delayed. Be responsible for prompt notification of deficiencies to the Consultant and submission of reports and certificates to the Consultant.

.11 Properly protect equipment and materials on site from damage due to elements and work of trades, to satisfaction of Owner and reviewed with the Consultant. Equipment and materials are to be in new condition upon Substantial Performance of the Work.

.12 Mechanical piping system work, including equipment, must comply in all respects with requirements of local technical standards authorities and CSA B51, Boiler, Pressure Vessels and Pressure Piping Code. Where required, mechanical work products must bear a CRN number.

.13 Electrical items associated with mechanical equipment are to be certified and bear stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

1.08 PERMITS, CERTIFICATES, APPROVALS, AND FEES

.1 Contact and confirm with local authorities having jurisdiction including utility providers, requirements for approvals from such authorities. Obtain and pay for permits, certificates, and approvals required to complete Work.

.2 Be responsible for ensuring that authorities having jurisdiction which require on-site inspection of work, have ample notification to perform inspection, with sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of Work. If any defect, deficiency or non-compliant is found in work by inspection, be responsible for costs of such inspection, including any related expenses, making good and return to site, until work is passed by governing authorities.

.3 Obtain and submit to Consultant, approval/inspection certificates issued by governing authorities to confirm that Work as installed is in accordance with rules and regulations of local governing authorities and are acceptable.

.4 Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities.

1.09 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

.1 Professional engineers retained to perform consulting services with regard to Project work, i.e. seismic engineer, fire protection engineer or structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in Place of the Work.

.2 Retained engineer's professional liability insurance is to protect Contractor's consultants and their respective servants, agents, and employees against any loss or damage resulting from professional services rendered by aforementioned consultants and their respective servants, agents, and employees in regards to the Work of this Contract.

.3 Unless otherwise specified in Division 00 or Division 01, liability insurance requirements are as follows:

.1 coverage is to be a minimum of $1,000,000.00 CDN inclusive of any one occurrence;

.2 insurance policy is not to be cancelled or changed in any way without insurer giving Owner minimum thirty days written notice;

.3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the Place of the Work;

.4 retained consultants are to ascertain that sub-consultants employed by them carry insurance in the form and limits specified above;

.5 evidence of the required liability insurance in such form as may be required is to be issued to Owner, Owner's Consultant, and Municipal Authorities as required prior to commencement of aforementioned consultant's services.

1.10 WORKPLACE SAFETY

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for products where required, and maintain one copy at site in a visible and accessible location available to personnel.

.2 Comply with requirements of Occupational Health and Safety Act and other regulations pertaining to health and safety, including worker's compensation/insurance board and fall protection regulations. When working in confined spaces, comply with requirements of Occupational Health and Safety Act - Ontario Regulation 632, "Confined Spaces" and any other applicable Ministry of Labour requirements.

.3 If at any time during course of work, hazardous materials other than those identified in Documents and pertaining to Project Scope of Work, are encountered or suspected that were not identified as being present and which specific instructions in handling of such materials were not given, cease work in area in question and immediately notify Consultant. Comply with local governing regulations with regards to working in areas suspected of containing hazardous materials. Do not resume work in affected area without approval from Owner and reviewed with the Consultant.

1.11 PLANNING AND LAYOUT OF WORK

.1 Base installation layout, design, terminations, and supply of accessories, on Contract Documents with specific coordination with reviewed shop drawings.

.2 Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other as well as other obstructions. Generally, order of right of way for services to be as follows:

.1 piping requiring uniform pitch;

.2 piping 100 mm (4") dia. and larger;

.3 large ducts (main runs);

.4 cable tray and bus duct;

.5 conduit 100 mm (4") dia. and larger;

.6 piping less than 100 mm (4") dia.;

.7 smaller branch ductwork;

.8 conduit less than 100 mm (4") dia.

.3 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify Consultant where headroom or ceiling space appears to be inadequate prior to installation of work.

.4 Do not use Contract Drawing measurements for prefabrication and layout of piping, sheet metal work and such other work. Locations and routing are to generally be in accordance with Contract Drawings, however, prepare layout drawings for such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for work of other trades. Accurately layout work, and be entirely responsible for work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with Contract Drawings, notify Consultant prior to proceeding with work.

.5 Prepare plan and interference drawings (at a minimum drawing scale of 1:50 or ¼"=1' 0") of work for coordination with each trade Contractor. Arrange for preparation of detailed section drawings of ceiling spaces of corridors and any other congested areas. Sections are to be cross referenced with plan drawings so that trades may make use of section drawings. Section drawings to indicate lateral and elevation dimensions of major services within ceiling space. Lateral dimensions are to be from grid lines and elevations from top of floor slab. Obtain from Consultant, engineering drawings for this use. Contractors' interference drawings are to be distributed among other Trade Contractors. Submit drawings to the Consultant for review. Failure of General Contractor to prepare and coordinate overall interface drawings of trades does not relieve respective Division Contractor of responsibility to ensure that work is properly planned and coordinated.

.6 Carry out alterations in arrangement of work that has been installed without proper coordination, study, and review, even if in accordance with Contract Documents, in order to conceal work behind finishes, or to allow installation of other work, without additional cost. In addition, make necessary alterations in other work required by such alterations, without additional cost.

.7 Shut-off valves, balancing devices, air vents, equipment, and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.

.8 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were missed due to lack of coordination.

1.12 SCHEDULING

.1 Include for any and all scheduling, coordination, and construction phasing to suit project, specified in Division 01 and/or as indicated on the drawings. Review exact phasing requirements with Consultant prior to start of Work.

.2 Phasing and scheduling of Work is required in order to maintain existing building operations. Include costs (including costs for "off hours" work) for scheduling, co-ordination, and construction phasing to suit

this project as specified in Division 01 and on drawings. Review phasing requirements with the Consultant prior to start of Work.

.3 Protect existing areas above, below and adjacent areas of Work from any debris, noise, or interruptions to existing services to satisfaction of Owner and reviewed with the Consultant. Maintain in operation existing services to these areas to allow Owner to continue use of these areas. If services that are required to be maintained run through areas of renovations, provide necessary protection to services or reroute, in coordination with Owner and Consultant. Include for required premium time work to meet these requirements.

.4 Work being performed within occupied spaces and work affecting surfaces adjacent to occupied spaces may need to be performed after regular business hours. For areas where spaces are used by Owner on a 24 hours basis or over various hours, coordinate hours of work with Owner on a regular basis to suit Owner's schedule. Execute work at times confirmed with and agreed to by Owner and reviewed with the Consultant, so as not to inconvenience Owner's occupation or in any way hinder Owner's use of building. Include for required premium timework to meet these requirements.

.5 Project partial occupancy permits may be required throughout project. Provide for each partial permit, required local governing authority certificate and any other testing/verification certificates for systems.

1.13 COORDINATION

.1 Review Contract Documents and coordinate work with work of each trade. Coordination requirements are to include but not be limited to following:

.1 requirements for openings, sleeves, inserts and other hardware necessary for installation of work;

.2 concrete work such as housekeeping pads, sumps, bases, etc., required for work, and including required dimensions, operating weight of equipment, location, etc.;

.3 depth and routing of excavation required for work, and requirements for bedding and backfill;

.4 wiring work required for equipment and systems but not specified to be done as part of mechanical work, including termination points, wiring type and size, and any other requirements.

.2 Ensure materials and equipment are delivered to site at proper time and in such assemblies and sizes so as to enter into building and be moved into spaces where they are to be located without difficulty.

.3 Wherever possible, coordinate equipment deliveries with manufacturers and/or suppliers so equipment is delivered to site when it is required, or so it can be stored within building, subject to available space as confirmed with Owner and reviewed with Owner, and protected from elements.

.4 Ensure proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Comply with code requirements with regards to access space provision around equipment. Remove and replace any equipment which does not meet this requirement.

.5 Where work is to be integrated, or is to be installed in close proximity with work of other trades, coordinate work prior to and during installation.

1.14 PRODUCTS

.1 Be responsible for ordering of products (equipment and materials) in a timely manner in order to meet project-scheduling timelines. Failure to order products to allow manufacturers sufficient production/delivery time to meet project-scheduling timelines is an unacceptable reason to request for other suppliers or substitutions.

.2 Provide Canadian manufactured products wherever possible or required and when quality and performance is obtainable at a competitive price. Products are to be supplied from manufacturer's

authorized Canadian representative, unless otherwise noted. Unless otherwise specified, products are to be new and are to comply with applicable respective Canadian standards. References to UL listings of products to include requirements that products are to be also Underwriters Laboratories of Canada (ULC) listed for use in Canada. Products are to meet or exceed latest ANSI/ASHRAE/IES 90.1 standards, as applicable. Do not supply any products containing asbestos materials or PCB materials.

.3 Systems and equipment of this Project are to be "State of the Art" and be most recent and up to date series/version of product that is available at time of shop drawing review process. Products that have been stored or "on shelf" for an extended period of time will not be accepted. Software is to be of latest version available and be provided with updates available at time of shop drawing review process. Systems are to be designed such that its software is backwards compatible. Future upgrades are not to require any hardware replacements or additions to utilize latest software.

.4 Products scheduled and/or specified have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In most cases, base specified manufacturers are stated for any product specified by manufacturer’s name and model number. Where manufacturers are listed, first name listed is base specified company. Bid Price may be based on products supplied by any of manufacturers’ base specified or named as acceptable for particular product. If manufacturers are not stated for a particular product, base Bid Price on product supplied by base specified manufacturer.

.5 Documents have been prepared based on product available at time of Bidding. If, after award of Contract, and if successful manufacturer can no longer supply a product that meets base specifications, notify Consultant immediately. Be responsible for obtaining other manufacturers product that complies with base specified performance and criteria and meets project timelines. Proposed products are subject to review and consideration by the Consultant and are considered as substitutions subject to a credit to Contract. In addition, if such products require modifications to room spaces, mechanical systems, electrical systems, etc., include required changes. Such changes are to be submitted in detail to the Consultant for review and consideration for acceptance. There will be no increase in Contract Price for revisions. Above conditions supplement and are not to supersede any specification conditions with regards to substitutions or failure to supply product as per issued documents.

.6 Listing of a product as "acceptable" does not imply automatic acceptance by the Consultant and/or Owner. It is responsibility of Contractor to ensure that any price quotations received and submittals made are for products that meet or exceed specifications included herein.

.7 If products supplied by a manufacturer named as acceptable are used in lieu of base specified manufacturer, be responsible for ensuring that they are equivalent in performance and operating characteristics (including energy consumption if applicable) to base specified products. It is understood that any additional costs (i.e. for larger starters, larger feeders, additional spaces, etc.), and changes to associated or adjacent work resulting from provision of product supplied by a manufacturer other than base specified manufacturer, is included in Bid Price. In addition, in equipment spaces where equipment named as acceptable is used in lieu of base specified equipment and dimensions of such equipment differs from base specified equipment, prepare, and submit for review accurately dimensioned layouts of rooms affected, identifying architectural and structural elements, systems and equipment to prove that equipment in room will fit properly meeting design intent. There will be no increase in Contract Price for revisions.

.8 In addition to manufacturer’s products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to the Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to the Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally, or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are accepted in writing by the Consultant.

.9 Where products are listed as "or approved equal", certify in writing that product to be used in lieu of base specified product, at least meets space, power, design, energy consumption, and other requirements of base specified product and is equivalent or better than base specified product. When requested by the Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equal" products is at sole discretion of the Consultant. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally, or architecturally, required by acceptance of approved equal product. There must be no increase in Contract price due to Consultant's rejection of proposed equivalent product.

.10 Whenever use of product other than base specified product is being supplied, ensure corresponding certifications and product information (detailed catalogue and engineering data, fabrication information and performance characteristics) are submitted to the Consultant for review. Failure of submission of these documents to the Consultant in a timely manner to allow for review will result in base specified product to be supplied at Consultant's discretion, at no additional cost to Contract.

.11 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable may be considered for acceptance by the Consultant if requested in writing with full product documentation submitted, a minimum of 10 working days prior to Bid closing date.

.12 Any proposed changes initiated by Contractor after award of Contract may be considered by the Consultant at the Consultant's discretion, with any additional costs for such changes if accepted by Owner and reviewed with the Consultant, and costs for review, to be borne by Contractor.

.13 Whenever use of product other than based specified products or named as acceptable is being supplied, time for process of submission of other products and Consultant's review of products will not alter contract time or delay work schedule.

1.15 SHOP DRAWINGS

.1 At start-up meeting, review with the Consultant products to be included in shop drawing submission. Prepare and submit list of products to the Consultant for review.

.2 Submit electronic copies of shop drawings unless otherwise directed by the Consultant. Coordinate exact requirements with the Consultant.

.3 Submit for review, drawings showing detail design, construction, and performance of equipment and materials as requested in Specification. Submit shop drawings to the Consultant for review prior to ordering and delivery of product to site. Include minimally for preparation and submission of following, as applicable:

.1 product literature cuts;

.2 equipment data sheets;

.3 equipment dimension drawings;

.4 system block diagrams;

.5 sequence of operation;

.6 connection wiring schematic diagrams;

.7 functionality with integrated systems.

.4 Each shop drawing or product data sheet is to be properly identified with project name and product drawing or specification reference. Shop drawing or product data sheet dimensions are to match dimension type on drawings.

.5 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure this requirement is clearly indicated on submission.

.6 Ensure proposed products meet each requirement of Project. Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS". Include company name, submittal date, and sign each copy. Shop drawings that are received and are not endorsed, dated and signed will be returned to be resubmitted.

.7 Consultant to review shop drawings and indicate review status by stamping shop drawing copies as follows:

.1 "REVIEWED" or "REVIEWED AS NOTED" (appropriately marked) – If Consultant's review of shop drawing is final, Consultant to stamp shop drawing;

.2 "RETURNED FOR CORRECTION" – If Consultant's review of shop drawing is not final, Consultant to stamp shop drawing as stated above, mark submission with comments, and return submission. Revise shop drawing in accordance with Consultant's notations and resubmit.

.8 Following is to be read in conjunction with wording on Consultant's shop drawing review stamp applied to each and every shop drawing or product data sheet submitted:

.1 "THIS REVIEW BY CONSULTANT IS FOR SOLE PURPOSE OF ASCERTAINING CONFORMANCE WITH GENERAL DESIGN CONCEPT. THIS REVIEW DOES NOT MEAN THAT CONSULTANT APPROVES DETAILED DESIGN INHERENT IN SHOP DRAWINGS, RESPONSIBILITY FOR WHICH REMAINS WITH CONTRACTOR. CONSULTANT'S REVIEW DOES NOT RELIEVE CONTRACTOR OF RESPONSIBILITY FOR ERRORS OR OMISSIONS IN SHOP DRAWINGS OR OF CONTRACTOR'S RESPONSIBILITY FOR MEETING REQUIREMENTS OF CONTRACT DOCUMENTS. BE RESPONSIBLE FOR DIMENSIONS TO BE CONFIRMED AND CORRELATED AT JOB SITE, FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION AND INSTALLATION, AND FOR COORDINATION OF WORK OF SUB-TRADES."

.9 Submit each system and each major component as separate shop drawing submissions. Submit together, shop drawings for common devices such as devices of each system are to be submitted together.

.10 Obtain shop drawings for submission from product manufacturer's authorized representatives and supplemented with additional items specified herein.

.11 Do not order product until respective shop drawing review process has been properly reviewed with the Consultant.

.12 Where extended warranties are specified for equipment items, submit specified extended warranty with shop drawing submittal.

.13 Applicable mechanical equipment has been selected to meet energy efficiency requirements of ANSI/ASHRAE/IES 90.1, Energy Standards for Buildings, and shop drawings/product data submittals for such equipment must indicate compliance with this Standard or they will be returned for correction and re-submittal.

1.16 EQUIPMENT LOADS

.1 Supply equipment loads (self-weight, operating weight, housekeeping pad, inertia pads, etc.) to the Consultant, via shop drawing submissions, prior to construction.

.2 Where given choice of specific equipment, actual weight, location and method of support of equipment may differ from those assumed by the Consultant for base design. Back-check equipment loads, location, and supports, and include necessary accommodations.

.3 Where supporting structure consists of structural steel framing, it is imperative that equipment loads, location, and method of support be confirmed prior to fabrication of structural steel. Review locations of equipment with the Consultant prior to construction.

1.17 OPENINGS

.1 Supply opening sizes and locations to the Consultant to allow verification of their effect on design, and for inclusion on structural drawings where appropriate.

.2 No openings are permitted through completed structure without written approval from Owner and reviewed with the Consultant. Show required openings on a copy of structural drawings. Identify exact locations, elevations, and size of proposed openings and submit to the Consultant for review, well in advance of doing work.

.3 Prior to leaving site at end of each day, walk through areas of work and check for any openings, penetrations, holes, and/or voids created under scope of work of project, and ensure that any openings created under scope of work have been closed off, fire-stopped and smoke-sealed. Unless directed by Owner and reviewed with the Consultant, do not leave any openings unprotected and unfinished overnight.

1.18 SCAFFOLDING, HOISTING AND RIGGING

.1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval from Owner and reviewed with the Consultant.

.2 Immediately remove from site scaffolding, rigging and hoisting equipment when no longer required.

.3 Do not place major scaffolding/hoisting equipment loads on any portion of structure without approval from Owner and reviewed with the Consultant.

1.19 CHANGES IN THE WORK

.1 Whenever Consultant proposes in writing to make a change or revision to design, arrangement, quantity, or type of work from that required by Contract Documents, prepare and submit to the Consultant for review, a quotation being proposed cost for executing change or revision.

.2 Quotation is to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.

.3 Unless otherwise specified in Division 00 or Division 01, allowable maximum percentages for overhead and profit are to be 7% and 5% respectively.

.4 Unless otherwise specified in Division 00 or Division 01, following additional requirements apply to all quotations submitted:

.1 when change or revision involves deleted work as well as additional work, cost of deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from cost of additional work before overhead and profit percentages are applied to additional work;

.2 material costs are not to exceed those published in the latest edition of Allpriser price guide, less the following discounts:

Item	Discount
Steel Pipe	50%
Copper Pipe	45%
Cast Iron Soil Pipe	45%
Stainless Steel Pipe and Fittings	45%
Welded Fittings	50%
Grooved Fittings	30%
Threaded Fittings	40%
Cast Iron Screwed Fittings	40%
Copper Fittings	45%
Cast Iron MJ Fittings	35%
Valves	25%
Insulation Materials	35%

.3 mechanical material labour unit costs are to be in accordance with Mechanical Contractors Association of America Labor Estimating Manual, less 25%;

.4 electrical material labour unit costs are to be in accordance with National Electrical Contractors Association Manual of Labor Units at difficult level, less 25%;

.5 costs for journeyperson and apprentice labour must not exceed prevailing rates at time of execution of Contract and must reflect actual personnel performing work;

.6 cost for site superintendent must not exceed 10% of total hours of labour estimated for change or revision, and change or revision must be such that site superintendent's involvement is necessary;

.7 costs for rental tools and/or equipment are not to exceed local rental costs;

.8 overhead percentage will be deemed to cover quotation costs other than actual site labour and materials, and rentals;

.9 quotations, including those for deleted work, to include a figure for any required change to Contract time.

.5 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable Consultant to expeditiously process quotation and issue a Change Order will not be grounds for any additional change to Contract time.

.6 Make requests for changes or revisions to work to Consultant in writing and, if Consultant agrees, will issue Notice of Change.

.7 Do not execute any change or revision until written authorization for the change or revision has been obtained from the Consultant.

1.20 PROGRESS PAYMENT BREAKDOWN

.1 Prior to submittal of first progress payment draw, submit a detailed breakdown of work cost to assist Consultant in reviewing and approving progress payment claims.

.2 Payment breakdown is subject to Owner's approval and Consultant's review. Progress payments will not be processed until an approved breakdown is in place. Breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, system testing and verification, and project closeout submittals.

.3 Indicate equipment, material and labour costs for site services (if applicable) and indicate work of each trade in same manner as indicated on progress draw.

1.21 NOTICE FOR REQUIRED FIELD REVIEWS

.1 Whenever there is a requirement for the Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect work for deficiencies prior to Substantial Performance of the Work, for commissioning demonstrations, and any other such field review, give minimum 5 working days' notice in writing to the Consultant.

.2 If Consultant is unable to attend a field review when requested, arrange an alternative date and time.

.3 Do not conceal work until the Consultant advises that it may be concealed.

.4 When Consultant is requested to perform a field review and work is not ready to be reviewed, reimburse Consultant for time and travel expenses.

1.22 PRELIMINARY TESTING

.1 When directed by the Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with Specification and governing Codes and Regulations, prior to Substantial Performance of the Work.

.2 When, in Consultant's opinion, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.

.3 These tests are not to be construed as evidence of acceptance of work, and it is agreed and understood that no claim for delays or damage will be made for injury or breakage to any part or parts of equipment or system due to test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.

.4 When, in Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from site and replace them with acceptable equipment and/or products, at no additional cost.

1.23 PROVISIONS FOR SYSTEMS/EQUIPMENT USED DURING CONSTRUCTION

.1 Permanent building mechanical systems are not to be used for temporary heating or cooling purposes during construction.

1.24 TEMPORARY SERVICES

.1 Coordinate with Prime Contractor, requirements for temporary services including but not limited to temporary heating, cooling, and water. Unless otherwise noted, provide required services in compliance with requirements of local governing building code and local governing inspection authorities.

.2 Maintain fire protection of areas which may include fire watch during temporary shutdowns of existing systems, in accordance with requirements of local governing code and local governing authorities.

1.25 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

.1 Maintain equipment in accordance with the manufacturer's printed instructions prior to start-up, testing and commissioning.

.2 Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.

.3 Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminium tubing.

.4 All filters are to be new upon Substantial Performance of the Work. This is in addition to any spare filters specified.

1.26 RECORD DOCUMENTATION

.1 Drawings for this project have been prepared on a CAD system using AutoCAD software of release version reviewed with the Consultant. For purpose of producing record "as built" drawings, copies of Contract Drawings can be obtained from the Consultant.

.2 As work progresses at site, clearly mark in red in a neat and legible manner on a set of bound white prints of Contract Drawings, changes, and deviations from routing of services and locations of equipment shown on Contract Drawings, on a daily basis. Changes and deviations include those made by addenda, change orders, and site instructions. Use notes marked in red as required. Maintain white print red line as-built set at site for exclusive use of recording as-built conditions, keep set up-to-date at all times, and ensure set is always available for periodic review. As-built set is also to include the following:

.1 dimensioned location of inaccessible concealed work;

.2 locations of control devices with identification for each;

.3 for underground piping and ducts, record dimensions, invert elevations, offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks to be preserved after construction is complete;

.4 for fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings;

.5 location of piping system air vents;

.6 location of concealed services terminated for future extension and work concealed within building in inaccessible locations.

.3 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to the Consultant for review. Make necessary revisions to drawings as per Consultant’s comments, to satisfaction of the Consultant.

.4 Use final reviewed "as-built" drawing set to provide CAD files of drawings thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by the Consultant as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Consultant.

.5 Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with AutoCAD software release version confirmed with the Consultant.

.6 Unless otherwise noted in Division 00 or Division 01, failure to maintain accurate record drawings will incur additional 5% holdback on progress claims until drawings are brought up to date to satisfaction of Owner and reviewed with the Consultant.

.7 For projects with phased turnover of project (refer to Division 01), review with the Consultant completeness of as-built drawings prior to turn over of an area. Interim as-built drawings to be made available to Owner's maintenance personnel.

.8 Where part of the Mechanical Scope of Work, retain and pay for services of a land surveyor registered in Place of the Work to measure, verify, and record size, location, invert elevation and pitch of buried piping services, and, when complete, transfer survey work to as-built drawings.

1.27 OPERATING AND MAINTENANCE DATA

.1 For each item of equipment for which a shop drawing is required (except for simple equipment), supply indexed copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Consolidate each copy of data as a PDF file on a USB drive. Consolidated O&M manual PDF to include:

.1 front cover: project name; wording – "Mechanical Systems Operating and Maintenance Manual"; and date;

.2 introduction sheet listing Consultant, Contractor, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses;

.3 equipment manufacturer's authorized contact person name, telephone number and company website;

.4 Table of Contents sheet, and corresponding index tab sheets;

.5 copy of each "REVIEWED" or clean, updated "REVIEWED AS NOTED" shop drawing or product data sheet, with manufacturer’s/supplier’s name, telephone and fax numbers, email address, company website address, and email address for local source of parts and service; when shop drawings are returned marked "Reviewed As Noted" with revisions marked on shop drawing copies, they are to be revised by equipment supplier to incorporate comments marked on "Reviewed" shop drawings and a clean updated copy is to be included in operating and maintenance manuals;

.6 Operating data is to include:

.1 pressure test reports, and certificates issued by governing authorities;

.2 description of each system and its controls;

.3 control schematics for equipment/systems including building environmental controls;

.4 wiring and connection diagrams;

.5 if applicable, BAS architecture and all required operating data;

.6 description of operation of each system at various loads together with reset schedules and seasonal variances;

.7 operation instruction for each system and each component;

.8 description of actions to be taken in event of emergencies and/or equipment failure;

.9 valve tag schedule, and flow diagrams to indicate valve locations.

.7 Maintenance data is to include:

.1 operation and trouble-shooting instructions for each item of equipment and each system;

.2 schedules of tasks, frequency, tools required, and estimated task time;

.3 recommended maintenance practices and precautions;

.4 complete parts lists with numbers.

.8 Performance data is to include:

.1 equipment and system start-up data sheets;

.2 equipment performance verification test results, and final commissioning report;

.3 final testing, adjusting and balancing reports.

.9 copies of warranties;

.10 items requested specifically in Section Articles.

.2 Operating and maintenance instructions are to relate to job specific equipment supplied under this project and related to Owner's building. Language used in manuals is to contain simple practical operating terms and language easy for in-house maintenance staff to understand how to operate and maintain each system.

.3 Before applying for a Certificate of Substantial Performance of the Work, assemble one copy of O&M Manual and submit to the Consultant for review prior to assembling remaining copies. Incorporate Consultant's comments into final submission.

1.28 COMMISSIONING

.1 After successful start-up and prior to Substantial Performance of the Work, commission the mechanical work. Commissioning work is the process of Contractor demonstrating to Owner and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents, as further described below.

.1 Retain services of a testing, adjusting, and balancing agency to perform testing and balancing of mechanical system air/fluid flows and capacities, prior to operational performance testing. Refer to Section 20 05 93 – Testing, Adjusting, and Balancing for Mechanical Systems.

.2 Test, adjust and operate equipment and systems after start-up but before functional performance testing, to confirm operations are in accordance with requirements of Contract Documents. Verify modes and sequences of control and monitoring, interlocks, and responses to emergency conditions. Complete commissioning data sheets to document successful operational performance testing.

.3 Repeat successful operational performance testing with completed commissioning data sheet documentation in the presence of Consultant and Owner to validate and verify equipment and systems are complete in all respects, function correctly, and are ready for acceptance.

.4 Submit final commissioning data sheets, TAB reports as specified in Section 20 05 93 – Testing, Adjusting, and Balancing for Mechanical Systems, project closeout documents, and other required submittals.

1.29 WARRANTY

.1 Unless otherwise specified in Division 00 and Division 01, warrant mechanical work to be in accordance with Contract Documents and free from defects for a period of 1 year from date of issue of a Certificate of Substantial Performance of the Work.

.2 Where equipment includes extended warranty period, e.g., 5 years, first year of warranty period is to be governed by terms and conditions of warranty in Contract Documents, and remaining years of warranty are to be direct from equipment manufacturer and/or supplier to Owner. Submit signed and dated copies of extended warranties to the Consultant.

.3 Warranty to include parts, labour, travel costs and living expenses incurred by manufacturer’s authorized technician to provide factory authorized on-site service.

.4 Repair and/or replace any defects that appear in Work within warranty period without additional expense to Owner. Be responsible for costs incurred in making defective work good, including repair or replacement of building finishes, other materials, and damage to other equipment. Ordinary wear and tear and damage caused wilfully or due to carelessness of Owner’s staff or agents is exempted.

.5 Do not include Owner deductible amounts in warranties.

.6 It is understood that warranties are to commence from time of Substantial Performance of the Work, regardless of what is noted within following Sections of Specification. Be responsible for providing whatever "bridging" or additional extended warranty period is required from time that material is purchased until this time.

.7 Visit building during warranty period with Owner representatives. Owner to organize these visits. At these meetings, Owner representatives are to review performance of systems. If performance is satisfactory, then no further action needs to be taken. If unsatisfactory, then correct deficiencies, as directed by Owner representatives, to satisfaction of Owner's representatives. These site visits to occur:

.1 once during 1st month of building operation;

.2 once during 3rd month of building operation;

.3 once between 4th and 10th month in a season opposite to 1st and 3rd month visits.

1.30 CLOSEOUT SUBMITTALS

.1 Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following as applicable to the project:

.1 Operating and Maintenance Manuals;

.2 as-built record drawings and associated data;

.3 extended warranties for equipment as specified;

.4 operating test certificates, i.e. Sprinkler Test Certificate;

.5 final commissioning report and TAB report;

.6 identified keys for equipment and/or panels for which keys are required, and other items required to be submitted;

.7 other data or products specified.

1.31 INSTRUCTIONS TO OWNER

.1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.

.2 Train Owner's designated personnel in aspects of operation and maintenance of equipment and systems as specified. Demonstrations and training are to be performed by qualified technicians employed by equipment/system manufacturer/supplier. Supply hard copies of training materials to each attendee.

.3 Unless where specified otherwise in trade Sections, minimum requirements are for manufacturer/suppliers of each system and major equipment, to provide minimum two separate sessions each consisting of minimum 4 hours on site or in factory training (at Owner's choice), of Owner's designated personnel (for up to 6 people each session), on operation and maintenance procedures of system.

.4 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Use Operating and Maintenance Manuals during training sessions. Training modules include but are not limited to:

.1 Operational Requirements and Criteria – equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations;

.2 Troubleshooting – diagnostic instructions, test and inspection procedures;

.3 Documentation – equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like;

.4 Maintenance – inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools;

.5 Repairs – diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.

.5 Before instructing Owner's designated personnel, submit to the Consultant for review preliminary copy of training manual and proposed schedule of demonstration and training dates and times. Incorporate Consultant's comments in final copy.

.6 Obtain in writing from the Consultant list of Owner's representatives to receive instructions. Submit to Consultant prior to application for Certificate of Substantial Performance of the Work, complete list of systems for which instructions were given, stating for each system:

.1 date instructions were given to Owner's staff;

.2 duration of instruction;

.3 names of persons instructed;

.4 other parties present (manufacturer's representative, consultants, etc.).

.7 Obtain signatures of Owner's staff to verify they properly understood system installation, operation, and maintenance requirements, and have received operating and maintenance instruction manuals and "as-built" record drawings.

.8 Submit to the Consultant copy of electronic version of training materials and include in operating and maintenance manuals submission.

1.32 FINAL INSPECTION

.1 Submit to Consultant, written request for final inspection of systems. Include written certification that:

.1 deficiencies noted during job inspections have been completed;

.2 field quality control procedures have been completed;

.3 systems have been tested and verified, balanced, and adjusted, and are ready for operation;

.4 maintenance and operating data have been completed and submitted to, reviewed with the Consultant and accepted by Owner;

.5 tags and nameplates are in place and equipment identifications have been completed;

.6 clean-up is complete;

.7 spare parts and replacement parts specified have been provided and acknowledged by the Consultant;

.8 as-built and record drawings have been completed and submitted to and reviewed with the Consultant and accepted by Owner;

.9 Owner's staff has been instructed in operation and maintenance of systems;

.10 commissioning procedures have been completed.

2 Products – Not Used

3 Execution

3.01 CLEANING

.1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Owner and Consultant. Before applying for a Certificate of Substantial Performance of the Work, remove rubbish and debris, and be responsible for repair of any damage caused as a result of work.

.2 Clean equipment and devices installed as part of this project.

End of Section

1 General

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for:

.1 electric motors (submit with equipment they are associated with).

.2 Submit a list of equipment identification nameplates indicating proposed wording and sizes.

2 Products

2.01 EQUIPMENT BELT DRIVES

.1 ANSI/RMA Standard V-belt type rated at minimum 1.5 times motor nameplate rating, and in accordance with following requirements:

.1 belts are to be reinforced cord and rubber, and multiple belts are to be matched sets;

.2 sheaves are to be cast iron or steel, secured to shafts with removable keys unless otherwise specified, standard adjustable pitch (± 10% range) for motors under 10 HP, fixed pitch type with split tapered bushing and keyway for motors 10 HP and larger, and, if required, replaced as part of mechanical work to suit system air/water quantity testing and balancing work;

.3 motor slide rail adjustment plates are to allow for centre line adjustment.

.2 Supply a spare belt set (tagged and identified) for each belt drive and hand to Owner upon Substantial Performance of the Work.

2.02 EQUIPMENT DRIVE GUARDS AND ACCESSORIES

.1 For V-belt drives – removable, 4-sided, fully enclosed, galvanized sheet steel guards to OHSA standards, cleaned, factory primed and painted with yellow equipment enamel, complete with a 2-piece full length hinged front panel to permit belt maintenance or replacement without removing guard, and 40 mm (1-½") diameter tachometer openings at each shaft location.

.2 For flexible couplings – removable "U" shaped galvanized steel guards to OHSA Standards with a 2.3 mm (3/32") thick frame and expanded mesh face.

.3 For unprotected fan inlets and outlets – unless otherwise specified, removable 20 mm (¾") galvanized steel wire mesh with galvanized steel frames, all to OHSA Standards.

2.03 ELECTRIC MOTORS

.1 Unless otherwise specified, motors are to conform to NEMA Standard MG1, applicable IEEE Standards, and applicable CSA C22.2 standards, and are to meet NEMA standards for maximum sound level ratings under full load. Confirm motor voltages prior to ordering.

.2 Vertically mounted and submersible motors are to be purposely designed for mounting in this attitude.

.3 Efficiency of 1-phase motors to 1 HP is to be in accordance with CAN/CSA C747. Efficiency of 3-phase motors 1 HP and larger is to be in accordance with CAN/CSA C390 or IEEE 112B.

.4 Unless otherwise specified, 1-phase motors smaller than ½ HP are to be 115 volt, continuous duty capacitor start type with an NEMA 48 or 56 frame size, solid base, heavy-gauge steel shell with solid die-cast end shields, dynamically balanced die-cast rotor, integral automatic reset thermal overload protection, Class "B" insulation, and a 1.15 service factor at 40°C (105°F) ambient temperature.

.5 Explosion-proof 1-phase motors are to be totally enclosed, fan cooled, 115 volt continuous duty capacitor start type in accordance with CSA C22.2 No. 145, as specified for standard 1-phase motors but suitable for use in Class 1 Group D hazardous locations and complete with a rolled steel shell and a 1.0 service factor at 40°C (105°F) ambient temperature.

.6 Unless otherwise specified, motors ½ HP and larger are to be totally enclosed, fan cooled, 3-phase, T-frame, squirrel cage continuous duty induction motors suitable for voltages indicated on Drawings, NEMA Design "B" for normal starting torque or Design "C" for high starting torque as required by the application, each complete with Class "B" insulation, a 1.15 service factor at 40°C ambient temperature, grease lubricated open ball bearings with grease fittings to permit re-lubrication without dismantling motor, a cast iron frame with cast iron feet where required, cast iron end bracket and precision machined bearing fit, and balanced carbon steel shaft assembly with die-cast aluminum rotor windings.

.7 Explosion-proof 3-phase motors are to be totally enclosed fan cooled motors in accordance with CSA C22.2 No. 145, generally as specified above for standard 3-phase motors but suitable for use in Class 1 Group D hazardous locations and with a 1.0 service factor at 40°C (105°F) ambient temperature.

.8 Motor(s) for 2-speed cooling tower(s) are to be as specified above but 2-speed single winding type.

.9 Motor(s) for 2-speed fan(s) are to be as above but 2-speed double winding type.

.10 Unless otherwise indicated, motors 30 HP and larger are to be complete with a heat sensing PTC thermistor in the end turn of stator winding for each phase and connected in series inside motor with 2 marked leads brought out to motor conduit box.

.11 Motors for equipment with variable frequency drives are to be generally as specified above but inverter duty type to NEMA Standard MG-1 Part 31, quantified by CSA for operation from a variable frequency drive of type specified, and complete with Class "H" insulation. Motors are to be equipped with AEGIS, or approved equal, shaft grounding ring system to protect bearings from damage by diverting harmful shaft voltages and bearing currents to ground.

.12 Motors 150 HP and larger with "wye-delta" reduced voltage starters are to be complete with six leads for connection to motor starter.

.13 Motors for equipment which is scheduled or specified with a corrosion resistant coating or constructed from corrosion resistant materials are to be factory coated with a primer and epoxy paint finish.

.14 Manufacturers:

.1 TECO-Westinghouse Motors (Canada) Inc.;

.2 Canadian General Electric;

.3 Baldor Electric Co.;

.4 U.S. Electrical Motors;

.5 Weg Electric Corp.;

.6 Marathon Electric;

.7 Toshiba Corp.;

.8 Leeson Canada.

2.04 MOTOR STARTERS AND ACCESSORIES

.1 Motor starters must be capable of starting associated motors under the imposed loads. Confirm starter voltage matches motor prior to ordering.

.2 Unless otherwise specified, starters for 1-phase motors are to be 115 volt, thermal overload protected manual starting switches with a neon pilot light, a surface or recessed enclosure to suit the application, and, where automatic operation is required, a separate H-O-A switch in an enclosure to match starter enclosure.

.3 Unless otherwise specified, starters for 3-phase motors less than 50 HP are to be combination "quick-make" and "quick-break" fused disconnects and full voltage non-reversing across-the-line starters, each complete with and overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.

.4 Unless otherwise specified, starters for 3-phase motors 50 HP to 150 HP are to be reduced voltage, non-reversing, auto-transformer type starters complete with one overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.

.5 Unless otherwise specified, starters for 3-phase motors 150 HP and larger are to be reduced voltage, non-reversing, closed transition "wye-delta" starters complete with one overload relay per phase, an enclosure to suit the application, and, a H-O-A switch, pilot lights, control transformer, auxiliary contacts, and other accessories as per motor starter schedule.

.6 Starters for 2-speed double winding motors are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.

.7 Starters for 2-speed single winding motors are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to permit equipment to coast down to low speed before it is operated at low speed.

.8 Starters for reversible motors for cooling towers are to be generally as specified above but suitable for motor and equipped with a 45 second time delay to allow fan(s) to coast down to a stop before being operated in reverse rotation.

.9 Unless otherwise specified, motor starter enclosures are to be in accordance with following NEMA ratings:

.1 enclosures located in sprinklered areas – Type 2;

.2 enclosures exposed to the elements – Type 3R, constructed of stainless steel;

.3 enclosures inside the building in wet areas – Type 3R, constructed of stainless steel;

.4 enclosures in explosion rated area – Type 7 with exact requirements to suit the area and application;

.5 enclosures except as noted above – Type 1;

.6 enclosures located in finished areas – as above but recess type with brushed stainless steel faceplate.

.10 Motor control centres are to be multi-unit, 2.28 m (9') high, NEMA Class 1, type "B", factory assembled, dead front, floor mounted, free-standing motor control centre with tin plated copper bus and an NEMA Type 1 or Type 2 enclosure as for loose starters specified above. Each motor control centre is to be complete with starters as specified above, load and control wiring terminal boards, and required facilities for line and load side power wiring connections.

.11 Disconnect switches for motor control centres are to be heavy-duty, CSA certified, front operated switches as per motor starter schedule, each complete with a handle suitable for padlocking in "off" position and arranged so that door cannot be opened with handle in "on" position and an NEMA

enclosure as specified for loose starters. Fusible units are to be complete with fuse clips to suit fuse types specified below.

.12 Fuses are to be, unless otherwise scheduled or specified, English Electric Ltd. HRC fuses, Form I Class "J" for constant running equipment and Form II Class "C" for equipment that cycles on and off.

.13 Manufacturers:

.1 Rockwell Automation Inc. - Allen-Bradley;

.2 Eaton Corp. – Cutler-Hammer;

.3 Eaton Corp. – Moeller Electric;

.4 Siemens Canada;

.5 Schneider Electric.

3 Execution

3.01 INSTALLATION OF EQUIPMENT DRIVE GUARDS AND ACCESSORIES

.1 Provide OHSA guards for exposed accessible rotating parts such as belt drives, couplings, fan wheels, and shaft ends on mechanical equipment.

.2 Install belt guards to allow movement of motors for adjusting belt tension.

.3 Provide a means to permit lubrication and use of test instruments with guards in place.

.4 Secure guards to equipment or equipment base but do not bridge sound or vibration isolation.

.5 Where equipment oil level gauges, oil reservoirs, grease cups, or grease gun fittings are integral with equipment but are not easily accessible for service, extend to an accessible location using aluminium or copper tubing.

3.02 SUPPLY OF MOTOR STARTERS AND ACCESSORIES

.1 Unless otherwise shown or specified, supply a starter for each item of motorized equipment.

.2 Where 3-phase starters are indicated in motor control centres, supply motor control centres with starters and bolt to a concrete housekeeping pad.

.3 Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with equipment is fed from a motor control centre, provide a disconnect switch in motor control centre in lieu of a motor starter.

.4 Where 3-phase starters are indicated and/or scheduled to be mounted on a motor starter panel, starters will be mounted and connected, complete with panels and splitter trough, as part of electrical work. Hand starters to electrical trade at site when they are required.

.5 Where package type equipment with integral starters, or equipment with starters integral in loose power and control panels supplied with equipment is fed from a motor starter panel, a disconnect switch will be provided on motor starter panel as part of electrical work.

.6 Unless otherwise specified or shown on drawings, 1-phase motor starters will be mounted adjacent to equipment they serve and connected complete as part of electrical work. Hand starters to electrical trade at site at the proper time.

3.03 ELECTRICAL WIRING WORK FOR MECHANICAL WORK

.1 Unless otherwise specified or indicated, following electrical wiring work for mechanical equipment will be done as part of the electrical work:

.1 "line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from starters or disconnects to equipment;

.2 "line" side power wiring to individual wall mounted starters, and "load" side wiring from starters to equipment;

.3 "line" side power wiring to pre-wired power and control panels and variable frequency drives (VFD), and "load" side power wiring from the panels and VFD's to equipment;

.4 provision of receptacles for plug-in equipment;

.5 provision of disconnect switches for motors in excess of 10 m (30') from starter location, or cannot be seen from starter location, and associated power wiring;

.6 motor starter interlocking in excess of 24 volts;

.7 wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts;

.8 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers;

.9 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units;

.10 120 volt wiring connections to duplex receptacles integral with air handling unit control panels;

.11 120 volt wiring connections to BAS system controllers/panels and other control system or component requiring 120 volt power including, but not limited to, VAV boxes, dampers, low voltage transformers, etc.

.2 Mechanical wiring work not listed above or specified herein or on drawings to be done as part of electrical work is to be installed in conduit and is to be done as part of mechanical work in accordance with wiring requirements specified for electrical work.

End of Section

1 General

2 Products

2.01 PIPING HANGERS AND SUPPORTS

.1 Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to following requirements:

.1 unless otherwise specified, ferrous hanger and support products are to be electro-galvanized;

.2 hangers and supports for insulated piping are to be sized to fit around insulation and insulation jacket.

.2 Hangers and supports for horizontal suspended piping as follows:

.1 adjustable steel clevis hanger – MSS Type 1;

.2 adjustable swivel ring band hanger – MSS Type 10;

.3 adjustable roller hanger – MSS Types 41, 43, and/or 45, with MSS Type 39 steel protection saddle.

.3 Supports for horizontal pipe on vertical surfaces as follows:

.1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;

.2 heavy-duty steel pipe clip – MSS Type 26;

.3 single steel pipe hook – Myatt Fig. 156;

.4 epoxy coated steel pipe stays are not permitted.

.4 Floor supports for vertical risers as follows:

.1 copper tubing riser clamp – MSS Type 8;

.2 heavy-duty steel riser clamp – MSS Type 8.

.5 Supports for vertical piping on vertical surfaces as follows:

.1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;

.2 heavy-duty steel pipe bracket or soil pipe bracket – MSS Type 26;

.3 extension split pipe clamp – MSS Type 12;

.4 epoxy coated steel pipe stays are not permitted.

.6 Base support for vertical risers in excess of 6 m (20') high extending out from base mounted equipment is to consist of a base elbow support with flange.

.7 For horizontal pipe on racks, Unistrut or equal galvanized steel pipe racks with pipe securing hardware as follows:

.1 standard galvanized steel U-bolts/clamps supplied by rack manufacturer;

.2 adjustable roller chair – MSS Type 44 with MSS Type 39 steel protection saddle.

.8 Special hangers and supports for various applications as follows:

.1 vibration isolated riser supports – black steel riser clamps as specified above, complete with neoprene–steel–neoprene sandwich type vibration isolation pads between clamp and floor;

.2 for groups of pipes having same slope – MSS Type 32 welded steel brackets, Anvil Fig. 46 universal trapeze assemblies, or Unistrut or equal support assemblies, all with U-bolts, clamps, etc., to secure pipes in place;

.3 for sections of piping connected to vibration isolated equipment – hangers and supports as specified above but complete with MSS Type 48 spring cushions;

.4 for piping on existing roof – wooden blocks as per typical detail indicated on drawings;

.5 for plastic piping – generally as specified above but in accordance with pipe manufacturer's recommendations;

.6 for bare horizontal copper piping – generally as above but factory vinyl coated to prevent direct copper/steel contact;

.7 for bare copper vertical piping – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate pipe from clamp;

.8 insulation protection shields to and including 40 mm (1-½") dia. – MSS Type 40 galvanized steel shields with ribs to keep shield centred on hanger.

.9 Hanger rods are to be electro-galvanized carbon steel (unless otherwise specified), round, threaded, to ASTM A36, complete with captive machine nuts with washers at hangers, sized to suit loading in accordance with Table 3 in MSS SP-58, but in any case, minimum 9.5 mm (3/8") diameter.

.10 Manufacturers:

.1 E. Myatt & Co. Inc.;

.2 Anvil International Inc.;

.3 Empire Industries Inc.;

.4 Hunt Manufacturing Ltd.;

.5 Unistrut Canada Ltd.;

.6 Nibco Inc. "Tolco";

.7 Taylor Pipe Supports.

3 Execution

3.01 INSTALLATION OF FASTENING AND SECURING HARDWARE

.1 Provide fastening and securing hardware required for mechanical work to maintain installations attached to structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding dead loads, live loads, superimposed dead loads, and any vibration of installed products.

.2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.

.3 Where floor, wall or ceiling construction is not suitable to support loads, provide additional framing or special fasteners to ensure proper securement to structure that is to support the products. Provide reinforcing or connecting supports where required to distribute loading to structural components.

.4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CAN/CSA Z166.1 and CAN/CSA Z166.2.

.5 Do not attach fasteners to steel deck without written consent from Consultant.

3.02 INSTALLATION OF PIPE HANGERS AND SUPPORTS

.1 Provide required pipe hangers and supports.

.2 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from structure only.

.3 For insulated pipe, size hanger or support to suit diameter of insulated pipe and install hanger or support on outside of insulation and insulation finish.

.4 Support requirements for underground piping are as follows:

.1 support underground pipe, unless otherwise specified, on a well compacted bed of dry, natural, undisturbed earth free from rocks or protrusions of any kind, or on compacted material as specified;

.2 support underground service piping penetrating building exterior walls or foundations to prevent pipe damage if minor building settlement occurs;

.3 ensure bedding and supports for underground pipes are flat and true and allowances are made for pipe hubs, couplings, or other protrusions so no voids are left between pipe and bedding.

.5 Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe less than or equal to 25 mm (1") dia. are to be clevis type or adjustable ring type, and hangers for suspended pipe greater than or equal to 40 mm (1-½") dia. are to be adjustable clevis type.

.6 Space hangers and supports in accordance with following:

.1 cast iron pipe – hang or support at every joint with maximum 2.4 m (8') spacing;

.2 plastic pipe – conform to pipe manufacturer’s recommended support spacing;

.3 glass pipe – conform to pipe manufacturer’s recommended support spacing and support requirements;

.4 copper and steel pipe – hang or support at spacing in accordance with following schedule:

Pipe dia.	Max. Spacing Steel (meters)	Max. Spacing Copper (meters)
to 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1-½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')

Pipe dia.	Max. Spacing Steel (meters)	Max. Spacing Copper (meters)
65 mm (2-½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3-½")	3.6 m (12’)	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')
250 mm (10")	6.0 m (20')	
300 mm (12")	6.7 m (22')	

.5 flexible grooved pipe/coupling joint piping – as above but with not less than one hanger or support between joints;

.7 Where pipes change direction, either horizontally or vertically, provide a hanger or support on horizontal pipe not more than 300 mm (12") from elbow, and where pipes drop from tee branches, support tees in both directions not more than 50 mm (2") on each side of tee.

.8 When pipes with same slope are grouped and a common hanger or support is used, space hanger or support to suit spacing requirement of smallest pipe in group and secure pipes in place on common hanger or support.

.9 Provide roller hangers or supports for heat transfer piping greater than or equal to 150 mm (6") diameter and conveying a material 75°C (170°F) or greater to facilitate pipe movement due to expansion and contraction, and at each hanger or support tack weld a steel protection saddle to pipe to protect piping insulation.

.10 Unless otherwise shown or specified, support vertical piping by means of supports specified in Part 2 of this Section, spaced in accordance with following:

.1 support vertical pipes at maximum 3 m (10') intervals or at every floor, whichever is lesser;

.2 for sections of vertical piping with a length less than 3 m (10'), support pipe at least once;

.3 for vertical cast iron plain end pipe (mechanical joint type), secure riser or pipe clamp around pipe under a flange integral with pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support;

.4 for vertical steel pipe risers in excess of 3 m (10'), weld shear lugs to pipe to carry load;

.5 for vibration isolated piping risers, provide rubber-steel-rubber vibration isolation pads between riser clamps and floor.

.11 Support piping on the roof as follows:

[OR]

.1 on new roof – supply manufactured roof supports as per Part 2 of this Section to accommodate piping involved and support spacing specified above, and hand supports to roofing trade on roof for installation as part of roofing work, then secure piping in place on supports.

.12 Each hanger, support or securement for horizontal bare copper tubing is to be plastic coated to prevent direct contact between pipe and ferrous hanger. Each wall or floor clamp for vertical bare copper piping is to be isolated from pipe by means of strips of flexible rubber inserts. Use of painted ferrous hangers and supports, including those painted with copper coloured paint, is not acceptable. Site application of tape or other types of isolation is not acceptable.

.13 For insulated horizontal piping less than or equal to 40 mm (1-½") diameter, provide galvanized steel insulation protection shields between insulation and hanger or support. Install shields immediately after pipe is insulated.

.14 Do not support piping from steel deck without written consent from Consultant.

3.03 EQUIPMENT BASES AND SUPPORTS

.1 Unless otherwise specified or required, set floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of equipment on each side and end, or a minimum of 200 mm (8") from centreline of equipment anchor bolts to edge of the base, whichever is larger. Conform to following requirements:

.1 supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads;

.2 place anchor bolts during concrete pour and be responsible for required levelling, alignment, and grouting of equipment;

.3 as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details.

.2 For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to following requirements:

.1 provide stands and supports, except those for small equipment, designed by a structural engineer registered in jurisdiction of the work, and submit stamped and signed design drawings with calculations as shop drawings for review;

.2 flange bolt steel stands to concrete housekeeping pads;

.3 seismically restrained stands and supports in accordance with applicable requirements.

.3 Where indicated on mechanical drawings, provide welded, cleaned and prime coat painted structural steel platforms, designed by a structural engineer registered in the jurisdiction of the work, for service access to equipment. Submit stamped and signed design drawings with calculations as shop drawings for review. Conform to following requirements:

.1 platforms in accordance with OHSA requirements and adequately sized, braced, anchored, and, as required, seismically restrained;

.2 flooring equal to Fisher & Ludlow "Tru-Weld" Type 19-4, Borden type W/B (19-W-4), welded steel bar type grating;

.3 support legs constructed of welded Schedule 40 black steel pipe with welded steel cross-bracing, securely anchored and sway braced;

.4 safety guard rails, constructed from minimum 32 mm (1-¼") dia. Schedule 40 black steel pipe, for all platforms and complete with vertical stanchions at maximum 1.2 m (48") centres, top and intermediate horizontal railing, and toe plates at floor;

.5 vertical ladders constructed of Schedule 40 black steel pipe, 25 mm (1") dia. for equal height rungs, 40 mm (1-½") for stringers, anchored to floors and walls and sway braced as required;

.6 ships ladders, used wherever space conditions permit, of welded steel construction, climbing at an approximate 60º angle, and complete with channel iron stringers, open grate equal height risers approximately 165 mm (6-½") wide and factory made by grating manufacturer, handrails, and suitable anchoring and support.

3.04 CONCRETE WORK FOR MECHANICAL EQUIPMENT BASES AND PADS

[OR]

End of Section

1 General

1.01 SECTION INCLUDES

.1 Nameplates.

.2 Tags.

.3 Pipe Markers.

1.02 REFERENCES

.1 ASME A13.1 – Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

.1 Section 01 33 00: Submittals.

.2 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.

.3 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

.4 Product Data: Provide manufacturers catalogue literature for each product required.

.5 Samples: Submit two labels, tags samples to Consultant for approval.

.6 Manufacturer's Installation Instructions: Indicate special procedures, and installation.

1.04 CLOSEOUT SUBMITTALS

.1 Section 01 77 00: Project Closeout.

.2 Record actual locations of tagged valves.

2 Products

2.01 MECHANICAL WORK IDENTIFICATION MATERIALS

.1 Confirm with the Owner if an existing mechanical work identification system is in place and, if so, match accordingly.

.2 If an existing mechanical work identification system is not in place, the following is to be used:

.1 Equipment nameplates are to be minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2-½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:

.1 unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved wording to completely identify equipment and its use with no abbreviations;

.2 wording is generally to be as per drawings, i.e. Fan EF-1, and is to include equipment service and building area/zone served, but must be reviewed prior to engraving;

.3 supply stainless steel screws for securing nameplates in place;

.4 nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level.

.2 Valve tags are to be coloured, 40 mm (1-½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:

VALVE V12
200 mm (8")
CHILL. WATER
NORMALLY OPEN

.3 Standard pipe identification is to be equal to Smillie McAdams Summerlin Ltd., Brady or Primark Manufacturing Inc. vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:

.1 for pipe less than or equal to 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around pipe or pipe insulation;

.2 for pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.

.4 Identification wording and colours for pipe identification materials are to be as follows:

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
domestic cold water	green	DOM. COLD WATER
domestic hot water supply	green	DOM. HW SUPPLY
domestic hot water recirculation	green	DOM. HW RECIRC.
tempered domestic water	green	TEMP. DOM. WATER
storm drainage	green	STORM
sanitary drainage	green	SAN.
plumbing vent	green	SAN. VENT
natural gas	to Code	to Code, c/w pressure
natural gas vent	to Code	to Code
heating water supply	yellow	HTG. WTR. SUPPLY
heating water return	yellow	HTG. WTR. RETURN
heating water drain	yellow	HTG. WTR. DRAIN
pumped condensate	yellow	PUMPED CONDENSATE
refrigerant suction	yellow	REFRIG. SUCTION
refrigerant liquid	yellow	REFRIG. LIQUID
refrigerant hot gas	yellow	REFRIG. HOT GAS

.5 Colours for pipe identification legends and directional arrows are to be as follows:

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
yellow	black
green	white
red	white

3 Execution

3.01 PREPARATION

.1 Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

.1 Identify new exposed piping and ductwork as per Part 2 of this Section in locations as follows:

.1 at every end of every piping or duct run;

.2 adjacent to each valve, strainer, damper and similar accessory;

.3 at each piece of connecting equipment;

.4 on both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified;

.5 at 6 m (20') intervals on pipe and duct runs exceeding 6 m (20') in length;

.6 at least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.

.2 Unless otherwise specified identify new concealed piping and ductwork as per Part 2 of this Section in locations as follows:

.1 at points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas;

.2 at maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room;

.3 at each access door location;

.4 at each piece of connected equipment, automatic valve, etc.

.3 Provide an identification nameplate for equipment provided as part of this project, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate nameplates in the most conspicuous and readable location.

.4 Paint new natural and/or propane gas piping with primer and 2 coats of yellow paint in accordance with Code requirements. Identify piping at intervals as specified above.

.5 Provide an identification nameplate for each motor starter or disconnect switch located in a motor control centre or on a motor starter panel, and on each individually mounted starter provided as part of mechanical work, and on each disconnect switch provided as part of the electrical work for motorized equipment provided as part of mechanical work.

.6 For electrically traced mechanical work, identification wording is to include "ELECTRICALLY TRACED".

.7 Tag valves and prepare a valve tag chart in accordance with following requirements:

.1 attach a valve tag to each new valve, except for valves located immediately at equipment they control;

.2 prepare a digital valve tag chart to list tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed);

.3 if an existing valve tag chart is available at site, valve tag numbering is to be an extension of existing numbering and new valve tag chart is to incorporate existing chart;

.4 include a copy of valve tag chart in each copy of operating and maintenance instruction manuals.

.8 Where shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in ceiling panel material, or stickers equal to Brady "Quick Dot" on ceiling grid material to indicate locations of items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:

.1	HVAC piping valves and equipment:	yellow
.2	fire protection valves and equipment:	red
.3	plumbing valves and equipment:	green
.4	HVAC ductwork dampers and equipment:	blue
.5	control system hardware and equipment:	orange

End of Section

1 General

1.01 SECTION INCLUDES

.1 This Section specifies mechanical system testing, adjusting, and balancing requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and is to be read accordingly.

1.02 DEFINITIONS

.1 “Agency” – means agency to perform testing, adjusting and balancing work.

.2 “TAB” – means testing, adjusting and balancing to determine and confirm quantitative performance of equipment and systems and to regulate specified fluid flow rate and air patterns at terminal equipment, e.g., reduce fan speed, throttling, etc.

.3 “hydronic systems” – includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.

.4 “air systems” – includes outside air, supply air, return air, exhaust air, and relief air systems.

.5 “flow rate tolerance” – means allowable percentage variation, minus to plus, of actual flow rate values in Contract Documents.

.6 “report forms” – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form permanent record to be used as basis for required future testing, adjusting and balancing.

.7 “terminal” – means point where controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.

.8 “main” – means duct or pipe containing system’s major or entire fluid flow.

.9 “submain” – means duct or pipe containing part of the systems’ capacity and serving 2 or more branch mains.

.10 “branch main” – means duct or pipe servicing 2 or more terminals.

.11 “branch” – means duct or pipe serving a single terminal.

1.03 SUBMITTALS

.1 Within 30 days of work commencing at site, submit name and qualifications of proposed testing and balancing agency in accordance with requirements of article entitled Quality Assurance below.

.2 Submit sample test forms, if other than those standard forms prepared by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB), are proposed for use.

.3 Submit a report by Agency to indicate Agency’s evaluation of mechanical drawings with respect to service routing and location or lack of balancing devices. Include set of drawings used and marked-up by Agency to prepare report.

1.04 CLOSEOUT SUBMITTALS

.1 Submit a report by Agency after each site visit made by Agency during construction phase of this Project.

.2 Submit a draft report, as specified in Part 3 of this Section.

.3 Submit a final report, as specified in Part 3 of this Section.

.4 Submit a testing and balancing warranty as specified in Part 3 of this Section.

.5 Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.05 QUALITY ASSURANCE

.1 Employ services of an independent testing, adjusting, and balancing agency meeting qualifications specified below, to be single source of responsibility to test, adjust, and balance building mechanical systems to produce design objectives. Agency is to have successfully completed testing, adjusting and balancing of mechanical systems for a minimum of 5 projects similar to this Project within past 3 years, and is to be certified as an independent agency in required categories by one of following:

.1 AABC – Associated Air Balance Council;

.2 NEBB – National Environmental Balancing Bureau.

.2 NBCTA certification in lieu of the above noted organizations is not permitted.

.3 Testing, adjusting and balancing of complete mechanical systems is to be performed over entire operating range of each system in accordance with 1 of following publications:

.1 National Standards for a Total System Balance published by Associated Air Balance Council;

.2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by National Environmental Balancing Bureau;

.3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications.

2 Products – Not Used

3 Execution

3.01 SCOPE OF WORK

.1 Perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of fluid quantities of mechanical systems as required to meet design specifications and comfort conditions, and recording and reporting results.

.2 Mechanical systems to be tested, adjusted and balanced include:

.1 TAB of heating systems is to include piping and equipment fluid temperatures, flows and control, and if TAB is not done during heating season, a follow-up site visit during heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".

.2 TAB of air handling systems is to include equipment and ductwork air temperatures, capacities and flows.

3.02 TESTING, ADJUSTING, AND BALANCING

.1 Conform to following:

.1 as soon as possible after award of Contract, Agency is to carefully examine a set of mechanical drawings with respect to routing of services and location of balancing devices, and is to issue a report listing results of the evaluation;

.2 set of drawings examined by Agency is to be returned with evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices;

.3 after review of mechanical work drawings and specification, Agency is to visit site at frequent, regular intervals during construction of mechanical systems, to observe routing of services, locations of testing and balancing devices, workmanship, and anything else that will affect testing, adjusting and balancing;

.4 after each site visit, Agency is to report results of site visit indicating date and time of visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing;

.5 testing, adjusting and balancing is not to begin until:

.1 building construction work is substantially complete and doors have been installed;

.2 mechanical systems are complete in all respects, and have been checked, started, adjusted, and then successfully performance tested.

.6 mechanical systems to be tested, adjusted and balanced are to be maintained in full, normal operation during each day of testing, adjusting and balancing;

.7 obtain copies of reviewed shop drawings of applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences;

.8 Agency is to walk each system from system "head end" equipment to terminal units to determine variations of installation from design, and system installation trades will accompany Agency;

.9 Agency is to check valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment;

.10 wherever possible, Agency is to lock balancing devices in place at proper setting, and permanently mark settings on devices;

.11 Agency is to leak test ductwork as specified in Section entitled HVAC Air Distribution in accordance with requirements of SMACNA "HVAC Air Duct Leak Test Manual", coordinate work with work of aforementioned Sections, provide detailed sketch(es) to Sheet Metal Contractor and Consultant identifying ductwork not in accordance with acceptable leakage values specified in aforementioned Sections, and retest corrected ductwork;

.12 Agency is to balance systems with due regard to objectionable noise which is to be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at design conditions, Agency is to immediately report problem and submit data, including sound readings, to permit an accurate assessment of noise problem to be made;

.13 Agency is to check supply air handling system mixing plenums for stratification, and where variation of mixed air temperature across coils is found to be in excess of ±5% of design requirements, Agency is to report problem and issue a detail sketch of plenum baffle(s) required to eliminate stratification;

.14 Agency is to perform testing, adjusting and balancing to within ±5% of design values, and make and record measurements which are within ±2% of actual values;

.15 for air handling systems equipped with air filters, test and balance systems with simulated 50% loaded (dirty) filters by providing a false pressure drop;

.16 test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8°C (5°F) wet bulb temperature of maximum summer design condition, and within 5.5°C (10°C) dry bulb temperature of minimum winter design condition, and take final temperature readings during seasonal operation.

.2 Prepare reports as indicated below.

.1 Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on AABC or NEBB forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in same manner specified for final reports and submit for review.

.2 Upon verification and approval of draft reports, prepare final reports organized and formatted as specified below. Use units of measurement (SI or Imperial) as used on Project Documents.

.3 Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Report forms complete with schematic systems diagrams and other data are to be consolidated in electronic format as a PDF. PDF file to be indexed and organized into sections, as it applies to the project, as follows:

.1 General Information and Summary;

.2 Air Systems;

.3 Hydronic Systems;

.4 Temperature Control Systems;

.5 Special Systems.

.4 Agency is to provide following minimum information, forms and data in report:

.1 inside cover sheet to identify Agency, Contractor, and Project, including addresses, and contact names and telephone numbers and a listing of instrumentation used for procedures along with proof of calibration;

.2 remainder of report is to contain appropriate forms containing as a minimum, information indicated on standard AABC or NEBB report forms prepared for each respective item and system;

.3 Agency is to include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying equipment, terminals, and accessories;

.4 Agency is to include report sheets indicating building comfort test readings for all rooms.

.3 After final testing and balancing report has been submitted, Agency is to visit site with Contractor and Consultant to spot check results indicated on balancing report. Agency is to supply labour, ladders, and instruments to complete spot checks. If results of spot checks do not, on a consistent basis, agree with final report, spot check procedures will stop and Agency is to then rebalance systems involved, resubmit final report, and again perform spot checks with Contractor and Consultant.

.4 When final report has been accepted, Contractor is to submit to Owner, in name of Owner, a certificate equal to AABC National Guaranty Certification or a NEBB Quality Assurance Program Bond, and in addition, Contractor is to submit a written extended warranty from Agency covering one full heating season and one full cooling season, during which time any balancing problems which occur, with exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by

Agency and reported on to Owner, and if it is determined that problems are a result of improper testing, adjusting and balancing, they are to be immediately corrected without additional cost to Owner.

End of Section

1 General

1.01 SECTION INCLUDES

.1 This Section specifies insulation requirements common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly.

1.02 DEFINITIONS

.1 "concealed" – means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces.

.2 "exposed" – means exposed to normal view during normal conditions and operations.

.3 "mineral fibre" – includes glass fibre, rock wool, and slag wool.

.4 "domestic water" or "potable water" – means piping extended from building Municipal supply main.

1.03 SUBMITTALS

.1 At least 4 weeks prior to insulation work commencing, submit a sample of each type of insulation (and insulation accessories and finish), in applied form, for review. Mount samples on a plywood board. Identify each product with manufacturer's name and insulation type, and proposed use of insulation. When sample board has been approved, mechanical insulation work is to conform to approved sample board.

.2 Submit a product data sheet for each insulation system product.

.3 Submit a fabrication drawing for each custom made cover to indicate material and fabrication details, and a 300 mm (12") square sample of proposed cover material.

.4 Submit a colour chart for coloured lagging adhesive for canvas jacketed insulation.

1.04 CLOSEOUT SUBMITTALS

.1 In accordance with Part 3 of this Section, submit a letter from fire rated duct wrap supplier to certifying duct wrap has been properly installed.

1.05 QUALITY ASSURANCE

.1 Mechanical insulation is to be applied by a licensed journeyman insulation mechanic, or by an apprentice under direct, daily, on-site supervision of a journeyman mechanic.

.2 Do not apply insulation unless leakage tests have been satisfactorily completed.

.3 Ensure surfaces to be insulated are clean and dry.

.4 Ensure ambient temperature is minimum 13°C (55°F) for at least 1 day prior to application of insulation, and for duration of insulation work, and relative humidity is and will be at a level such that mildew will not form on insulation materials.

.5 Company with sub-contract for mechanical insulation work is to be a member in good standing of Thermal Insulation Association of Canada.

.6 Insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from site.

2 Products

2.01 FIRE HAZARD RATINGS

.1 Unless otherwise specified, insulation system materials inside building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with ULC S102, Surface Burning Characteristics of Building Materials and Assemblies.

2.02 THERMAL PERFORMANCE

.1 Unless otherwise specified, thermal performance of insulation is to meet or exceed values given in Tables entitled Minimum Piping Insulation Thickness Heating and Hot Water Systems and Minimum Piping Insulation Thickness Cooling Systems, as stated in ANSI/ASHRAE/IES Standard 90.1 version referenced in Ontario Building Code.

2.03 PIPE INSULATION MATERIALS

.1 Horizontal pipe insulation at hangers and supports are to be equal to Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, pre-moulded, rigid, sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a captive galvanized steel saddle.

.2 Flexible foam elastomeric is to be closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation with a water vapour transmission rating of 0.10 in accordance with ASTM E96, Procedure B, and required installation accessories.

.1 Manufacturers:

.1 Armacell AP/Armaflex SS;

.2 IK Insulation Group K-Flex "LS" Self-Seal Pipe Insulation.

.3 Closed cell foamed glass is to be Owens Corning "FOAMGLASS", expanded, sectional, rigid sleeve type insulation with a liquid or vapour permeability rating (as per ASTM C240) of 0.00, and a factory applied "PITTWRAP SSII" self-sealing jacket and protective metal cladding.

.4 Premoulded mineral wool is to be rigid, sectional, sleeve type, non-combustible, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket.

.1 Manufacturers:

.1 Roxul "Techton 1200";

.2 IIG (Johns Manville Inc.) MinWool-1200;

.3 Paroc 1200.

.5 Fire rated pre-moulded mineral wool is to be non-combustible, fire-rated, rigid, sectional, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket and compatible with ULC-S115 and ULC-S101 firestopping.

.1 Manufacturers:

.1 Roxul "Techton 1200";

.2 IIG (Johns Manville Inc.) MinWool-1200;

.3 Paroc 1200.

.6 Pre-moulded mineral fibre is to be rigid, sectional, sleeve type insulation to ASTM C547, with a factory applied vapour barrier jacket.

.1 Manufacturers:

.1 Johns Manville Inc. "Micro-Lok AP-T Plus";

.2 Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket;

.3 Manson Insulation Inc. "ALLEY K APT";

.4 Owens Corning “Fiberglas” Pipe Insulation.

.7 Blanket mineral fibre is to be blanket type roll insulation to CGSB 51-GP-11M, 24 kg/m3 (1-½ lb/ft³) density, with a factory applied vapour barrier facing.

.1 Manufacturers:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

.8 Pre-moulded weatherproof jacketed mineral fibre is to be Knauf Insulation "Redi-Klad 1000" sectional, sleeve type pipe insulation with a self-sealing weather-proof jacket and a 100 mm (4") butt joint sealing strip with each section.

2.04 BARRIER-FREE LAVATORY PIPING INSULATION KITS

.1 Removable, flexible, reusable, white moulded plastic insulation kits for barrier-free lavatory drain piping and potable water supplies exposed under lavatory.

.2 Manufacturers:

.1 Truebo "Lav-Guard 2" E-Z Series;

.2 Zeston "SNAP-TRAP";

.3 McGuire Manufacturing Co. Inc. "ProWrap".

2.05 EQUIPMENT INSULATION MATERIALS

.1 Blanket mineral fibre is to be blanket type roll form insulation to ASTM C553, 24 kg/m3 (1-½ lb/ft³) density, with a factory applied vapour barrier facing.

.1 Manufacturers:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

.2 Semi-rigid mineral fibre board is to be roll form, moulded insulation to ASTM C1393, with a factory applied vapour barrier facing consisting of laminated aluminum foil and kraft paper.

.1 Manufacturers:

.1 Knauf Fiber Glass Pipe and Tank Insulation;

.2 Manson Insulation Inc. "AK FLEX";

.3 Johns Manville Inc. Pipe and Tank Insulation “Micro-Flex”;

.4 Multi-Glass Insulation Ltd. "MULTI-FLEX MF";

.5 Owens Corning Pipe and Tank Insulation;

.6 Glass-Cell Fabricators Ltd. "R-Flex".

.3 Semi-rigid mineral wool blanket is to be equal to Roxul "Enerwrap MA 960" flexible, black fibrous scrim faced mineral wool blanket insulation to ASTM C553.

.4 Closed cell foamed glass is to be Owens Corning "FOAMGLAS" expanded, rigid board and block type insulation with a liquid or vapour permeability rating (as per ASTM C240) of 0.00.

2.06 DUCTWORK SYSTEM INSULATION MATERIALS

.1 Rigid mineral fibre board is to be pre-formed board type insulation to ASTM C612, 48 kg/m3 (3 lb/ft^3) density, with a factory applied reinforced aluminum foil and kraft paper facing.

.1 Manufacturers:

.1 Knauf Fiber Glass Insulation Board with FSK facing;

.2 Manson Insulation Inc. "AK BOARD FSK";

.3 Johns Manville Inc. Type 814 "Spin-Glas";

.4 Owens Corning 703.

.2 Semi-rigid mineral fibre board is to be roll form insulation to ASTM C1393, consisting of cut strips of rigid mineral board insulation glued to an aluminium foil and kraft paper facing.

.1 Manufacturers:

.1 Multi-Glass Insulation Ltd. "Multi-Flex MKF";

.2 Glass-Cell Fabricators Ltd. "R-FLEX";

.3 Owens Corning Pipe and Tank Insulation;

.4 Johns Manville Inc. Pipe and Tank Insulation.

.3 Blanket mineral fibre is to be blanket type roll form insulation to ASTM C553, 24 kg/m3 (1-½ lb/ft3) density, 40 mm (1-½") thick, with a factory applied vapour barrier facing.

.1 Manufacturers:

.1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;

.2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;

.3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;

.4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

.4 Pre-moulded calcium silicate is to be rigid block and sheet insulation.

.1 Manufacturers:

.1 Johns Manville Inc. "Thermo-12 Gold";

.2 Industrial Insulation Group "Thermo-12 Gold".

.5 Flexible foam elastomeric sheet is to be sheet form, CFC free, closed cell, self-adhering elastomeric nitrile rubber insulation with a water vapour permeability rating of 0.08 in accordance with ASTM E96 Procedure A.

.1 Manufacturers:

.1 Armacell "AP/Armaflex SA";

.2 IK Insulation Group "K-Flex Duct Wrap", S2S.

.6 Extruded polystyrene tapered insulation – equal to Soprema Sopra-ISO Tapered, closed cell polyisocyanurate foam core with organic facers reinforced with glass fibres, 172 kPa compressive strength as per ASTM D1621, 32 kg/m3 density, 50 mm minimum thickness, 2% slope. Thickness shall increase if width of duct work is larger than 1200 mm to maintain 2% slope.

2.07 INSULATING COATINGS

.1 Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:

.1 anti-condensation coating, "No Sweat-FX";

.2 thermal insulating coating, "ThermaLite".

2.08 INSULATION FASTENINGS

.1 Wire – minimum #15 gauge galvanized annealed wire.

.2 Wire with Mesh – minimum #15 gauge galvanized annealed wire factory woven into 25 mm (1") hexagonal mesh.

.3 Aluminium Banding – equal to ITW Insulation Systems Canada "FABSTRAPS" minimum 12 mm (½") wide, 0.6 mm (1/16") thick aluminium strapping.

.4 Stainless Steel Banding – equal to ITW Insulation Systems Canada "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.

.5 Duct Insulation Fasteners – weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1-½") square plastic or zinc plated steel self-locking washers.

.6 Tape Sealant – equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match surface being sealed.

.7 Mineral Fibre Insulation Adhesive – clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with type of material to be secured, and WHMIS classified as non-hazardous.

.8 Flexible Elastomeric Insulation Adhesive – Armacell "Armaflex" #520 air-drying contact adhesive.

.9 Closed Cell Foamed Glass Insulation Adhesive – Pittsburgh Corning PC88 multi-purpose 2-component adhesive.

.10 Lagging Adhesive – white, brush consistency, ULC listed and labelled, 25/50 fire/smoke rated lagging adhesive for canvas jacket fabric, suitable for colour tinting, complete with fungicide and washable when dry.

.11 Screws – No. 10 stainless steel sheet metal screws.

2.09 INSULATION JACKETS AND FINISHES

.1 Canvas Jacket Material – ULC listed and labelled, 25/50 fire/smoke rated, roll form, minimum 170 g (6 oz.).

.2 Roll Form Sheet and Fitting Covers – minimum 15 mm (1/2") thick white PVC, 25/50 fire/smoke rated tested in accordance with ULC S102, complete with installation and sealing accessories.

.1 Manufacturers:

.1 Proto Corp. "LoSMOKE";

.2 The Sure-Fit System "SMOKE-LESS 25/50";

.3 Johns Manville Inc. "Zeston" 300.

.3 Rigid Aluminium Jacket – equal to ITW Insulation Systems Canada "Lock-on" 0.406 mm (0.016") thick embossed aluminum jacket material to ASTM B209, factory cut to size and complete with polysurlyn moisture barrier and continuous modified Pittsburgh Z-Lock, butt straps with "Fabstraps" to weatherproof the end to end joints, and 2-piece epoxy coated pressed aluminum fittings with weather locking edges.

.4 Stainless Steel Jacket – equal to ITW Insulation Systems Canada "Lock-on" 0.254 mm (0.010") thick type 304 embossed stainless steel jacket material to ASTM A240, factory cut to size and complete with moisture barrier and continuous modified Pittsburgh Z-Lock, butt straps with "Fabstraps" to cover end to end joints, and 2-piece pressed stainless steel fittings with weather locking edges.

.5 Adhesive backed flexible aluminium is to be MFM Building Products Corp. "Flex-Clad 400" roll form sheet material with an aggressive rubberized asphalt adhesive backing, high density polyethylene reinforcement, and an embossed aluminum facing.

.6 Heat resistant, trowel consistency thermal insulating and finishing cement to CAN/CGSB 51.12, and suitable for the application.

.7 Foamed glass insulation protective coating is to be Pittsburgh Corning "PITTCOTE 300e" flexible acrylic latex weather barrier coating, white unless otherwise specified.

.8 UV and moisture resistant flexible foam insulation with protective jacket equal to Armacell “ArmaFlex Shield".

.9 Self adhesive multilayer jacketing - equal to 3M Venturecclad 1577CW or 1579GCW series. Multi-ply laminate flexible jacketing, acrylic adhesive, zero permeability vapor barrier. Properties for 1577CW Flat White – 480 N/mm tensile strength, 22N/25 mm peel adhesion strength, 15.2 kPa shear adhesion after 72 hours, 147 N puncture resistance, 0.2 mm thickness. Properties for other colours or 1579GCW series shall match current technical data sheets from 3M.

3 Execution

3.01 GENERAL INSULATION APPLICATION REQUIREMENTS

.1 Unless otherwise specified, do not insulate following:

.1 factory insulated equipment and piping;

.2 acoustically lined ductwork and/or equipment;

.3 factory insulated flexible branch ductwork;

.2 Install insulation directly over pipes and ducts, not over hangers and supports.

.3 Install piping insulation and jacket continuous through pipe openings and sleeves.

.4 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.

.5 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect insulation jacketing from the action of condensation at its junction with metal.

.6 When insulating vertical piping risers 75 mm (3") diameter and larger, use insulation support rings welded directly above lowest pipe fitting, and thereafter at 4.5 m (14.7') centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.

.7 Where existing insulation work is damaged as a result of mechanical work, repair damaged insulation work to Project work standards.

.8 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover exposed end of insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.

.9 Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.

.10 Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in insulation and provide a suitable grommet in the opening.

3.02 INSULATION FOR HORIZONTAL PIPE AT HANGERS AND SUPPORTS

.1 At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply insulation sections to piping installers for installation as pipe is erected.

.2 For 100 mm (4") diameter and larger heating system piping where roller type hangers and supports are provided, a steel saddle will be tack welded to pipe at each roller hanger or support location. Pack saddle voids with loose mineral wool insulation.

3.03 DUCTWORK INSULATION REQUIREMENTS – MINERAL FIBRE

.1 Insulate following ductwork systems inside building and above ground with mineral fibre insulation of thickness indicated:

.1 Outdoor air and combustion air intake ductwork, casings and plenums from fresh air intakes to and including mixing plenums or sections, or, if mixing plenums or sections are not provided, to first heating coil, or if both mixing plenums or sections and heating coil sections are not provided, and fresh air is not tempered, then the fresh air ductwork system complete – minimum 40 mm (1-½") thick as required;

.2 mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

.3 supply air ductwork outward from fans, except for supply ductwork exposed in area it serves – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

.4 exhaust discharge ductwork for a distance of 3 m (10') downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10') distance – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;

.5 any other ductwork, casings, plenums or sections specified or detailed on drawings to be insulated – thickness as specified.

.2 Provide rigid board type insulation for casings, plenums, and exposed rectangular ductwork. Provide blanket type insulation for round ductwork and concealed rectangular ductwork.

.3 Liberally apply adhesive to surfaces of exposed rectangular ducts and/or casings. Accurately and neatly press insulation into adhesive with tightly fitted butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom and side surfaces. Secure and seal joints with 75 mm (3") wide tape sealant. Additional installation requirements as follows:

.1 at trapeze hanger locations, install insulation between duct and hanger;

.2 provide drywall type metal corner beads on edges of ductwork, casings and plenums in equipment rooms, service corridors, and any other area where insulation is subject to accidental damage, and secure in place with tape sealant.

.4 Liberally apply adhesive to surfaces of concealed rectangular or oval ductwork, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom surfaces. Secure and seal joints with 75 mm (3") tape sealant. At each trapeze type duct hanger, provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between duct and hanger.

.5 Accurately cut sections of insulation to fit tightly and completely around exposed and concealed round or oval ductwork. Liberally apply adhesive to surfaces of duct, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Seal joints with tape sealant. At duct hanger locations install insulation between duct and hanger. At each hanger location for concealed ductwork where flexible blanket insulation is used, provide a 100 mm (4") wide full circumference strip of semi-rigid board type duct insulation between duct and hanger.

.6 Insulation application requirements common to all types of rigid ductwork are as follows:

.1 at duct connection flanges, insulate flanges with neatly cut strips of rigid insulation material secured with adhesive to side surfaces of flange with a top strip to cover exposed edges of the side strips, then butt the flat surface duct insulation up tight to flange insulation, or, alternatively, increase insulation thickness to depth of flange and cover top of flanges with tape sealant;

.2 installation of fastener pins and washers is to be concurrent with duct insulation application;

.3 cut insulation fastener pins almost flush to washer and cover with neatly cut pieces of tape sealant;

.4 accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers;

.5 prior to concealment of insulation by either construction finishes or canvas jacket material, patch vapour barrier damage by means of tape sealant.

3.04 DUCTWORK INSULATION REQUIREMENTS – FLEXIBLE ELASTOMERIC

.1 Insulate exposed exterior ductwork (except outdoor air intake ductwork) and associated plenums and/or casings outside building with minimum 75 mm (3") thick flexible elastomeric sheet insulation as required, applied in 2 minimum 40 mm (1 ½") thick layers with staggered tightly butted joints.

.2 Install with adhesive in strict accordance with manufacturer's instructions to produce a weather-proof installation. Ensure sheet metal work joints are sealed watertight prior to applying insulation.

.3 Provide Calcium Silicate insulation between ductwork and duct supports. Tightly butt flexible elastomeric insulation to Calcium Silicate insulation. Cover Calcium Silicate insulation with a continuous sheet of self-adhesive multilayer jacketing which overlaps 75 mm past the Calcium Silicate insulation to the adjacent flexible elastomeric insulation.

.4 Provide extruded polystyrene tapered insulation between flexible elastomeric insulation and jacketing to allow for water runoff on all exterior duct work.

3.05 APPLICATION OF INSULATING COATINGS

.1 Apply, in accordance with manufacturer's instruction, insulating coatings to following bare metal surfaces:

.1 paint bare metal surfaces clear of "cold" piping and/or equipment insulation for a distance of from 300 mm (12") to 600 mm (24") clear of pipe or equipment insulation, with "No Sweat-FX" anti-condensation coating;

.2 paint bare metal surfaces associated with mechanical systems with an operating temperature 60°C (140°F) with "ThermaLite" insulating coating.

.2 Apply coatings with a brush. Remove any splatter or excess coating from adjacent surfaces.

3.06 INSULATION FINISH REQUIREMENTS

.1 Unless otherwise shown and/or specified, jacket exposed mineral fibre insulation, and calcium silicate duct insulation work inside building with canvas secured in place with a full covering coat of lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent uninsulated surfaces.

.2 Unless otherwise shown or specified, jacket exposed mineral fibre insulation listed below with canvas jacket secured in place with a full covering coat of coloured lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent surfaces. Insulated services to receive coloured lagging adhesive are as follows:

.1 Indoor Ductwork.

.3 Jacket exposed pipe insulation work inside building with white sheet PVC and fitting covers. Install sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal joints to produce a neat water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions.

.4 Apply 2 heavy coats of "PITTCOTE 300e" coating with 24 hr. between coats to foamed glass insulation exposed above grade.

.5 Apply 2 coats (with 24 hr. between coats) of specified coating to flexible elastomeric insulation outside building.

.6 Install 3M Ventureclad jacketing on ductwork and ensure ductwork supports are installed on the outside of the jacketing. Jacketing shall be [1577CW] [1579GCW] [Flat White] [Aluminum] [Aluminum Embossed]. Provide necessary insulation and jacketing materials at the time of duct work installation. Do not penetrate jacketing or install jacketing around duct supports. Provide 24GA G90 38 mm x 38 mm steel

angle to protect all corners of rectangular ductwork and install between insulation and jacketing. Steel angle shall be continuous on entire duct work run. Provide additional steel angle between jacketing and duct support. Ensure jacketing is continuous with minimum 75 mm (or as required by manufacturer) overlapping on all joints. Provide jacketing on the following duct work:

.1 Exposed exterior duct work including outdoor air intake duct work, plenums and casings installed outside;

.2 Exposed interior insulated duct work;

.3 Interior outdoor air intake duct work, plenums, and casings;

.4 Single wall plenum casings (intake or exhaust) field insulated;

.5 Wherever indicated on drawings;

End of Section

1 General

1.01 SECTION INCLUDES

.1 This Section specifies commissioning requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. When requirements of this Section contradict requirements of Division 00 or Division 01, conditions of Division 00 or Division 01 to take precedence.

1.02 REFERENCES

.1 Refer to commissioning requirements specified in Division 01.

1.03 COMMISSIONING AGENT INVOLVEMENT VERSUS WARRANTY OBLIGATIONS

.1 Involvement of Commissioning Agent performing duties as described in this Section is not in any way to void or alter any Contractual warranty obligations.

1.04 SUBMITTALS

.1 Submit to Commissioning Agent, at same time as submittal to the Consultant, one copy of each shop drawing or product data sheet associated with equipment or systems to be commissioned.

.2 Submit for review, a Commissioning Plan with schedule, commissioning procedures for commissioning events, and a copy of Commissioning Agent's commissioning data sheets for equipment/systems to be commissioned.

.3 Submit a list of commissioning instruments and for each instrument, indicate purpose of instrument and include a recent calibration certificate.

.4 Submit equipment and system manufacturer's start-up and test report sheets for review a minimum of 1 month prior to equipment and system start-up procedures.

1.05 CLOSEOUT SUBMITTALS

.1 After start-up and successful pre-functional performance testing and submittal of completed forms, submit, for each system or subsystem, a letter confirming pre-functional performance testing has been successfully completed and system or subsystem is ready for functional performance testing and commissioning process to commence.

1.06 DEFINITIONS

.1 Commissioning: process of demonstrating to Owner and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents, all as further described below.

.2 Commissioning Agent: commissioning authority who will supervise commissioning process, and who will recommend final acceptance of commissioned mechanical work.

.3 Start-Up and Adjusting: process of equipment manufacturer's/supplier's technical personnel, with Contractor, starting and operating equipment and systems, making any required adjustments, documenting process, and submitting manufacturer's/supplier's start-up reports to confirm equipment has been properly installed and is operational as intended.

.4 Pre-Functional Performance Testing: testing, adjusting and operating of components, equipment, systems and/or subsystems, by Contractor, after start-up but before functional performance testing, to confirm components, equipment, systems and/or subsystems operate in accordance with requirements of Contract Documents, including modes and sequences of control and monitoring, interlocks, and

responses to emergency conditions, and including submittal of pre-functional performance testing documentation sheets.

.5 Functional Performance Testing: a repeat of successful pre-functional performance testing by Contractor, in presence of Commissioning Agent and the Consultant with completed Commissioning Agent's commissioning documentation sheets to document, validate and verify equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.

.6 Commissioning Documentation Sheets: prepared sheets for pre-functional performance testing and for functional performance testing supplied by Commissioning Agent for each piece of equipment/system to be commissioned, each sheet or set of sheets complete with Project name and number, date of commissioning, equipment/system involved, equipment/system name and model number, equipment tag in accordance with drawings, and, for each commissioning procedure listed, a column giving expected data in accordance with Contract Documents, a column to fill in observed data during commissioning, and space for signatures of Contractor and Commissioning Agent.

.7 Systems Operating Manual: a manual prepared by Commissioning Agent to present an overview of building mechanical systems and equipment to be used by building maintenance personnel to assist them in daily operation of systems.

.8 Validate: to confirm by examination and witnessing tests correctness of equipment and system operation.

1.07 QUALITY ASSURANCE

.1 Commissioning work is to be in accordance with requirements of following:

.1 CSA Z320, Building Commissioning Standard and Check Sheets;

.2 CSA Z8001, Commissioning of Health Care Facilities;

.3 ASHRAE Guideline 0, The Commissioning Process;

.4 ASHRAE Guideline 1.1, The HVAC Commissioning Process;

.5 ASHRAE Guideline 1.2, The Commissioning Process for Existing HVAC&R Systems;

.6 ASHRAE Guideline 1.5, Commissioning Smoke Control Systems;

.7 Owner designated Commissioning Agent.

1.08 COMMISSIONING OBJECTIVES

.1 Objectives of commissioning process:

.1 to support quality management by means of monitoring and checking installation;

.2 to verify equipment/system performance by means of commissioning of completed installation;

.3 to move completed equipment/systems from "static completion" state to "dynamic" operating state so as to transfer a complete and properly operating installation from Contractor to Owner.

1.09 TESTING EQUIPMENT

.1 Supply instruments and test equipment required to conduct start-up, testing and commissioning procedures.

2 Products – Not Used

3 Execution

3.01 COMMISSIONING

.1 Commission work in accordance with requirements of this Section and as required by Commissioning Agent.

.2 Prerequisites to successful completion of commissioning:

.1 submittal of signed start-up and test reports;

.2 completion of system testing, adjusting and balancing (TAB), and acceptance of TAB reports;

.3 permanent electrical and control connections of equipment;

.4 successful completion and documentation of pre-functional performance testing;

.5 submittal of letters to the Consultant certifying systems and subsystems have been started, tested, adjusted, successfully pre-functional performance tested, are ready for functional performance testing, and are in accordance with requirements of Contract Documents.

3.02 PHASING OF COMMISSIONING

.1 If Project will be constructed in phases, phase commissioning accordingly to suit progress and phases of Work.

3.03 DEFICIENCIES LISTED DURING COMMISSIONING

.1 Correct deficiencies listed by the Consultant and Commissioning Agent during commissioning process within 15 calendar days of notification unless agreed otherwise with the Consultant, and when deficiencies have been corrected, notify the Consultant and Commissioning Agent immediately.

3.04 SYSTEMS TO BE COMMISSIONED

.1 Mechanical systems to be commissioned include, but are not to be limited to, systems described below. Specific commissioning procedures are to be as directed by Commissioning Agent.

.2 Commissioning of air handling systems includes equipment, ductwork, ductwork specialties, controls, interlocks, and checking and validating air capacities and flows in accordance with TAB reports.

.3 Control work commissioning includes confirmation of proper operation of individual control components, and overall operation of controls in conjunction with operation of connected building systems, including heating season/cooling season testing requirements specified above.

.4 Commissioning of BAS includes confirmation of proper operation of components, input/output points, hardware and software, and demonstration of system performing required procedures.

.5 Commissioning of noise and vibration control equipment includes noise and vibration measurements to confirm proper operation of equipment.

3.05 COMMISSIONING PROCESS

.1 Perform commissioning process in stages and include, but not be limited to, following:

.1 Stage 1: Commissioning of equipment/systems as listed in this Section, which is a prerequisite to an application for Substantial Performance of the Work and includes supervising and validating results of functional performance testing, and submittal of reviewed Systems Operating Manual.

.2 Stage 2: Commissioning work performed 12 months after issue of a Certificate of Substantial Performance and which includes supervision of Contractor's "fine tuning" of equipment/systems through seasonal occupancy, and any other such work to achieve optimal comfort and performance conditions.

.3 Stage 3: Successful completion of satisfactory equipment/system operation during 1st month after issue of a Certificate of Total Performance of the Work.

.4 Stage 4: Successful completion of satisfactory equipment/system operation during 3rd month after issue of a Certificate of Total Performance of the Work.

.5 Stage 5: Successful seasonal commissioning of building.

3.06 RESPONSIBILITIES OF CONTRACTOR

.1 During construction phase, Contractor is to:

.1 prepare and submit an installation schedule which includes a time schedule for each activity with lead and lag time allowed and indicated, shop drawing and working detail drawing submissions, and major equipment factory testing and delivery dates;

.2 prepare and submit a commissioning schedule which is to include a time schedule coordinated with installation schedule referred to above and Commissioning Agent, and allowances for additional time for re-tests as may be required, and update schedule on a monthly basis as required;

.3 when requested by Commissioning Agent, arrange site commissioning meetings with Owner, the Consultant, and applicable subcontractors present, to be chaired by Commissioning Agent who will also prepare and distribute meeting minutes;

.4 promptly correct reported deficient work, and report when corrective work is complete;

.5 where required by Codes and/or Specification, retain equipment manufacturers/suppliers or independent 3rd parties to certify correct installation of equipment/systems;

.6 under supervision of equipment manufacturers/suppliers, start-up and adjust equipment to design requirements, and submit start-up sheets which include equipment data such as manufacturer and model number, serial number where applicable, and performance parameters, all signed by equipment manufacturer/supplier and Contractor;

.7 complete Commissioning Agent's commissioning data sheets for multiple items of smaller equipment such as air terminal boxes, fan coil units, backflow preventers, etc., submit sheets to Commissioning Agent, accompany Commissioning Agent for an on-site check of 30% of data sheet information for each type of equipment, and perform any corrective action required as a result of site checks;

.8 perform system testing, adjusting and balancing and, when complete, issue a copy of final report to Commissioning Agent for review and a site check of results, and perform any corrective work required as a result of site checks by Commissioning Agent;

.9 in accordance with updated commissioning schedule and actual progress at site, certify in writing to the Consultant and Commissioning Agent that equipment and/or systems are complete, have been checked, started and adjusted, successfully pre-functional performance tested and documented, and are ready for functional performance testing and commissioning procedures, giving the Consultant and Commissioning Agent a minimum of 5 working days' notice;

.10 perform system and subsystem functional performance testing under supervision of Commissioning Agent, and submit to the Consultant and Commissioning Agent, completed and

signed functional performance testing and commissioning data sheets (issued by Commissioning Agent) and also signed by Commissioning Agent.

.2 During post construction phase, Contractor is to:

.1 optimize system operation in accordance with building occupant's needs and comments using System Operation Manual prepared by Commissioning Agent as reference;

.2 complete commissioning procedures, activities, and performance verification procedures that were delayed or not concluded during construction phase;

.3 accompanied by Commissioning Agent, complete system checks and "fine tuning" with signed documentation as follows:

.1 once during 1st month of building operation;

.2 once during 3rd month of building operation;

.3 once between 4th and 10th months in a season opposite to 1st and 3rd month visits.

.4 correct deficiencies revealed by system checks described above, and, where required, involve equipment manufacturers/suppliers during corrective actions, and report completion of corrective work;

.5 3 months after Substantial Completion conduct a question and answer session(s) at building with Owner's operating and maintenance personnel, with duration of session(s) dictated by number of questions and concerns that have to be addressed.

End of Section

1 General

1.01 REFERENCES

.1 Domestic water piping and valves are to comply with following codes, regulations and standards (as applicable):

.1 applicable local codes and regulations;

.2 CAN/CSA B125.1, Plumbing Supply Fittings;

.3 CAN/CSA B125.3, Plumbing Fittings;

.4 CAN/CSA B137 Series, Thermoplastic Pressure Piping Compendium;

.5 NSF/ANSI 14, Plastics Piping System Components and Related Materials;

.6 NSF/ANSI 61, Drinking Water System Components – Health Effects;

.7 NSF/ANSI 372, Drinking Water System Components – Lead Content.

1.02 SUBMITTALS

.1 Submit shop drawings/product data sheets for all products specified in Part 2 of this Section except for pipe, fittings, and chlorine solution.

1.03 CLOSEOUT SUBMITTALS

.1 Submit laboratory water purity test results indicating chlorine residual prior to application for Substantial Performance of the Work.

.2 Prior Substantial Performance of the Work, submit a minimum of 3 identified keys for key operated hydrants.

.3 Submit signed test results and inspection and test log cards for each backflow preventer as specified in Part 3 of this Section.

.4 Submit anchor drawing(s) to detail fabrication and installation of water piping anchors. Drawing(s) are to be prepared and stamped by a professional structural engineer registered and licensed in jurisdiction of the work.

.5 As specified in Part 3 of this Section, submit a letter from anchor design engineer stating anchor installation has been examined at site and anchors are properly fabricated and installed.

2 Products

2.01 PIPE, FITTINGS, AND JOINTS

.1 PVC

.1 ULC listed, rigid, Class 150, DR18, 1035 kPa (150 psi) pressure rated bell and spigot pattern PVC pipe to CAN/CSA B137.3, and CSA certified fittings to CAN/CSA B137.2, and AWWA C900, complete with gasket joints, and Ford "Uni-Flange" or equal restraint collars as per Part 3 of this Section.

.2 Soft Copper

.1 Type "K" soft copper to ASTM B88, supplied in a continuous coil with no joints if possible, and complete with, if joints are required, compression type flared joint couplings.

.3 Stainless Steel

.1 Schedule 10S type 304 stainless steel, ASTM A312, factory or site roll grooved, complete with Victaulic or equal type 304 stainless steel roll grooved end fittings and, unless otherwise specified, Victaulic Style 807, 877 or 889 couplings color coland coupling gaskets equal to Victaulic Grade P fluoroelastomer.

.4 Copper - Solder Joint

.1 Type "L" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints using The Canada Metal Co. Ltd. "SILVABRITE 100" or equal lead-free solder for cold water pipe, and 95% tin / 5% Antimony or "SILVABRITE 100" solder for other services.

.5 Copper - Pressure Coupled Joint

.1 Type "L" hard drawn seamless copper to ASTM B88 with Viega "ProPress with Smart Connect feature" copper fittings with EDPM seals, and pressure type crimped joints made by use of manufacturer recommended tool.

.6 Copper - Grooved

.1 Type "L" hard drawn seamless copper to ASTM B88 with Victaulic QuickVic Style 607 non-reducing, bolted connection type suitable and approved for application intended, 2” - 8" for copper tubing consisting of ductile iron cast housings, complete with a Grade P fluoroelastomer gasket of a pressure-responsive design, with plated nuts and bolts to secure unit together.

.7 Semi-Rigid Polyethylene Tubing

.1 Versa Fittings and Mfg. Inc. 12 mm (½") dia., high density, semi-rigid polyethylene tubing, 1380 kPa (200 psi) rated.

.8 Flexible Polyethylene

.1 Flexible polyethylene pipe to CAN/CSA B137.1, 690 kPa (100 psi) rated, complete with insertion type fittings secured with Series 300 stainless steel gear type clamps.

.9 Cross-Linked Polyethylene (PEX) Tubing

.1 Non-barrier type PEX piping in accordance with CAN/CSA B137.5, ASTM F876 and tested for compliance by an independent third-party agency, 25/50 flame spread/smoke developed rated when tested to CAN/ULC S102.2 and complete with brass inserts and crimp-ring or cold-expansion joint fittings and couplings.

2.02 SHUT-OFF VALVES

.1 Ball Valves

.1 Class 600, 4140 kPa (600 psi) WOG rated, lead-free, full port ball type valves, each complete with a forged brass body with solder ends, forged brass cap, blowout-proof stem, 304 stainless steel ball, "Teflon" or "PTFE" seat, and a removable lever handle. Valves in insulated piping are to be complete with stem extensions.

.2 Manufacturers:

.1 Toyo Valve Co.

.2 Milwaukee Valve Co.

.3 Kitz Corporation Code

.4 Apollo Valves

.5 Watts Industries (Canada) Inc.

.2 Butterfly Valves - Flanged Joint

.1 Non-corrosive, minimum 1200 kPa (175 psi) cold water pressure rated, resilient seated butterfly valves, each complete with a coated cast ductile iron lug type body, stainless steel shaft, bronze disc, and EPDM seat, and each suitable for domestic water bubble-tight dead end service with valve in position and either side of connecting piping removed. Butterfly valves to and including 100 mm (4") dia. are to be equipped with lever handles. Butterfly valves larger than 100 mm (4") dia. are to be equipped with worm gear operators.

.2 Manufacturers:

.1 DeZurik #632L Series;

.2 Kitz Corporation Code #6122EL/EG;

.3 Toyo Valve Co. #918BESL/EG;

.4 Bray Valve and Controls Canada Series 31;

.5 Apollo Valves #141 Series;

.6 Watts Industries (Canada) Inc. #BF-03.

.3 Butterfly Valves – Grooved End

.1 Equal to Victaulic Series 608N, for copper pipe rated to 300 psi and be both bi-directional and dead-end service capable to full rated pressure. Seat material shall be EPDM UL Classified in accordance with ANSI/NSF 61 for ambient +86°F and hot +180°F potable water service and ANSI/NSF 372.

.2 Victaulic Series 461, for stainless steel pipe rated to 300 psi and be both bi-directional and dead-end service capable to full rated pressure. Seat material shall be EPDM UL Classified in accordance with ANSI/NSF 61 for ambient +86°F and hot +180°F potable water service and ANSI/NSF 372.

2.03 CHECK VALVES

.1 Horizontal

.1 Lead-free, Class 125, bronze, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with solder ends.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 237A-LF;

.2 Milwaukee Valve Co. #UP1509;

.3 Kitz Corporation Code 823;

.4 Apollo Valves #61LF Series.

.2 Vertical

.1 Equal to Kitz Corp. Code 826, lead-free, 1725 kPa (250 psi) WOG rated vertical lift check valve with soldering ends.

2.04 DRAIN VALVES

.1 Minimum 2070 kPa (300 psi) water rated, 20 mm (¾") dia., straight pattern full port bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm (¾") dia. garden hose, and a cap and chain. Ball material to be 304 stainless steel.

.2 Manufacturers:

.1 Toyo Valve Co.

.2 Dahl Brothers Canada Ltd.

.3 Kitz Corporation

.4 Apollo Valves

.5 Watts Industries (Canada) Inc.

2.05 DOMESTIC HOT WATER PIPING BALANCING VALVES

.1 Equal to Victaulic Series 76X Low Lead Balancing Valve, lead-free and compliant with NSF-61 and NSF-372 for use in potable water applications, automatic flow limiting balancing valve (+/-5% over rated operating pressure range), complete with removable flow cartridge.

.2 Equal to Victaulic TA Series 78BL, solder or flange end type as required, ball valve style, lead-free and compliant with NSF-61 and NSF-372 for use in potable water applications, circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.

2.06 PARTITION STOPS

.1 Equal to Dahl Brothers Canada Ltd. Fig. E2300 Series or equal lead-free partition stops with EDPM packing, slotted spindles, extension tubes, stainless steel access plates, and 3 identified keys.

2.07 PRESSURE REDUCING VALVES

.1 For piping less than or equal to 50 mm (2") diameter, lead-free, non-corrosive, non-ferrous direct spring acting pressure reducing valves to CAN/CSA B356, each factory set at 345 kPa (50 psi) unless otherwise specified or required, each field adjustable from 175 kPa (25 psi) to 520 kPa (75 psi) and each complete with an integral inlet strainer.

.1 Manufacturers:

.1 Apollo Valves #36HLF Series;

.2 Zurn/Wilkins #600XL Series;

.3 Watts Industries (Canada) Inc. #LF25AUB-Z3 Series;

.4 Cash-Acme EB-25 Series;

.5 Bermad Series 935-H

.2 For piping greater than or equal to 65 mm (2-½") diameter, lead-free, non-corrosive pilot operated pressure reducing valve to CAN/CSA B356, factory set at required pressure, field adjustable, and complete with a bronze body and trim, screwed or flanged connections, and brass body pilot valve with stainless steel seat.

.1 Manufacturers:

.1 Singer Valve #106 PR;

.2 Zurn/Wilkins #ZW209;

.3 Watts Industries (Canada) Inc. #LFN223 Series;

.4 Bermad Series 972.

2.08 DOMESTIC HOT WATER THERMOSTATIC MIXING VALVES

.1 Lawler Manufacturing Co. Inc. 800 Series "High-Low Thermostatic Mixer" factory assembled rough bronze thermostatic mixing valve assembly complete with rotatable union end inlet piping with check stops and stainless steel strainer screens, union outlet piping with thermometer connection, all sized as shown, and following:

.1 mixing valve with liquid motor, stainless steel piston and liner, tamper-resistant control adjustment, and 3-way protection against runaway temperatures, thermal shock, and scalding;

.2 dial type thermometer conforming to requirement specified in Section 20 05 00 – Common Work Results for Mechanical;

.3 ball type outlet shut-off valve conforming to valve requirements specified in this section;

.4 surface wall mounting enamelled steel cabinet with hinged door, key lock, and permanent identification;

.5 recessed wall mounting type 304 stainless steel cabinet with a #4 finish, hinged door, key lock, and permanent identification.

.2 Manufacturers:

.1 Lawler Manufacturing Co. Inc.;

.2 Leonard Valve Co.;

.3 Symmons Industries Inc.

2.09 CHLORINE

.1 Sodium hypochlorite to AWWA B300.

2.10 PIPE ANCHORS

.1 Welded structural black steel anchors of a design, size, and type to securely anchor pipe at point shown. Each anchor is to withstand 150% axial thrust, and is to be designed and detailed by a professional structural engineer registered and licensed in jurisdiction of the work. Submit anchor design and fabrication shop drawings, stamped by design engineer.

2.11 LAVATORY SUPPLY FITTING TEMPERING VALVES

.1 Equal to Powers "HydroGuard" Series 490, model LM490 12 mm (½") dia. or model LM491 20 mm (¾") dia. as required, each CSA B125 certified, forged brass, tamper-proof thermostatic mixing valves, adjustable for water supply between 29°C and 49°C (85°F and 120°F), sized to suit number of lavatories in grouping, and complete with a stop and check valve and a lockable handle.

.2 Each mixing valve is to be complete with a stainless steel flush wall mounting cabinet with vandal-proof hinged door.

2.12 AIR VENTS

.1 Equal to ITT Hoffman Specialty No. 78 cast brass, 1035 kPa (150 psi) rated, 20 mm (¾") straight water main vent valves, each tapped at the top for a 3.2 mm (1/8") safety drain connection.

3 Execution

3.01 DEMOLITION

.1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 UNDERGROUND MUNICIPAL SERVICE CONNECTION

.1 Make required arrangements with Municipality for installation of domestic water service piping from Municipal main to property line.

.2 Pay charges levied by Municipality for service connection work.

.3 Municipal charges for underground street service connection work will be paid out of a prime cost allowance. Submit original copies of invoices issued by Municipality for street service connection work.

3.03 PIPING INSTALLATION REQUIREMENTS

.1 Provide required domestic water piping.

.2 Piping, unless otherwise specified, is as follows:

.1 for underground piping 100 mm (4") dia. and larger outside and/or inside the building – rigid PVC;

.2 for underground piping less than 100 mm (4") dia. inside building – Type "K" soft copper;

.3 for pipe 75 mm (3") dia. and larger inside building and above ground – Schedule 10 stainless steel;

.4 for 12 mm (½") dia. trap seal primer tubing located underground or in concrete or masonry construction – semi-rigid polyethylene;

.5 for pipe inside building and aboveground in sizes to 100 mm (4") dia., except in vertical shafts and through fire barriers – rigid CPVC;

.6 for branch hot and cold piping aboveground from mains and risers to fixtures, fittings, and equipment where fire rated construction is not penetrated – at your option, PEX tubing installed and joined in strict accordance with manufacturer’s instructions; when installed in unfinished areas, ensure piping is protected from ultra-violet light exposure.

.7 for underground piping outside building to fixtures/outlets at grade level – flexible polyethylene, snaked in the trench and in a continuous length wherever possible;

.8 for pipe inside building and aboveground in sizes to 100 mm (4") dia. – Type "L" hard copper with solder joints.

.1 Option: Type "L" hard copper with pressure coupled mechanical joints.

.2 Option: Type “L” hard copper with grooved end mechanical joints.

.1 Grooved pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. All couplings will meet Victaulic standards for visual inspection sizes 2” to 8”. The

gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Install in accordance with manufacturer's latest recommendations. A Victaulic factory trained representative shall periodically visit the job site and review the installation for best practices. The installing Contractor shall correct any identified deficiencies. Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Victaulic prior to the completion of the project.

.3 Brace and secure underground water service pipe at bends, tees and similar fittings with restraint devices, and provide concrete thrust blocks in accordance with Municipal standards and details. Regardless of what is specified elsewhere in this Specification regarding provisions of concrete, provide thrust block concrete. Paint restraint devices with 2 coats of corrosion resistant black asphalt base coating prior to backfilling.

.4 Lay pipes true to line and grade with bells upgrade. Fit sections together so that, when complete, pipe has a smooth and uniform invert. Keep pipe thoroughly clean so jointed compound will adhere. Inspect pipe for defects before being lowered into trench.

.5 Slope piping so it can be completely drained.

.6 Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe or equipment.

3.04 INSTALLATION OF SHUT-OFF AND CHECK VALVES

.1 Refer to Part 3 of Section 20 05 00 – Common Work Results for Mechanical.

.2 For shut off valves installed on solder joint copper piping up to and including 75 mm (3") diameter, provide ball type valves, and for flanged joints copper or stainless steel piping larger than 75 mm (3") diameter provide butterfly type valves.

3.05 INSTALLATION OF DRAIN VALVES

.1 Provide a drain valve at the bottom of domestic water piping risers, at other piping low points, and wherever else shown.

.2 Locate drain valves so they are easily accessible.

3.06 INSTALLATION OF DOMESTIC HOT WATER PIPING BALANCING VALVES

.1 Provide balancing valves in domestic hot water recirculation piping where shown or required.

.1 for pipe 25 mm (3/4") dia. and less ground – equal to Victaulic Series 76X

.2 for pipe greater than 25 mm (3/4") dia. – equal to Victaulic TA Series 78BL

.2 Locate each valve so it is easily accessible.

3.07 INSTALLATION OF PARTITION STOPS

.1 Provide partition stops in domestic water piping to each group of suite washroom plumbing fixtures. Locate partition stops in piping near floor level in inconspicuous but accessible locations. Confirm exact locations prior to roughing-in.

3.08 INSTALLATION OF LAVATORY SUPPLY FITTING TEMPERING VALVES

.1 Provide thermostatic water tempering valves for hot water supply to public washroom lavatory supply fittings. Conceal valves and piping.

.2 Provide a flush wall mount panel for each valve. Confirm exact location prior to roughing-in.

.3 Install in accordance with manufacturer's instructions and set mixing valves to deliver 32°C (90°F) tempered water.

3.09 INSTALLATION OF AIR VENTS

.1 Provide accessible air vents in domestic water piping to prevent air binding.

.2 Extend copper indirect drain piping from top drain connection of each vent to nearest suitable drain.

.3 Locate exact vent locations on as-built record drawings.

3.10 INSTALLATION OF DOMESTIC WATER THERMAL EXPANSION TANKS

.1 Provide domestic water thermal expansion tanks.

.2 Unless otherwise specified, mount at least 450 mm (18") from cold water inlet to domestic water heater.

.3 Adjust pre-charge to match incoming water pressure after installation.

.4 Install in accordance with manufacturer's instructions and as per local governing Codes and Regulations.

3.11 FLUSHING AND DISINFECTING PIPING

.1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.

.2 Isolate new piping from existing piping prior to flushing and disinfecting procedures.

.3 Flush piping until all foreign materials have been removed and flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.

.4 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with AWWA C601.

.5 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of test results and fill the systems.

End of Section

1 General

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings.

1.02 CLOSEOUT SUBMITTALS

.1 Submit a copy of plumbing inspection certificate prior to application for Substantial Performance of the Work.

.2 Submit letters from product manufacturers/suppliers to certify correct installation of products as specified in Part 3 of this section.

.3 Record Drawings: Indicate inverts of new below grade sanitary and storm piping on as-builts drawings.

2 Products

2.01 PIPE, FITTINGS, AND JOINTS

.1 PVC Sewer

.1 DR35 rigid, green PVC hub and spigot pattern sewer pipe and fittings to CAN/CSA B182.2, with gasket joints assembled with pipe lubricant.

.2 DR35 rigid, PVC sewer pipe and fittings, with solvent weld joints, all certified to CSA B182.1 and colour-coded as per local governing codes, regulations and standards.

.2 PVC - DWV

.1 For Low Buildings: Equal to IPEX System 15 drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating not more than 25 when tested to CAN/ULC S102.2, with solvent weld joints or MJ Grey mechanical joint couplings, and, for fire barrier penetration, approved firestop conforming to CAN/ULC S115.

.2 For High Buildings and Plenums: Equal to IPEX System XFR drain, waste and vent pipe and fittings to CAN/CSA B181.2, complete with a flame spread rating not more than 25 and a smoke developed classification not more than 50 when tested to CAN/ULC S102.2, with solvent weld joints or MJ Grey mechanical joint couplings, and, for fire barrier penetration, approved firestop conforming to CAN/ULC S115.

.3 Copper - Solder Joint

.1 Type DWV hard temper to ASTM B306, with forged copper solder type drainage fittings and 50% lead - 50% tin solder joints.

.4 Cast Iron

.1 Class 4000 cast iron pipe, fittings, and mechanical coupling joints to CAN/CSA B70.

.5 Copper-Victaulic Coupling Joint

.1 Type DWV hard temper to ASTM B306, with factory or site rolled grooved ends (with grooving rolls designed for copper) and Victaulic "Copper Connection" wrought copper or cast bronze fittings and Style 606 gasket type couplings.

.6 Galvanized Steel - Victaulic Coupling Joint

.1 Schedule 40 mild steel, galvanized, ASTM A53, factory or site rolled grooved, complete with Victaulic galvanized ductile iron grooved end fittings and, unless otherwise specified, Victaulic Style 77 hot dip galvanized mechanical joint couplings with Grade M gaskets.

.7 PVC Weeper Piping

.1 150 mm (6") dia. corrugated perforated PVC pipe with an integral geodesic sock, supplied in coils.

2.02 SHUT-OFF AND CHECK VALVES

.1 Shut-off Valves

.1 Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass body, blowout-proof stem, chrome plated solid brass ball, solder or screwed ends as required, and removable lever handle.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 5049A or Fig. 5044A;

.2 Milwaukee Valve Co. #BA-155 or #BA -125;

.3 Kitz Corporation Code 58 or Code 59;

.4 Victaulic Co. of Canada Ltd. Series 722;

.5 Apollo Valves # 77-100 or # 77-200;

.6 Watts Industries (Canada) Inc. #FBVS-3C.

.2 Check Valves

.1 Class 125, bronze, 1725 kPa (250 psi) WOG rated vertical lift check valve with solder or screwed ends as required, and, for horizontal piping, Class 125, bronze 1380 kPa (200 psi) WOG rated swing check valves with solder or screwed ends.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 231 or Fig. 236 or Fig. 237;

.2 Milwaukee Valve Co. #1510 or #510;

.3 Kitz Corporation Code 36 or Code 22 or Code 23.

2.03 VENT STACK COVERS

.1 Equal to Lexcor Model "Flash-Tite" seamless, spun aluminum, insulated vent stack covers with caps and a factory applied asphalt primer coating on top and bottom of flange.

.2 Each vent stack cover is to be complete with a vandal-proof cap.

2.04 CLEANOUTS

.1 Horizontal Piping

.1 TY pipe fitting with an extra heavy brass plug screwed into the fitting.

.2 Vertical Piping

.1 Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.

.3 Urinal(s)

.1 Wall access cleanout assemblies, each complete with a tapered plug, threaded brass insert, urethane rubber seal, and polished stainless steel access cover with vandal-proof stainless steel securing screw.

.2 Manufacturers:

.1 Watts Industries (Canada) Ltd. #CO-590-RD.

.2 Jay R. Smith #SQ4-1819;

.3 Zurn #ZSS-1666-1;

.4 Mifab #C1440-RD;

2.05 FLOOR CLEANOUT TERMINATIONS

.1 Factory finished cast iron terminations, each adjustable and complete with a cast iron body with neoprene sleeve, solid, gasketed, polished nickel-bronze scoriated top access cover to suit floor finish, a seal plug, and captive, vandal-proof, stainless steel securing hardware.

.2 Manufacturers:

.1 Watts Industries (Canada) Ltd. # CO-200-R-1.

.2 Jay R. Smith #4020-F-C Series;

.3 Zurn # ZN-1602-SP Series;

.4 Mifab # C1100-XR-1 or #C1000-R-3;

.3 Cleanout terminations in areas with a tile or sheet vinyl floor finish are to be as above but with a square top in lieu of a round top.

2.06 FLOOR DRAINS, FUNNEL FLOOR DRAINS, AND HUB DRAINS

.1 Unless otherwise specified or indicated, floor drains are to be vandal-proof drains in accordance with drawing symbol list, each complete with a cast iron body **and a trap seal primer connection**. Cast iron components are to be factory finished with latex based paint coating.

.2 Floor drains in areas with a tile or sheet vinyl floor finish are to be as above but with a square grate in lieu of a round grate.

.3 Manufacturers:

.1 Watts Industries (Canada) Ltd.;

.2 Jay R. Smith Manufacturing Co.;

.3 Zurn Industries Ltd.;

.4 Mifab Inc.

3 Execution

3.01 DEMOLITION

.1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 UNDERGROUND MUNICIPAL SERVICE CONNECTION

.1 Make required arrangements with Municipality for installation of drain service piping mains from Municipal main to property line.

.2 Pay charges levied by Municipality for service connection work.

.3 Municipal charges for underground street service connection work will be paid out of a prime cost allowance. Submit original copies of invoices issued by Municipality for street service connection work.

3.03 DRAIN AND VENT PIPING INSTALLATION REQUIREMENTS

.1 Provide required drainage and vent piping. Pipe, unless otherwise specified, as follows:

.1 for underground pipe inside building and to points 1.5 m (5') outside building lines – rigid PVC sewer pipe, minimum 75 mm (3") dia.;

.2 for pipe inside building and aboveground in sizes less than or equal to 65 mm (2-½") dia. – type DWV copper;

.3 for pipe inside building and aboveground in sizes greater than or equal to 75 mm (3") dia. – Class 4000 cast iron;

.4 for pipe inside building and aboveground in lieu of type DWV copper and cast iron, at your option and where permitted by governing Codes and Regulations – rigid PVC DWV;

.5 for drainage pump discharge pipe connections from pump to and including shut-off and check valve connections – Type "DWV" copper with Victaulic "Copper Connection" fittings and couplings, or Schedule 40 galvanized steel with Victaulic fittings and couplings.

.2 Unless otherwise specified, slope horizontal drainage piping aboveground in sizes to and including 75 mm (3") dia. 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") dia. and larger 25 mm (1") in 2.4 m (8').

.3 Install and slope underground drainage piping to inverts or slopes indicated on drawings to facilitate straight and true gradients between points shown. Verify available slopes before installing pipes.

.4 Unless otherwise specified, slope horizontal branches of vent piping down to fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4').

.5 Extend vent stacks up through roof generally where shown but with exact locations to suit site conditions and in any case a minimum of 3 m (10') from fresh air intakes. Terminate vent stacks a minimum of 330 mm (13") above roof (including roof parapets) in vent stack covers. Where not shown on drawings, route vent piping from source to building exterior as required in order to satisfy local governing codes and authority. Coordinate vent routing with other building services and ensure there is no architectural impact.

.6 Provide cast brass dielectric unions at connections between copper pipe and ferrous pipe or equipment.

3.04 INSTALLATION OF SHUT-OFF AND CHECK VALVES

.1 Provide a shut-off valve and a check valve in discharge piping of each drainage pump.

.2 Locate valves so they are easily accessible without the use of ladders or other such devices.

3.05 SUPPLY OF VENT STACK COVERS

.1 Supply a properly sized vent stack cover for each vent stack penetrating roof.

.2 Hand vent stack covers to roofing trade at site for installation and flashing into roof construction as part of roofing work. Coordinate installation to ensure proper locations. Provide waterproofing caps over vent stacks.

3.06 INSTALLATION OF CLEANOUTS

.1 Provide cleanouts in drainage piping in locations as follows:

.1 in building drain or drains as close as possible to inner face of outside wall, and, if a building trap is installed, locate cleanout on downstream side of building trap;

.2 at or as close as practicable to the foot of each drainage stack;

.3 at maximum 15 m (50') intervals in horizontal pipe 100 mm (4") dia. and smaller;

.4 at maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") dia.;

.5 in the wall at each new urinal or bank of urinals in a washroom;

.6 wherever else shown on drawings.

.2 Cleanouts are to be same diameter as pipe in piping to 100 mm (4") dia., and not less than 100 mm (4") dia. in piping larger than 100 mm (4") dia.

.3 Where cleanouts in vertical piping are concealed behind walls or partitions, install cleanouts near floor and so cover is within 25 mm (1") of the finished face of the wall or partition.

3.07 INSTALLATION OF FLOOR CLEANOUT TERMINATIONS

.1 Where cleanouts occur in horizontal inaccessible underground piping, extend cleanout TY fitting up to floor, and provide a cleanout termination set flush with finished floor.

.2 In waterproof floors, ensure each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit floor finish.

.3 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.

.4 Ensure cleanout termination covers in tiled floor are square in lieu of round.

3.08 INSTALLATION OF FLOOR DRAINS, FUNNEL FLOOR DRAINS AND HUB DRAINS

.1 Provide floor drains, funnel floor drains and hub drains.

.2 Coordinate location of floor drains, funnel floor drains and hub drains with equipment provided by Mechanical Division and Owner's supplied equipment. Install in accordance with manufacturer's instructions.

.3 Equip each drain with a trap.

.4 In equipment rooms and similar areas, exactly locate floor drains to suit location of mechanical equipment and equipment indirect drainage piping. In washrooms, exactly locate floor drains to avoid interference with toilet partitions.

.5 Confirm exact location of drains prior to roughing in. Where floor drains occur in washrooms coordinate locations with toilet partition installations.

.6 Temporarily plug and cover floor drains during construction procedures. Remove plugs and covers during final clean-up work and when requested, demonstrate free and clear operation of each drain. Replace any damaged grates, and refinish any areas of the drain where cast iron finish has been damaged or removed, including rusted areas.

3.09 INSTALLATION OF ROOF DRAINS

.1 Supply roof drains and place roof drain bodies in position for flashing into roof construction as part of roofing work. Connect with piping and provide accessories.

.2 Protect roof drains from damage and entrance of debris until roofing work is complete, and refinish any areas where cast iron factory finish has been damaged or removed, including rusted areas.

End of Section

1 General

1.01 SUBMITTALS

.1 Submit product data sheets (fixture cuts) for all plumbing fixtures and fittings.

.2 Submit fixture manufacturer's standard colour charts for all fixtures where colours are available, but a particular colour is not specified.

2 Products

2.01 GENERAL RE: PLUMBING FIXTURES AND FITTINGS

.1 Fixtures and fittings, where applicable, are to be in accordance with requirements of CAN/CSA B45 Series, General Requirements for Plumbing Fixtures, including supplements, ASME A112.1.18.1/CSA B125.1, Plumbing Supply Fittings, and CSA B125.3, Plumbing Fittings.

.2 Barrier-free fixtures and fittings are to be in accordance with governing Code requirements.

.3 Unless otherwise specified, vitreous china, porcelain enamelled, and acrylic finished fixtures are to be white.

.4 Unless otherwise specified, fittings and piping exposed to view are to be chrome plated and polished.

.5 Fittings located in areas other than private washrooms are to be vandal-proof.

.6 Fixture carriers are to be suitable in all respects for the fixture they support and construction in which they are located.

.7 Floor flanges for floor mounted water closets are to be cast iron or brass, secured to floor to prevent movement and complete with a wax seal and brass or stainless steel bolts, nuts, and washers. Plastic floor flanges will not be acceptable.

.8 Proper seal to mate with fixture carrier flange and produce a water-tight installation.

.9 Exposed traps for fixtures not equipped with integral traps, such as lavatories, are to be adjustable chrome plated cast brass "P" traps with cleanouts, minimum #17 gauge chrome plated tubular extensions, and chrome plated escutcheons, all to suit fixture type and drain connection.

.10 Concealed traps for fixtures not equipped with integral traps, such as counter sinks, are to be adjustable cast brass with cleanout plugs, all to suit fixture type and drain connection.

.11 Exposed supplies for fixtures which do not have supply trim/fittings with integral stops, i.e. lavatories, are to be solid chrome plated brass angle vales with screwdriver stops for public areas, wheel handle stops for private areas, flexible stainless steel risers, and stainless steel or chrome plated steel escutcheons, all arranged and sized to suit fixture.

.12 Water piping as specified, complete with ball type shut-off valves as specified with water piping, or Dahl Bros. Canada Ltd. ¼ turn Mini Ball Valves.

2.02 PLUMBING FIXTURES AND FITTINGS

.1 Plumbing fixtures and fittings are to be in accordance with the following:

.1 S-1 Classroom Single Bowl Stainless Steel Sink

.1 Franke Commercial #LBS6808/316P-1-1, Single Bowl Countertop Mount Laboratory Sink, self rimming with faucet ledge, 522 mm (20-9/16") wide x 508 mm (20") long x 178 mm (7") deep overall, Counter mounted, Grade 18 gauge (1.2 mm) type 316 stainless

steel, Satin finish, Mounting kit provided, Fully undercoated to reduce condensation and resonance, factory applied rim seal, 3-1/2" (89 mm) stainless steel crumb cup waste assembly with 1-1/2" (38 mm) type 316stainless steel tailpiece. Certified to ASME A112.19.3-2008 and CSA B45.4-08

.2 Faucet – “DELTA” model# 27C643, Cass Brass single handle kitchen pantry faucet. Polished Chrome plated spout and trim finish. VER-TECK 1/4 turn ceramic structure. Metal hold-down package. 4-1/2" (114 mm) long spout swivel. 1.5 gpm (5.7L/min.) vandal resistant aerator. 3” (76mm) ADA Compliant metal colour index compliant vandal resistant lever handle.

.3 McGuire #LFBV170 or equivalent Faucet Supplies, Chrome plated finish polished brass, commercial duty 1/4 turn ball valve angle stops, 13 mm (1/2") I.D. Inlet x 127 mm (5") horizontal extension tubes, convertible 1/4 turn/loose key handles, Escutcheon and flexible copper risers.

.4 McGuire #8912CB P-Trap, heavy cast brass adjustable body, with slip nut, 38 mm (1-1/2") size, Box flange and Seamless tubular wall bend.

.2 WF-1 –Wash Fountain Lavatory – Floor mounted

.1 Washfountain – “Bradley” WF2703 – 14-gauge stainless steel bowl, #4 polished finish, 36’’(914mm) diameter semi-circular bowl, 9’’(229mm) deep, 0.5GPM(1.9LPM) 20-80psi(138-552kPa) operating range, zinc chromate plated 14 gauge steel legs, 16 gauge galvanized steel upper braces, 300 series stainless steel scuff bases & pedestal panels with #4 polished finish, in compliance with IGC156 and ASME A112.19.3/CSA B45.4 & A112.18.1/CSA B125.1 requirements, certified to NSF/ANSI 372, complete with foot pedal for operations

2.03 MANUFACTURERS

.1 Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, following:

.1 Plumbing Brass:

.1 Sloan;

.2 Acorn Engineering;

.3 American Standard;

.4 Delta Commercial;

.5 Chicago Faucet;

.6 Moen Commercial.

.2 Stainless Steel Sinks:

.1 Franke Commercial;

.2 Novanni Commercial;

.3 Aristaline;

.4 Arch Metal Ind;

.5 Watts.

.3 Drain Fittings, Angle Supplies, and Traps:

.1 McGuire;

.2 American Standard;

.3 Delta Commercial;

.4 Zurn Industries.

2.04 CAULKING

.1 General Electric Series SCS-1200 Silicone Construction Sealant or Dow Corning 780 silicone rubber sealant with primers as recommended by sealant manufacturer. Caulking colour(s) for coloured fixtures other than white, if any, will be selected by the Consultant from sealant manufacturer's standard colour range.

3 Execution

3.01 DEMOLITION

.1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 INSTALLATION OF PLUMBING FIXTURES AND FITTINGS

.1 Provide required plumbing fixtures and fittings.

.2 Where new fixtures and fittings are to be connected to existing piping, include for required piping revisions.

.3 Connect plumbing fixtures and fittings with piping sized in accordance with drawing schedule. Refer to manufacturer's published connection (rough-in) requirements. Where manufacturer requires piping connection larger than shown below, provide piping accordingly:

Fixture and/or Fitting	Drain Size mm (IN)	Vent Size mm (in)	DHW Size mm (in)	DCW Size mm (in)	Temp Water Size mm (in)
Water Closets Flush Valve Type	100 (4)	38 (1-½)	----------	25 (1)	----------
Urinals	75 (3)	38 (1-½)	----------	25 (1)	----------
Lavatories	32 (1-¼)	32 (1-¼)	12 (½)	12 (½)	----------
Lavatories (Electronic Faucet)	32 (1-¼)	32 (1-¼)	12 (½)	12 (½)	12 (½)
Counter Sinks	38 (1-½)	32 (1-¼)	12 (½)	12 (½)	----------
Shower Valves and Heads	----------	----------	12 (½)	12 (½)	12 (½)
Shower Stalls	50 (2)	38 (1-½)	12 (½)	12 (½)	12 (½)
Prefab. Mop Sinks with Drain	75 (3)	38 (1-½)	20 (¾)	20 (¾)	----------
Emergency Eye Wash	----------	----------	----------	----------	12 (½)
Emergency Shower	----------	----------	----------	----------	25 (1)

.4 Confirm exact location of plumbing fixtures and trim prior to roughing-in. Refer to architectural plan and elevation drawings.

.5 When installation is complete, check, and test operation of each fixture and fitting. Adjust or repair as required.

.6 Supply templates for counter mounted fixtures and trim and hand to trades who will cut the counter. Ensure openings in counter are properly located.

3.03 CAULKING AT PLUMBING FIXTURES AND FITTINGS

.1 Caulk around plumbing fixtures and fittings where they contact walls, floors, and any other building surface.

.2 Clean areas/surfaces to be caulked and prime in accordance with sealant manufacturer's instructions. Where damage to a building surface may occur, mask surface to prevent damage and ensure a clean exact edge to the caulking bead.

.3 Apply caulking using a gun with proper size and shape of nozzle and force sealant into joints to ensure good surface contact and a smooth and even finished bead of sealant.

.4 If joints have been masked sealant may be tooled in a continuous stroke to obtain complete void filling. Remove masking tape immediately after tooling and before sealant begins to skin.

End of Section

1 General

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for all products specified in this section except piping and unions.

.2 Submit motor product data sheets and certified performance curves with all pump shop drawings.

1.02 CLOSEOUT SUBMITTALS

.1 Submit with delivery of each unit a copy of factory inspection and test report, and include a copy of each report with O&M Manual project closeout data.

.2 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

.3 Prior to Substantial Performance of the Work, submit a spare seal flush line filter for each pump equipped with a seal flush line.

.4 Shop drawings for piping anchors must be prepared and stamped by a professional Structural Engineer registered in the jurisdiction of the work. Refer to requirements for Contractor retained engineers specified in Section 20 05 10 - Mechanical Work General Instructions.

.5 Submit a letter from pipe anchor design engineer to stating engineer has visited site to examine installation of pipe anchors and pipe anchor installation is in accordance with reviewed anchor shop drawing.

1.03 QUALITY ASSURANCE

.1 Pump motors are to comply with requirements of Section 20 05 00 – Common Work Results for Mechanical.

2 Products

2.01 PIPE, FITTINGS, AND JOINTS

.1 Black Steel - Screwed Joint

.1 Mild black carbon steel, Grade B, ASTM A53, complete with Class 125 cast iron threaded fittings to ANSI/ASME B16.4, and screwed joints.

.2 Black Steel - Welded Joint

.1 Mild black carbon steel, Grade B, ASTM A53, mill or site bevelled, complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, with long sweep pattern elbows unless otherwise specified, and welded joints.

.3 Soft Copper Pipe

.1 Type "L" seamless soft copper to ASTM B77.

.4 Hard Copper - Solder Joint

.1 Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper fittings to ANSI B16.22, and 95% tin / 5% Antimony solder joints.

.5 Hard Copper - Pressure Coupled Joint

.1 Type "L" hard drawn seamless copper to ASTM B88, complete with Viega "ProPress with Smart Connect feature" system copper fittings with EDPM seals, and pressure type crimped joints made by use of manufacturer recommended tool.

2.02 PIPING UNIONS

.1 Screwed Piping

.1 Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).

.2 Flanged Piping

.1 Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.

2.03 SHUT-OFF VALVES

.1 Ball Type

.1 Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass or bronze body and cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, threaded ends, and removable lever handle.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 5044A;

.2 Watts Industries (Canada) Inc. #FBV-3;

.3 Kitz Corp. Code 58;

.4 Victaulic Co. of Canada Ltd. Series 722;

.5 Apollo Valve #77-100.

.2 Butterfly Type

.1 Cast ductile iron, lug body style, 1200 kPa (175 psi) rated butterfly valve, each complete with a neck to permit 50 mm (2") of insulation above the flange, a field replaceable EPDM seat, ductile iron disc, stainless steel shaft with EPDM seal, a lever handle for valves to and including 150 mm (6") diameter, a handwheel and gear type operator for valves larger than 150 mm (6") diameter, and each suitable for bubble-tight dead end service with valve closed and either side of connecting piping removed.

.2 Manufacturers:

.1 DeZurik of Canada Ltd., Figure No. 632;

.2 Victaulic Co. of Canada Ltd. Vic-300 MasterSeal or AGS Vic-300;

.3 Apollo Valve 143 Series;

.4 Watts Industries (Canada) Inc. #BF-03;

.5 Kitz Corp. 6112 Series;

.6 Toyo Valve Co. 918DESL/G2.

2.04 SWING CHECK VALVES

.1 Bronze - Screwed

.1 Class 125, 1380 kPa (200 psi) WOG rated horizontal swing check valves, each complete with a "Y" pattern bronze body, hinged brass disc, easy access screw-in cap, and screwed ends.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 236;

.2 Nibco #T-433;

.3 Kitz Corp. Code No. 22.

.2 Cast Iron - Screwed and Flanged

.1 Cast iron, bronze trim, 1380 kPa (200 psi) rated swing check valves, each complete with a bronze disc and seat, malleable iron hinge, bolted cover, and screwed or flanged ends as required.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 435A;

.2 Watts Industries (Canada) Inc. #F-511;

.3 Kitz Corp. Code No. 78.

2.05 VERTICAL LIFT CHECK VALVES

.1 Class 150, 1380 kPa (200 psi) WOG rated bronze vertical lift check valves, each complete with screwed ends and a bronze disc.

.2 Manufacturers:

.1 Toyo Valve Co. Fig. 231;

.2 Watts Industries (Canada) Inc. #600;

.3 Kitz Corp. Code No. 36.

2.06 WAFER CHECK VALVES

.1 Threaded lug body type, full bore, ANSI Series 150, 1965 kPa (285 psi) rated at 38°C (100°F), non-slam wafer check valves, each complete with a carbon steel body, stainless steel discs, a shaft, springs, disc stop and thrust bearings constructed of type 316 stainless steel, and seat materials to suit the application. The inside diameter of the valve must equal the inside diameter of the connecting pipe.

.2 Manufacturers:

.1 Gulf Valve Co. "WAFER CHECK";

.2 Watts Industries (Canada) Inc. Series ICV-125;

.3 The Metraflex Co. Style CVXX.

2.07 DRAIN VALVES

.1 Minimum 2070 kPa (300 psi) WOG rated, 20 mm (¾") diameter straight pattern bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm (¾") diameter hose, and a cap and chain.

.2 Manufacturers:

.1 Toyo Valve Co. Ltd. Fig. 5046;

.2 Watts Industries (Canada) Inc. #B-6000-CC;

.3 Kitz Corp. Code No. 68AC;

.4 Apollo Valves #78-104-01.

2.08 CIRCUIT BALANCING VALVES

.1 Screwed or flanged as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.

.2 Manufacturers:

.1 Equal to Victaulic Co. of Canada Ltd. (Tour & Anderson) Series 787 screwed, Series 788 flanged, , and Series 78K "Koil Kit" valves.

2.09 RADIATOR SHUT-OFF AND BALANCING VALVES

.1 Heavy pattern, straight, 1750 kPa (250 psi) rated at 120°C (250°F) bronze radiator valves, each complete with composition disc, spring loaded packing, and union. Equip inlet valves with a handle for shut-off. Equip outlet valves with a lockshield for shut-off and balancing.

.2 Manufacturers:

.1 Dahl Brothers Canada Ltd. #11042 and #13013;

.2 Spirax Sarco Ltd. Type R.

2.10 AIR VENTS

.1 Manual Air Vents

.1 Equal to Conbraco 27 Series, 3.2 mm (⅛") diameter with a key handle.

.2 Automatic Air Vents

.1 Float actuated air vents, each complete with a semi-steel body and cap, a stainless steel float assembly and seat, and a neoprene head.

.2 Manufacturers:

.1 Spirax Sarco Ltd., Type 13 W for system working pressures to 1035 kPa (150 psi), 13 WH for system working pressures greater than 1035 kPa (150 psi);

.2 Armstrong International Inc. No. 1-AV.

2.11 STRAINERS

.1 Cast iron wye shaped strainers, minimum 890 kPa (125 psi) rated and complete with a removable type 304 stainless steel screen with perforations sized to suit the application, and, for strainers 50 mm (2") diameter and larger, a blowdown pipe connection tapping.

.2 Manufacturers:

.1 Spirax Sarco Ltd. Type IF-125 screwed or Type AF-250 flanged;

.2 Toyo Valve Co. Ltd. Fig. 380A screwed or Fig. 381 flanged;

.3 Victaulic Co. of Canada Style 732 or W732 "Vic-Strainer";

.4 Armstrong International Inc. A1 Series;

.5 Watts Industries (Canada) Inc. #77SCI;

.6 Mueller Steam Specialty Products Model 11M screwed or Model 758 flanged.

3 Execution

3.01 DEMOLITION

.1 Perform required hydronic piping system demolition/revision work. Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 PIPING INSTALLATION REQUIREMENTS

.1 Provide required hydronic piping. Pipe, unless otherwise specified, is to be:

.1 for pipe sizes up to and including 50 mm (2") diameter, Schedule 40 black steel, screwed, or type "L" hard copper with solder joints or pressure coupled joints;

.2 for pipe 65 mm (2-½") to 300 mm (12") dia. and larger, Standard weight black steel pipe, 10 mm (0.375") thickness, with welding fittings and welded joints;

.3 for short branch connections, 25 mm (1”) pipe diameter size and less, to heating equipment where structural obstructions occur and site bending of pipe is advantageous, a single length of type "L" soft copper.

.2 Slope horizontal piping mains to provide a minimum continuous up-grade of 25 mm (1") in 6 m (20') to high points. Slope branch supply and return piping connections to equipment a minimum of 25 mm (1") in 1.2 m (4'). Leave sufficient room at high points for installation and maintenance of air vents.

.3 Install automatic control valves, piping wells and similar piping and/or equipment mounted control components required for automatic temperature control systems supplied as part of the control work. Refer to drawing control diagrams and details.

.4 Connect equipment provided as part of the work of other sections with piping as indicated and/or required. Refer to pipe connection details on drawings.

.5 Provide screwed unions, removable mechanical joint couplings, or weld-on or solder-on flanges in piping at all connections to valves, strainers and similar piping system components which may need maintenance or repair, at equipment connections, in runs of piping exceeding 9 m (30') at 4.5 m (15') regular intervals to permit removal of sections of piping, and wherever else indicated on drawings.

.6 Provide shut-off valves in piping connections to equipment, to isolate piping risers, to isolate other sections of systems as shown, and wherever else indicated on drawings. Valves in piping to and including

50 mm (2") dia. are to be ball type. All other shut-off valves are to be ball or butterfly type unless otherwise specified. Locate valves so they are easily accessible. Wherever possible, install valves at uniform height. Provide chain operators for valves which are inaccessible for operation from floor level.

.7 Provide a check valve in discharge piping of every pump, and elsewhere in piping where shown on drawings. Where check valves are required in vertical piping, ensure they are suitable in all respects for the application. Check valves for vertical in-line and/or base mounted circulating pumps are integral with the discharge accessory.

.8 Provide a drain valve at base of each piping riser, in drain connections to equipment, in low points of horizontal piping, and wherever else shown and/or specified.

.9 Provide circuit balancing valves in piping generally where shown on drawings but with exact locations in accordance with instructions of personnel doing system flow balancing work. Confirm locations prior to installation.

3.03 INSTALLATION OF AIR VENTS

.1 Provide an air vent in piping mains at all high points, at equipment connections, and wherever else shown and/or specified. Equip each air vent with a ball type shut-off valve. Install vents in 100 mm (4") dia. and larger piping and all vents in mechanical rooms in accordance with drawing detail.

.2 Provide 9 mm (3/8") dia. copper drain piping from each automatic air vent to nearest suitable drain and terminate so discharge is visible. Identify drain piping.

3.04 INSTALLATION OF STRAINERS

.1 Provide strainers in piping. Locate strainers so baskets are easily accessible and removable. Clean strainer baskets during and after piping system flushing and cleaning is complete, and before water quantity balancing commences.

3.05 FLUSHING AND CLEANING PIPING

.1 Flush and clean new piping in accordance with requirements specified in Section 23 25 00 - HVAC Water Treatment.

3.06 TESTING, ADJUSTING AND BALANCING

.1 When work is complete and equipment is operating as intended, test, adjust and balance water flows in accordance with requirements specified in Section 20 05 93 - Testing, Adjusting, and Balancing for Mechanical Systems, and Section 20 08 00 – Commissioning of Mechanical Systems.

End of Section

1 General

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for all products specified in this section except shop fabricated ductwork and fittings.

.2 Include capacity, throw and terminal velocity, noise criteria, and pressure drops with grille and diffuser shop drawing/product data sheet submission.

1.02 QUALITY ASSURANCE

.1 Grilles and diffusers are to be tested and performance certified to ANSI/ASHRAE 70, Method of Testing the Performance of Air Outlets and Air Inlets.

2 Products

2.01 GALVANIZED STEEL DUCTWORK

.1 Galvanized steel sheet is to be hot dipped in accordance with requirements of ASTM A653. G60 galvanizing for bare uncovered duct to be finish painted. G90 for all other galvanizing.

.2 Rectangular

.1 Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.

.3 Round

.1 Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings and couplings.

.4 Flat Oval

.1 Factory machine fabricated, single wall, 4-ply spiral lock seam duct, fittings and couplings.

2.02 FLEXIBLE METALLIC DUCTWORK

.1 Bare

.1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-UN", ULC S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, and supplied in 3 m (10') lengths.

.2 Insulated

.1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-I", ULC S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, supplied in 3 m (10') lengths and factory covered with 40 mm (1-½") thick, 12 kg/m3 (0.75 lb/ft³) density fibreglass insulation with a vinyl jacket meeting 25/50 flame spread and smoke developed requirements tested in accordance with CAN/ULC S102.

2.03 FLEXIBLE CONNECTION MATERIAL

.1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber. Acceptable products are:

.1 Duro Dyne Canada Inc. "DUROLON";

.2 Dyn Air Inc. "HYPALON".

.2 Waterproof, flameproof, high temperature flexible connection material meeting requirements of NFPA 90A, consisting of a woven glass fibre fabric coated on both sides with silicone rubber. Acceptable products are:

.1 Duro-Dyne Canada Inc. "THERMAFAB";

.2 Dyn Air Inc. "SILICON HI-T".

2.04 METAL DUCT SYSTEM JOINT SEALANT

.1 ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 tested maximum flame spread rating of 5 and smoke developed rating of 0.

.2 Acceptable manufacturers are:

.1 Johns Manville;

.2 Manson Insulation;

.3 Knauf Insulation.

2.05 ACOUSTIC LINING

.1 Minimum 25 mm (1") thick acoustic lining material meeting 25/50 flame spread and smoke developed ratings tested in accordance with CAN/ULC S102, meeting NFPA 90A, ASTM C1071, and ASTM G21 requirements, not supporting microbial growth, flexible for round ducts, board type for rectangular ducts, consisting of a bonded fiberglass mat coated on inside (airside) face with a black fire-resistant coating.

.2 Acceptable manufacturers are:

.1 Johns Manville;

.2 Manson Insulation;

.3 Knauf Insulation.

2.06 CASING AND PLENUM MATERIAL AND ACCESSORIES

.1 Unless otherwise specified, casing and plenum material is to be same as connecting duct material.

.2 Accessories such as access doors and drain pans are to be constructed of same material as casing and plenum and are to be in accordance with Chapter 6 of SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.07 PLENUM ACCESS DOORS

.1 Factory fabricated, double wall insulated access doors, sized as indicated on drawings, and constructed of same material as connecting ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit operating pressure of the system.

2.08 ROUND TO RECTANGULAR DUCT CONNECTIONS

.1 Equal to Flexmaster Canada Ltd. galvanized steel, flared, flanged or notched "Spin-On" round duct take-off collars with locking dampers in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.09 SPLITTER DAMPERS

.1 Minimum #20 gauge damper blade constructed of same material as duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to DynAir Inc. #Q-50 "DYN-A-QUAD S-S" quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.

2.10 AIR TURNING VANES

.1 For square elbows, multiple-radius turning vanes interconnected with bars, adequately reinforced to suit pressure and velocity of system, constructed of same material as duct they are associated with, and in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 For short branch ducts at grille and diffuser connections, air extractor type each equipped with a matching bottom operated 90° opposed blade volume control damper, constructed of same material as duct it is associated with and in accordance with requirements and details in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.11 MANUAL BALANCING (VOLUME) DAMPERS

.1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of same material as connecting ductwork unless otherwise specified, each designed to maintain internal free area of connecting duct, and each complete with:

.1 hexagonal or square shaft extension through frame;

.2 non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers;

.3 blade stops for single blade dampers, designed to prevent blade from moving more than 90°;

.4 linkage for multiple blade dampers;

.5 locking hand quadrant damper operator with, for insulated ducts 50 mm (2") standoff mounting.

.2 Rectangular Dampers: Nailor Industries Inc. 1800 Series, maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.

.3 Round Dampers: Nailor Industries Inc. Model 1890, maximum 600 mm (24") diameter, equipped with a minimum 200 mm (8") deep frame, and blade stiffeners where required.

.4 Multiple Rectangular Damper Section Assembly: Rectangular assembly supplied with the dampers or site constructed, of same material as damper and designed for tight and secure mounting of individual dampers.

.5 Acceptable manufacturers are:

.1 Nailor Industries Inc.;

.2 T.A. Morrison & Co. Inc. "TAMCO";

.3 NCA Manufacturing Ltd.;

.4 Greenheck Fan Corp.;

.5 Ruskin Co.

2.12 BACKDRAFT DAMPERS

.1 Nailor Industries Model 1370CB counterbalanced backdraft dampers, vertical or horizontal mounting, 50 mm (2") wide, sized as shown and complete with:

.1 extruded 6063-T5 aluminum frame, 2.3 mm (0.090") nominal wall thickness, with mitred corners;

.2 extruded 6063-T5 aluminum blades, 1.3 mm (0.050") nominal wall thickness on 92 mm (3-5/8") centres, and with extruded PVC blade seals;

.3 corrosion-resistant synthetic bearings;

.4 adjustable plated steel counterweights mounted internally in the airstream;

.5 concealed blade linkage located out of the airstream.

.2 Acceptable manufacturers are:

.1 Nailor Industries Inc.;

.2 T.A. Morrison & Co. Inc. "TAMCO";

.3 NCA Manufacturing Ltd.;

.4 Greenheck Fan Corp.;

.5 Ruskin Co.

2.13 DUCT ACCESS DOORS

.1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, with sizes suitable in all respects for purpose for which they are provided, and, unless otherwise specified, constructed of same material as duct they are associated with.

2.14 DUCTWORK DRAIN POINTS

.1 Equal to Ductmate Canada Ltd. "Moisture Drain", 20 mm (¾") diameter moisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut and cap.

2.15 INSTRUMENT TEST PORTS

.1 Equal to Duro-Dyne of Canada Ltd. #IP1 or #IP2 (to suit insulation thickness where applicable) gasketed, leakproof instrument test ports for round or rectangular ducts as required, each complete with a neoprene expansion plug and a plug securing chain.

2.16 WIRE MESH (BIRDSCREEN)

.1 Heavy-gauge galvanized steel or aluminum mesh, 12 mm x 12 mm (½" x ½") secured in a rigid galvanized steel or aluminum framework, sized as indicated on drawings, and constructed so as to be removable.

2.17 LOUVRE BLANK-OFF PANELS

.1 Insulated, framed, sandwich construction panels consisting of 40 mm (1-½") thick rigid insulation (meeting NFPA 90A requirements) between minimum #20 gauge galvanized sheet steel with exterior face of panels finished to match finish of exterior wall louvres.

2.18 GRILLES AND DIFFUSERS

.1 Grilles and diffusers of type, size, capacity, finish, and arrangement as shown on drawings and in accordance with drawing schedule, each equipped with all required mounting and connection accessories to suit mounting location and application.

.2 Acceptable manufacturers are:

.1 Price Industries Inc.;

.2 Anemostat;

.3 Krueger Division of Air System Components Inc.;

.4 Titus;

.5 Nailor Industries Inc.;

.6 Tuttle & Bailey.

3 Execution

3.01 CLEANLINESS REQUIREMENTS FOR HANDLING AND INSTALLATION OF DUCTWORK

.1 Handle and install ductwork in accordance with CSA Z317.2, Special Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Healthcare Facilities and SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.

.2 Handle and install ductwork in accordance with SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.

3.02 FABRICATION AND INSTALLATION OF GALVANIZED STEEL DUCTWORK

.1 Provide required ductwork, rectangular, round and/or flat oval. Where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.

.2 It is to be understood that all duct dimensions shown on drawings are clear internal dimensions.

.3 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit duct pressure class designation of minimum 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so ductwork does not "drum". Flat surfaces of rectangular ductwork are to be cross-broken. Duct system sealing is to meet ANSI/SMACNA Seal Class A requirements.

.4 Confirm routing of all ductwork at site and site measure ductwork prior to fabrication. Duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by Consultant. Duct routing and/or dimension revisions to suit conditions at site are not grounds for a claim for an extra cost.

.5 Refer to structural drawings. Where ductwork is to be run within or through open web steel joists, ductwork shown on mechanical drawings is schematic only and is to be altered as required to suit steel joist configuration, spacing, panel points, and cross-bridging at no additional cost.

.6 Wherever ductwork is required at locations where sprayed fireproofing is applied to building construction, install ductwork only after fireproofing work is complete and do not compromise fire rating of sprayed fireproofing.

.7 Install (but do not connect) duct system mounted automatic control components supplied as part of the automatic control work.

.8 Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.

.9 Flange connect ductwork to hot water reheat coils in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Coils will be suspended independent of connecting ductwork as part of the heat transfer work.

.10 Support horizontal rectangular ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with, unless otherwise specified, galvanized steel channels, and galvanized steel hanger rods for exposed ducts and concealed ducts wider than 500 mm (20"). Support hardware constructed of same material as duct for metal duct, and, unless otherwise specified, type 316 stainless steel for non-metal duct. Supports for "heavy" duct such as cementitious core duct is to be suitable in all respects for the application and approved by Consultant.

.11 Support round and flat oval ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at top of duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If duct is insulated, size strap to suit diameter of insulated duct. Unless otherwise specified, duct support hardware for metal duct is constructed of same material as duct, and for non-metal duct, type 316 stainless steel.

.12 Where flanged duct joints are used, do not locate joints in wall or slab openings, or immediately at wall or slab openings. Do not use flanged joints for exposed uninsulated ducts in finished areas.

.13 Where watertight horizontal ductwork is required, construct ducts without bottom longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer. Slope horizontal duct to hoods, risers, or drain points. Provide drain points. Provide watertight ductwork for:

.1 fresh air intakes;

.2 wherever else shown.

.14 Seal all ductwork in accordance with SMACNA Seal Class "A", except for round duct with self-sealing gasketed fittings and couplings which does not require site applied sealant. Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.

.15 Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.

.16 Clean exterior exposed (uninsulated) ducts and coat with a heavy full coverage of Bakor #410-02 black metal paint.

.17 Where dissimilar metal ducts are to be connected, isolate ducts by means of flexible duct connection material.

3.03 INSTALLATION OF FLEXIBLE DUCTWORK

.1 Provide maximum 3 m (10') long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles and diffusers. Do not install flexible ductwork through walls, even if shown on drawings.

.2 At rectangular galvanized steel duct, accurately cut holes and provide flanged or "Spin-in" round flexible duct connection collars. Seal joints with duct sealer.

.3 Install flexible ducts as straight as possible and support in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, and secure at each end with

nylon or stainless steel gear type clamps, and seal joints. Provide long radius duct bends where they are required.

.4 Do not penetrate fire barriers with flexible duct.

3.04 INSTALLATION OF ACOUSTIC LINING

.1 Provide acoustic lining in ductwork in locations as follows:

.1 wherever shown and/or specified on drawings.

.2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel in accordance with detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

3.05 INSTALLATION OF CASINGS AND PLENUMS

.1 Provide required shop or site fabricated casings and plenums. Unless otherwise specified or shown, construct casings and plenums of same material as connecting duct system.

.2 Construct and install casings and plenums in accordance with Chapter 6 of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit systems' pressure classification. Ensure plenums and casings secured to building structure are gasketed air-tight and equipped with angle reinforcing.

.3 Provide drain pans with accessible trapped drains for fresh air intake plenums, and wherever else shown.

3.06 INSTALLATION OF CASING AND PLENUM ACCESS DOORS

.1 Provide access doors into all site or shop fabricated casings and plenums requiring access, and wherever shown.

.2 Construct access doors to open in or out to suit positive and negative pressures of system.

.3 Provide pitot tube openings in access doors where required for system air quantity balancing purposes.

.4 Provide suitably sized, engraved, red-white laminated Lamacoid warning nameplates on access doors into casings and plenums where equipment is located, i.e. fans.

3.07 INSTALLATION OF ROUND TO RECTANGULAR DUCT CONNECTIONS

.1 Cut round holes in rectangular ducts and provide round to rectangular lock-in fittings with dampers for connection of flexible round ductwork.

3.08 INSTALLATION OF SPLITTER DAMPERS

.1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified on drawings. Install splitter dampers so they cannot vibrate and rattle and so damper operation mechanisms are in an easily accessible and operable location. Ensure operators for dampers in insulated ducts are equipped with stand-off mounting brackets.

3.09 INSTALLATION OF TURNING VANES

.1 Provide turning vanes in ductwork elbows where shown on drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Provide volume extractor type turning vanes in short branch supply duct connections off mains to grilles and diffusers where shown and/or specified.

3.10 INSTALLATION OF MANUAL BALANCING (VOLUME) DAMPERS

.1 Provide manual balancing dampers as required to provide a fully balanced system, including but not limited to in all open end ductwork, in all duct mains, and wherever else shown and/or specified.

.2 Install dampers so operating mechanism is accessible and positioned for easy operation, and so dampers cannot move or rattle. Ensure operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.

.3 Where a duct for which a balancing damper is required has dimensions larger than dimensions of maximum size volume damper available, provide multiple dampers bolted together in a properly sized assembly, or bolted to a heavy-gauge black structural steel angle or channel framework which is properly sized. Seal to prevent air by-pass, and provide connecting linkage.

.4 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing 5 additional dampers at no additional cost.

3.11 INSTALLATION OF BACKDRAFT DAMPERS

.1 Provide backdraft dampers.

.2 Install and secure dampers so they cannot move or rattle.

3.12 INSTALLATION OF FLEXIBLE CONNECTION MATERIAL

.1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums, and/or easings connect to fans, and wherever else shown or specified.

.2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of flexible fabric and to fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure connections to flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.

3.13 INSTALLATION OF DUCT ACCESS DOORS

.1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Install in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

.2 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure doors are properly located for damper maintenance.

.3 When requested, submit a sample of proposed duct access doors for review.

.4 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce ductwork to suit access door installed.

3.14 INSTALLATION OF INSTRUMENTS TEST PORTS

.1 Provide instrument test ports in all main ducts at connections to fans, plenums or casings, in all larger branch duct connections to mains, and wherever else required for proper air quantity balancing and testing.

.2 Locate test ports where recommended by personnel performing air quantity testing and balancing work.

3.15 INSTALLATION OF WIRE MESH (BIRDSCREEN)

.1 Provide framed, removable wire mesh panels over openings in ducts and/or walls where shown and/or specified on drawings. Rigidly secure in place but ensure panels are removable.

.2 Provide wire mesh panels for open-end return air ducts in ceiling spaces whether shown on drawings or not.

3.16 INSTALLATION OF LOUVRE BLANK-OFF PANELS

.1 Provide blank-off panels for inactive portions of exterior wall louvres.

.2 Secure panels in place with non-ferrous hardware so they cannot move or rattle, yet are easily removable.

.3 Confirm exact finish of panels prior to fabrication.

3.17 INSTALLATION OF GRILLES AND DIFFUSERS

.1 Provide grilles and diffusers. Wherever possible, grilles and diffusers are to be product of same manufacturer.

.2 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.

.3 Exactly locate grilles and diffusers to conform to final architectural reflected ceiling plans and detailed wall elevations, and to conform to final lighting arrangement, ceiling layout, ornamental and other wall treatment.

.4 Equip supply diffusers having a basic 4-way or all round air pattern for operation in 1-, 2-, or 3-way pattern where indicated on drawings.

.5 Confirm grille and diffuser finishes prior to ordering.

3.18 DUCT SYSTEM PROTECTION, CLEANING AND START-UP

.1 Temporarily cover all open ends of ducts during construction.

.2 Remove all dirt and foreign matter from entire duct systems and clean duct system terminals and interior of air handling units prior to operating fans.

.3 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.

.4 Provide cheesecloth over duct system inlets and outlets and run system for 24 hours, after which remove cheesecloth and construction filters, and install new permanent filters.

.5 Include all labour for a complete site walk-through with testing and balancing personnel following route of all duct systems to be tested, adjusted and balanced for the purpose of confirming proper position and attitude of dampers, location of pitot tube openings, and any other work affecting testing and balancing procedures. Perform corrective work required as a result of this walk-through.

End of Section

1 General

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for all products specified in this section.

.2 Prior to Substantial Performance of the Work, submit a set of spare filters in original identified packaging for each air handling unit requiring filters. Store filters on site where directed by Consultant or Owner.

.3 Prior to Substantial Performance of the Work, submit a spare bottle of red manometer filter gauge oil, with instructions, to Owner for each manometer type gauge installed.

2 Products

2.01 GENERAL

.1 Unless otherwise specified or noted, filters are to be synthetic and/or glass fibre disposable media type in accordance with drawing schedule(s).

.2 Minimum Efficiency Reporting Values (MERV) ratings in accordance with ASHRAE Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Sizes.

.3 Unless otherwise specified or noted, filters are to be UL/ULC Class 1 in accordance with UL Standard 900, Air Filter Units, ULC S111, Standard Method of Fire Tests for Air Filter Units, and CAN/CGSB 115.10, Disposable Air Filters for Removal of Particulate Matter from Ventilation Systems.

.4 Acceptable manufacturers are:

.1 AAF International;

.2 Camfil Farr Inc.;

.3 Modern Air Filter Corp.

2.02 CONSTRUCTION FILTERS

.1 Roll type, disposable, MERV 7 to 9 woven glass fibre media, UL Class 2.

3 Execution

3.01 INSTALLATION OF CONSTRUCTION FILTERS

.1 Provide roll type medium efficiency disposable media filter(s) across entire filter bank of each supply air handling unit, either at factory where fan is produced or at site as soon as fan is installed. Secure media in place so it will not be dislodged by fan operation. Replace roll media periodically if it becomes loaded and clogged.

.2 For exhaust systems, secure filter media across exhaust air openings and ductwork to prevent construction dirt and dust from fouling the fan

.3 Leave media in place until fan start-up, at which time remove and dispose of construction media.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Heat Recovery Ventilators

1.02 SUBMITTALS

.1 Submit shop drawings/product data sheets for heat recovery ventilators, including accessories, and all required power and control wiring schematics.

.2 Submit with delivery of each unit a copy of the factory inspection report, and include a copy of each report with O & M Manual project close-out data.

.3 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this section.

.4 Supply a spare filter set for each ventilator and store at site where directed prior to Substantial Performance of the Work.

.5 Submit a signed extended warranty direct from manufacturer to Owner covering the energy recovery wheel from material and workmanship defects for an additional 4 years after Contract warranty expires.

.6 Supply reviewed copies of ventilator/curb assembly shop drawings or product data to trade who will cut roof openings for ventilators, and ensure openings are properly located.

1.03 QUALITY ASSURANCE

.1 Heat recovery ventilator manufacturers are to be current members of Air Movement and Control Association International Inc. (AMCA), and fans are to be rated (capacity and sound performance) and certified in accordance with requirements of following standards:

.1 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating;

.2 AMCA Standard 211, Product Rating Manual for Fan Air Performance;

.3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans;

.4 AMCA Standard 311, Product Rating Manual for Fan Sound Performance;

.5 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans;

.6 AHRI Standard 1060, Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment;

.7 ASHRAE 84, Method of Testing Air-to-Air Heat/Energy Exchangers;

.8 UL 1812, Ducted Heat Recovery Ventilators;

.9 CSA or ETL certification for all electrical components.

.2 Acceptable manufacturers are:

.1 RenewAire;

.2 Aldes;

.3 Loren Cook Co.;

.4 Greenheck Fan Corp.;

.5 Venmar CES Inc.;

.6 Summeraire Manufacturing;

.7 Carrier Corp.

2 Products

2.01 HEAT RECOVERY VENTILATORS

.1 CABINET

.1 Materials: Formed double wall insulated metal cabinet, fabricated to permit access to internal components for maintenance.

.2 Outside casing: 20 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. Painted components as supplied by the factory shall have polyester urethane paint on 20 gauge G90 galvanized steel.

.3 Access doors shall be hinged with airtight closed cell foam gaskets. Door pressure taps, with captive plugs, shall be provided for cross-core pressure measurement allowing for accurate airflow measurement.

.4 Cabinet Insulation: Case walls and doors shall be fully insulated with 1 inch, expanded polystyrene foam insulation faced with a cleanable foil face on all exposed surfaces.

.5 Enthalpy core: Energy recovery core shall be of the total enthalpy type, capable of transferring both sensible and latent energy between airstreams. Latent energy transfer shall be accomplished by direct water vapor transfer from one airstream to the other, without exposing transfer media in succeeding cycles directly to the exhaust air and then to the fresh air. No condensate drains shall be allowed. The energy recovery core shall be designed and constructed to permit cleaning and removal for servicing. The energy recovery core shall have a ten year warranty. Performance criteria are to be as specified in AHRI Standard 1060.

.6 Control center / connections: Energy Recovery Ventilator shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections to the non-fused disconnect.

.7 Passive Frost Control: The ERV core shall perform without condensing or frosting under normal operating conditions (defined as outside temperatures above -10ºF and inside relative humidity below 40%). Occasional more extreme conditions shall not affect the usual function, performance or durability of the core. No condensate drains will be allowed.

.8 Motorized Isolation Damper(s): Outdoor Air motorized damper of an AMCA Class I low leakage type.

.2 BLOWER SECTION

.1 Blower section construction, Supply Air and Exhaust Air: Blower assemblies consist of a 208-230V 1 Phase 60 HZ, ECM motor, and a direct driven backward-curved blower.

.2 Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

.3 MOTORS

.1 Blower motors shall be Premium Efficiency, EISA compliant for energy efficiency. The blower motors shall be totally enclosed (TEFC) and shall be supplied with factory installed motor starters.

.4 UNIT CONTROLS

.1 Fan control: Terminal strip for EC motors.

.2 Factory-installed microprocessor controller and sensors, Premium ERV controls that:

.1 Has factory-installed hardware and software to enable the building automation interface via BACnet to monitor, control, and display status and alarms

.2 The microprocessor controller shall be capable of operating at temperatures between -20F to 160F

.3 The microprocessor controller shall be a DIN rail mounting type

.4 Factory-installed microprocessor controller shall come with backlit display that allows menu-driven display for navigation and control of unit

.5 The microprocessor controller shall have the ability to communicate with the BMS via Modbus RTU/TCP and BACnet MSTP/IP

.6 The microprocessor controller shall have integrated ethernet interface and a web server for displaying unit parameters

.7 The microprocessor shall have near field communication (NFC) capability for android devices

.8 The microprocessor controller shall have an internal programmable time clock that will allow the user to add up to different occupancy schedules and add holidays

.9 The microprocessor control shall be capable of integral diagnostics

.10 The microprocessor control shall be capable of IP or SI unit display

.11 The microprocessor controller shall have a battery powered clock

.12 The microprocessor controller shall at a minimum offer the ability for three modes of determining occupancy: a dry contact, the internal time clock or the BMS

.13 A remote user terminal to allow for remote monitoring and adjustment of parameters, allowing ease of control access without going outdoors or into the mechanical room if desired by the user

.14 The microprocessor controller shall have at a minimum (10) universal inputs/outputs (AI, DI, AO) and have (6) six relay outputs (DO)

.15 The microprocessor controller shall have an integrated fieldbus port

.16 The microprocessor controller shall have the capability for I/O expansion

.17 The microprocessor controller shall have a micro USB port to load the application program, the unit parameters, saving logs, etc.

.3 The microprocessor controller shall have the capability to monitor the unit conditions for alarm conditions. Upon detecting an alarm, the microprocessor controller shall have the capability to record the alarm description, time, date, available temperatures, and unit status for user review. A

digital output shall be reserved for remote alarm indication. Alarms to be also communicated via BMS as applicable. Provide the following alarm functions:

.1 Outside air temperature sensor alarm

.2 Outside air humidity sensor alarm

.3 Return air temperature sensor alarm

.4 Return air humidity sensor alarm

.5 Fresh air sensor alarm

.6 Exhaust air sensor alarm

.7 Dirty filter alarm

.8 Supply and exhaust air proving alarm

.4 Display the following on the face of microprocessor controller:

.1 Unit on

.2 Outdoor air temperature

.3 Outdoor air humidity

.4 Return air temperature

.5 Return air humidity

.6 Supply air temperature

.7 Unit on/off

.8 Fan on/off

.9 Damper status

.10 Alarm digital display

.5 The microprocessor controller shall have factory pre-programmed multiple operating sequences for control of the ERV. Factory default settings shall be fully adjustable in the field. Available factory pre-programmed sequences on operations are:

.5 FILTER SECTION

.1 ERV shall have 2" thick MERV 13 disposable pleated filters located in the outdoor air and exhaust airstreams. All filters shall be accessible from the exterior of the unit.

3 Execution

3.01 INSTALLATION

.1 Provide heat recovery ventilators.

.2 Supply an assembled roof curb for each outdoor roof mounted ventilator and hand to roof trade at site on roof. Carefully locate and size roof openings. Provide gasket material supplied with curb on perimeter of curb and secure ventilator in place.

.3 Coordinate power wiring connection and provision of a disconnect switch for each ventilator in accordance with electrical work Specification where power wiring is specified.

.4 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system manufacturer certification requirements.

.5 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system start-up requirements.

3.02 DEMONSTRATION AND TRAINING

.1 Include for a ½ day on-site heat recovery ventilator operation demonstration and training session. Training is to be a full review of all components including, but not limited to, a full heat recovery ventilator internal inspection, construction details, operation, maintenance, abnormal events, and setting up controls.

End of Section

1 General

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for heating coils, including accessories.

2 Products

2.01 DUCT MOUNTED ELECTRIC REHEAT COILS

.1 Electric reheat coils in accordance with drawing schedule, each certified in accordance with CSA C22.2 No. 155, Electric Duct Heaters and CAN/CSA C22.2 No. 236, Heating and Cooling Equipment, and each complete with frame members, terminal boxes and covers and associated sheet metal work constructed of heavy-gauge die-formed steel with an integral corrosion-resistant coating and fabricated into coil shape by spot welding, a corrosion protected sheathed heating element, an automatic reset and an auxiliary manual reset snap-action high temperature limit control to protect coils from overheating from any cause, and a pre-wired control panel for electrical power and control connections.

.2 Each control panel is to be complete with:

.1 disconnect switch;

.2 magnetic contactor(s);

.3 terminal blocks for power and control wiring connections;

.4 pre-wired differential pressure switch to shut-down coil upon sensing a "no-airflow" condition;

.5 fused control transformer;

.6 fused SCR (silicon control rectifier).

.3 Manufacturers:

.1 INDEECO;

.2 Thermolec Manufacturing Ltd.;

.3 Chromalox Inc.;

.4 Condex Wattco Inc.

3 Execution

3.01 INSTALLATION OF DUCT MOUNTED ELECTRIC REHEAT COILS

.1 Provide electric reheat coils in supply ductwork.

.2 Secure each coil in place from structure by means of hanger rods, independent of connecting ductwork and located for easy removal and access to power and control panel.

.3 Coordinate installation with electrical trade who will connect coil with power wiring.

End of Section

1 General

1.01 SUBMITTALS

.1 Submit shop drawings/product data sheets for following:

.1 all control system components;

.2 identified schematic control diagrams with component identification, catalogue numbers, and sequence of operation for all systems;

.3 certified wiring diagrams for all systems.

.2 Submit following samples for review:

.1 control damper section with linkage, operator, and certified flow and leakage data;

.2 wall mounting control system flow diagram as specified in Part 2 of this Section;

.3 each type of thermostat to be used, each identified as to intended use.

.3 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.

.4 Submit written confirmation from control component manufacturer that site installation personnel are qualified and experienced in installation of components, and have parts and service availability on a 24/7 basis.

1.02 QUALITY ASSURANCE

.1 Control systems are to be installed by control component manufacturer or by licensed personnel authorized by control component manufacturer. Submit written confirmation from control component manufacturer.

.2 Control wiring work is to be performed by licensed journeyman electricians, or under direct daily supervision of journeyman electricians.

2 Products

2.01 AUTOMATIC CONTROL VALVES AND OPERATORS

.1 Each control valve must be suitable in all respects for the application, including system pressure, and must have design output and flow rates with maximum pressure drops as follows:

.1 Two-Position: Line size or size using a pressure differential of 1 psi.

.2 Two-Way Modulating: 3 psid or twice the load pressure drop, whichever is more.

.3 Three-Way Modulating: Twice the load pressure drop, but not more than 5 psid.

.2 Unless otherwise indicated, control valves for proportional operation are to have equal percentage characteristics, and control valves for open/shut 2-position operation are to have straight line flow characteristics. All valves are to have position indicators. Valves for outdoor applications must be suitable in all respects for the application.

.3 Heating valves are to be normally open unless otherwise specified.

.4 Cooling valves are to be normally closed unless otherwise specified.

.5 Unless otherwise specified, control valves in hydronic piping systems are to conform to requirements specified in Section 23 21 00 – HVAC Piping and Pumps.

.6 Unless otherwise specified, valves in steam/condensate piping are to generally conform to requirements specified in Section 23 22 00 – Steam and Condensate Piping and Pumps, but must be equipped with stainless steel plugs and stems, removable screwed stainless steel seat rings, and spring loaded Teflon V-ring packing.

.7 All control valve operators are to be spring return type for fail safe operation, sized to tightly shut the control valves against differentials imposed by system, equipped with position indicators, and suitable in all respects for environment in which they are located.

.8 Electric valve operators are to be equal to Belimo "EF Series" enclosed reversible gear type operators that can accept modulating control signals as required. Each is to be 1-phase AC, 120 or 24 volt as required or indicated, overload protected, and complete with an enclosure to suit the mounting location.

2.02 CONTROL DAMPERS AND OPERATORS

.1 T. A. Morrison & Co. Inc. "TAMCO" 100 mm (4') deep, flanged, AMCA low leakage certified aluminium dampers. Dampers for modulating and mixing applications are to be parallel blade type. Dampers for open-shut service are to be opposed blade type. Maximum blade length is to be 1 m (4'). Dampers greater than 2 sections wide are to be complete with a jackshaft. Each damper is to be complete with:

.1 extruded 6063T5 aluminum frame and airfoil blades, each with an integral slot to receive a gasket;

.2 extruded TPE frame gaskets and extruded EPDM blade gaskets;

.3 slip-proof aluminium and corrosion resistant plated steel linkage of a metal thickness to prevent warping or bending during damper operation, concealed in frame, equipped with seal-sealing and self-lubricating bearings consisting of a Celcon inner bearing fixed on hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in frame.

.2 For standard damper(s), Series 1000 as above.

.3 For insulated damper(s), Series 9000 as above but with all 4 sides of frame insulated with polystyrene, and blades thermally broken and insulated with expanded polyurethane foam.

.4 Each damper motor is to be shaft mounted, spring return, fail safe in the normally open or normally closed position, sized to control damper against maximum pressure or dynamic closing pressure, whichever is greater, to suit sizes of dampers involved, and to provide sufficient force to maintain damper rated leakage characteristics. Each operator is to be complete with a damper position indicator, and external adjustable stops to limit length of stroke in either direction, and is to be mounted on a corrosion resistant adjustable bracket. Operating arms are to have double yoke linkages and double set screws for fastening to damper shaft. Operators for dampers to be connected to building fire alarm system or to freeze protection devices are to be equipped with additional relays to permit dampers to respond and go to required position in less than 15 seconds upon receipt of a signal. Operator enclosures are to be suitable in all respects for environment in which they are located.

.5 Electric damper operators are to be equal to Belimo EF Series 24 volt or 120 volt AC spring return, direct coupled electric motor operators for either modulating or 2-position control as required. Each operator is to be overload protected and complete with an enclosure to suit the mounting location.

2.03 LOCAL CONTROL PANELS

.1 NEMA 1 (NEMA 2 in sprinklered areas) wall mounting, enamelled steel barriered enclosures sized to suit the application with 20% spare capacity, a perforated sub-panel, numbered terminal strips for all low and line voltage wiring, hinged door, and slotted flush latch.

2.04 CONTROL SYSTEM COMPONENTS

.1 Components specified below are required for control of equipment and systems in accordance with drawing control diagrams and sequences of operation. Not all required components may be specified.

.2 Sensor/transmitter input devices must be suitable in all respects for the application and mounting location. Devices are as follows:

.1 unless otherwise specified, temperature sensors are to be resistance type, either 2-wire 1000 ohm nickel RTD or 2-wire 1000 ohm platinum RTD with accuracy (includes errors associated with sensor, lead wire, and A to D conversion), equipped with type 316 stainless steel thermowells for pipe mounting applications, as follows:

.1 chilled water, room temperature, and duct temperature points, ±1°C (±0.5°F);

.2 all other points, ±0.75°C (±1.3°F).

.2 room temperature sensors constructed for surface or recessed wall box mounting, complete with an adjustable set-point reset slide switch with a ± 1.66°C (±3°F) range, individual heating/cooling set-point slide switches as required, a momentary override request pushbutton for activation of after-hours operation, an analogue thermometer;

.3 outside air sensors designed and constructed for ambient temperatures and to withstand environmental conditions to which they are exposed, complete with a NEMA 3R enclosure, solar shield, and a perforated plate surrounding sensor element where exposed to wind velocity pressure;

.4 insertion duct mounting sensors type with lock nut and mounting plate, designed to mount in an electrical box (weather-proof with gasket and cover where outside) through a hole in duct;

.5 for ducts greater than 1.2 m (4') or for ducts where air temperature stratification occurs, averaging type sensors with multiple sensing points, and for plenums for applications such as mixed air temperature measurement to account for air turbulence and/or stratification, an averaging string of sensors with capillary supports on the sides of duct/plenum;

.3 Power (amps) monitoring is to be performed by a combination of a current transformer and a current transducer with transformer sized to reduce full amperage of monitored circuit to a maximum 5 ampere signal which will be converted to a 4 to 20 mA DDC compatible circuit for use by building automation system. Current transformer and current transducer are as follows:

.1 equal to Veris Industries split core current transformer with an operating frequency of from 50 to 400 Hz, 0.6 Kv class, 10 Kv BIL insulation, and 5 ampere secondary;

.2 equal to Veris Industries current to voltage or current to mA transducer with an accuracy of ±5%, a minimum load resistance of 30 kOhm, an input of 0 to 20 amperes and an output of 4 to 20 mA, and a 24 VDC regulated power supply.

.4 Double contact switches to monitor equipment status and safety conditions, and generate alarms when a failure or abnormal condition occurs. Status and safety switches are to be as follows:

.1 current sensing switches: equal to Veris Industries self-powered dry contact output switches for sensing run status of motor loads, each calibrated to indicate a positive run status only when motor is operating under load, and each consisting of a current transformer, a solid-state current sensing circuit, adjustable trip point, solid-state switch, SPDT relay, and a LED to indicate on or off status;

.2 air filter status switches: equal to Johnson Controls Inc. or Cleveland Controls automatic reset type differential pressure switches, each complete with SPDT contacts rated for 2 amperes at 120

VAC, a scale range and differential pressure adjustment appropriate for the service, and an installation kit which includes static pressure taps, tubing, fittings, and air filters;

.3 air flow switches: equal to Johnson Controls Inc. or Cleveland Controls pressure flow switches, bellows actuated mercury switch or snap-acting micro-switch type with an appropriate scale range and pressure adjustment;

.4 air pressure safety switches: equal to Johnson Controls Inc. or Cleveland Controls manual reset switches, each complete with SPDT contacts rated for 2 amperes at 120 VAC and an appropriate scale range and pressure adjustment;

.5 water flow switches: equal to Johnson Controls Inc. Model P74;

.6 low temperature limit switches: manual reset type equal to Johnson Controls Inc. Model A70, each complete with DPST snap acting contacts rated for 16 amperes at 120 VAC, a minimum 4.5 m (15') sensing element for mounting horizontally across duct/plenum with sensing reaction from coldest 450 mm (18") section of element, and where sensing element does not provide full coverage of air stream, additional switches are to be supplied as required.

.5 Control relays as follows:

.1 control pilot relays: equal to Johnson Controls Inc. or Lectro modular plug-in design with snap-mount mounting bases, retaining springs or clips, DPDT, 3 PDT or 4 PDT as required for the application, with contacts rated for 10 amperes at 120 VAC;

.2 lighting control relays: latching type with integral status contacts rated for 20 amperes at 120 VAC, each complete with a split low voltage coil that moves the voltage contact armature to On or Off latched position, each controlled by a pulsed tri-state output (preferred) or pulsed paired binary outputs, and each designed so power outages will not result in a change-of-state and so multiple same state commands will simply maintain commanded state.

.6 Electronic signal isolation transducers equal to Advanced Control Technologies for installation whenever an anolog output signal from building automation system is to be connected to an external control system as an input (i.e. equipment control panel), or is to receive as an input signal from a remote system, and to provide ground plane isolation between systems.

.7 Each manual override station is to be complete with contacts rated minimum 1 ampere at 24 VAC and is to provide following:

.1 integral H-O-A switch to override controlled device pilot relay;

.2 status input to building automation system to indicate whenever switch is not in the Auto position;

.3 status LED to illuminate whenever output is On;

.4 override LED to illuminate whenever H-O-A switch is in either the Hand or Off position.

.8 Electronic/pneumatic transducers equal to Johnson Controls Inc. transducers with an output of from 3 to 15 psig, an input of from 4 to 20 mA or 10 VDC, manual output adjustment, a pressure gauge, and an external replaceable supply air filter.

.9 Thermostats:

.1 Wall mounting adjustable set-point thermostats, each suitable in all respects for equipment (and operating sequence) they are provided for, equipped with a thermometer, a cover and any required mounting and connection accessories.

.2 Line voltage thermostats are to be 115 volt.

.3 Low voltage thermostats are to be 24 volt electronic type.

.4 Set-point adjustment for thermostats in public spaces is to be concealed behind cover. Set-point adjustment for other thermostats is to be accessible through cover.

.5 Covers are to be removable, tamper-proof covers with temperature set-point and thermometer displays.

.6 Guards for thermostats are to be clear, ventilated acrylic covers with allen key locking hardware.

.10 Hardware to permit building automation system control and monitoring of input/output points in accordance with drawing control diagrams and operation sequences. All such hardware is to be suitable in all respects for interface with the building automation system.

2.05 SYSTEM WIRING MATERIALS

.1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in appropriate Section(s) of Electrical Work specification.

3 Execution

3.01 DEMOLITION

.1 Perform required control system demolition work.

.2 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 GENERAL RE: INSTALLATION OF CONTROLS

.1 Provide complete systems of control and instrumentation to control and supervise building equipment and systems in accordance with this Section and drawings.

.2 Control systems are to generally be as indicated on drawing control diagrams and are to have all the elements therein indicated or implied.

.3 Control diagrams show only the principal components controlling the equipment and systems. Supplement each control system with all relays, transformers, sensors, etc., required to enable each system to perform as specified and to permit proper operation and supervision.

3.03 SUPPLY OF AUTOMATIC CONTROL VALVES AND OPERATORS

.1 Unless otherwise specified, supply required automatic control valves. Hand valves to appropriate piping trades at site in locations they are required for installation as part of piping work. Ensure each valve is properly located and installed.

.2 Provide an operator for each valve.

3.04 INSTALLATION OF THERMOSTATS

.1 Unless otherwise noted, provide required thermostats.

.2 Provide a ventilated clear acrylic cover for each thermostat located in finished areas, and a wire type guard for each thermostat located in unfinished areas and in areas such as mechanical rooms where thermostat is subject to damage.

.3 Unless otherwise indicated, mount room thermostats 1.5 m (5 ft.) above finished floor level. Confirm exact location of thermostats prior to roughing-in.

.4 Provide stand-off mounting and an insulated sub-base for thermostats on outside walls.

.5 Perform control wiring associated with installation of electric or electric-electronic thermostats.

3.05 INSTALLATION OF CONTROL SYSTEM COMPONENTS

.1 Provide required control system components and related hardware. Refer to drawing control diagrams and sequences.

.2 Where components are pipe, duct, or equipment mounted supply components at proper time, coordinate installation with appropriate trade, and ensure components are properly located and mounted.

3.06 CONTROL WIRING

.1 Perform required control wiring work for control systems except:

.1 power wiring connections to equipment and panels, except as noted below;

.2 control wiring associated with mechanical plant equipment and systems whose control is not part of work specified in this Section;

.3 starter interlock wiring.

.2 Except as specified below, install wiring in conduit. Unless otherwise specified, final 600 mm (2') connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.

.3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.

.4 Wiring work is to be in accordance with certified wiring schematics and instructions, and wiring standards specified in appropriate Sections of Electrical Work Specification.

3.07 IDENTIFICATION AND LABELLING OF EQUIPMENT AND CIRCUITS

.1 Refer to identification requirements specified in Section 20 05 00 – Common Work Results for Mechanical.

.2 Identify equipment as follows:

.1 enclosures and components: engraved laminated nameplates with wording listed and approved prior to manufacture of nameplates;

.2 wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings.

3.08 TESTING, ADJUSTING, CERTIFICATION, START-UP, AND TRAINING

.1 When control work is complete, check installation of components and wiring connections, make any required adjustments, and coordinate adjustments with personnel doing HVAC testing, adjusting and balancing work.

.2 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system manufacturer certification requirements.

.3 Refer to Section 20 05 00 – Common Work Results for Mechanical for equipment/system start-up requirements.

.4 Include for 2 full, 8 hour days on-site operation demonstration and training sessions. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

.5 Include for 2 follow-up site training and troubleshooting visits, one 6 months after Substantial Completion and other at end of warranty period, both when arranged by Owner and for a full, 8 hour day to provide additional system training as required, and to demonstrate troubleshooting procedures.

End OF Section

1 General

1.01 SECTION INCLUDES

.1 Common requirements for electrical work.

.2 Mounting heights for electrical equipment and devices.

1.02 RELATED REQUIREMENTS

.1 Provisions of this section apply to all sections of Division 26, Division 27, and Division 28.

.2 Section 07 62 00 – Flashing and Sheet Metal.

.3 Section 07 85 00 – Firestopping and Smoke Seals.

.4 Section 08 31 00 – Access Doors and Panels.

.5 Section 09 91 00 – Painting.

.6 This section is to be read in conjunction with Division 00 documents, and Division 01 specification sections, which take precedence as described in CCDC 2-2020.

.1 General Conditions.

.2 Supplementary General Conditions.

.3 General Requirements.

1.03 INTENT

.1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter.

.2 Leave complete systems ready for continuous and efficient satisfactory operation.

.3 Discipline and Trade Jurisdiction

.1 In accordance with CCDC 2-2020 GC 1.1.9: Neither the organization of the Specifications nor the arrangement of Drawings shall control the Contractor in dividing the work among Subcontractors and Suppliers.

.2 MasterFormat's organizational structure used in a project manual does not imply how the work is assigned to various design disciplines, trades, or subcontractors. MasterFormat is not intended to determine which particular elements of the project manual are prepared by a particular discipline. Similarly, it is not intended to determine what particular work required by the project manual is the responsibility of a particular trade. A particular discipline or trade is likely to be responsible for subjects from multiple Divisions, as well as from multiple Subgroups.

1.04 DRAWINGS AND SPECIFICATIONS

.1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a ruling is to be obtained from the Consultant in writing before submitting Bid. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.

.2 All drawings and all Divisions of these specifications shall be considered as a whole, and work of this Division shown anywhere therein shall be furnished under this Division.

.3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of conductors and wiring is not assured. Exact requirements are governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull and junction boxes, etc. necessitated by such conditions are to be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.

.4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job. Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other, as well as other obstructions.

.5 Determine final locations of major work within ceiling spaces based on the largest equipment first.

.6 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.

.7 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made at no additional cost to the Owner.

.8 Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc. may not be shown, but where such items are required by other sections of the specifications of where there are required for proper installation of the work, such items are to be furnished and installed.

.9 Before ordering any conduit, cable tray, conductors, wireways, raceway bus duct, fittings, etc., verify all pertinent dimensions at the job site and be responsible for their accuracy.

.10 If obvious ambiguities or omissions are noticed when tendering refer same to the Consultant for a ruling and obtain the ruling in writing in the form of an Addendum. Claims for extras for ambiguities or omission of items brought to the attention of the Consultant after the award of a contract which, due to the nature of the ambiguity or omission, should have been brought to the attention of the Consultant during the tendering period, will not be allowed.

.11 The drawings are performance drawings, diagrammatic, and show locations for apparatus and materials. The drawings are intended to convey the scope of work and do not intend to show Architectural and Structural details. The locations shown are approximate, and may be altered, when approved by the Consultant, to meet requirements of the material and/or apparatus, other equipment and systems being installed, and of the building. Do not scale drawings.

.12 Control devices, equipment requiring maintenance, junction boxes, and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.

.13 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were foreseeable by a review of existing conditions or a review of drawings prepared by other disciplines.

.14 Where drawings indicate that acoustic tile ceiling is being suspended below existing plaster ceilings, coordinate the design of framework used to support this suspended ceiling, lighting, diffusers, and other components that are mounted within or through ceiling. Do not mount devices to suspended ceilings. Secure and mount to ceiling slab above. Seal ceiling openings to maintain required fire rating.

.15 Provide any fitting, offset, transformation, etc., required to suit architectural and structural details but not shown.

1.05 WORK RESTRICTIONS

.1 Refer to Section 01 10 00.

.2 Do all cutting, patching and making good to leave in a finished condition and to make the several parts of the Work come together properly. Co-ordinate work to keep cutting and patching to a minimum.

.3 Quality of workmanship and materials used in patching, making good and refinishing of existing construction and/or compartments shall be of a standard equal to that specified for new construction and if not specified, equal to or exceeding that of original existing work.

.4 Prior to cutting openings, examine wall, floor and ceiling construction for buried electrical cables and pipes; and take adequate protection. Conduct cable locating tests to locate buried cables in existing work.

1.06 ALLOWANCES

.1 Cash allowances are to be carried as indicated in Section 01 21 00 for the items indicated, each including all equipment, wiring material, labour, incidentals, profit, overhead, taxes, etc.

1.07 SUBSTITUTION PROCEDURES

.1 Refer to Section 01 10 00 and General Provisions of the Contract.

.2 Additionally, "Approved equal" shall be defined as a substitution approved by the Consultant.

.3 If during the tender bid process, the bidding contractor wishes to substitute the specified equipment for an "Approved equal", the bidding contractor must submit shop drawings to the Consultant before the tender close for approval. If no substitution request is made, the as-specified equipment is that to be provided.

.4 Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.

.5 This contractor, at his option, may use equipment as manufactured by any of the listed manufacturers. This Contractor is responsible to ensure that all items submitted by these other manufacturers meets are requirements of the drawings and specification and fits in the allocated space. The final determination of a product being equivalent is to be determined by the Consultant when a catalog number is not listed, or listed in part.

.6 Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Consultant as described in the General Provisions of the Contract for Submittals. The Contractor bears full responsibility for the unnamed manufacturers' equipment adequately meeting the intent of the design. The Owner or the Consultant may reject manufacturer at time of shop drawing submittal.

.7 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to the Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to the Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of proposed substitution. The Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are accepted in writing by the Consultant.

1.08 CONTRACT MODIFICATION PROCEDURES

.1 When submitting quotations in response to changes in the contract, quotations for electrical work are to include a breakdown of all material, including material unit rates, and labour units as indicated in the NECA Manual of Labor Units (MLU).

1.09 COORDINATION

.1 Refer to Section 01 30 00.

.2 Coordinate work with other trades to avoid conflict and to provide correct rough-in and connection for equipment furnished under other trades that require electrical connection. Inform Contractors of other trades of the required access to and clearances around electrical equipment to maintain serviceability and code compliance.

.3 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.

.4 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Co-operate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other trades.

.5 Coordinate utility service outages with the owner. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.

.6 Co-ordinate work with all trades to ensure a proper and complete installation. Notify all trades concerned of the requirement for openings, sleeves, insets and other hardware necessary for the installation and, where work is to be integrated with the work of other trades or is to be installed in close proximity with the work of other trades, carefully co-ordinate the work prior to installation.

.7 Working Detail Drawings

.1 The contractor is to prepare working detail drawings supplementary to the contract drawings, when deemed necessary by the Consultant, for all areas where a multiplicity of materials and or apparatus occur, or where the work due to architectural and structural considerations involves special study and treatment. Such drawings may be prepared jointly by all trades affected, or by the one trade most affected with due regard for and approval of the other trades, all as the Consultant will direct in each instance. Such drawings must be reviewed by the Consultant before the affected work is installed.

.2 Carry out all alterations in the arrangement of work which has been installed without proper study and approval, even if in accordance with the contract documents, in order to make such work come within the finished lines of walls, floors and ceilings, or to allow the installation of other work, without additional cost. In addition, make any alterations necessary in other work required by such alterations, without additional cost.

1.10 SUBMITTAL PROCEDURES

.1 Refer to Section 01 30 00.

.2 Before delivery to site of any item of equipment, submit shop drawings complete with all data, pre-checked and stamped accordingly, for review by the Consultant. Indicate project name on each brochure or sheet, make reference to the number and title of the appropriate specification section, type identifier such panelboard ID or luminaire type as indicated on appropriate schedule, and provide adequate space to accommodate the Consultant's review stamp(s).

.3 Verify field measurements and affected adjacent Work are coordinated, including passageway clearances for movement of equipment into location.

.4 Submit shop drawings to the Consultant in electronic (PDF) format, as coordinated after award of contract. Where submittals are derived from digital originals, do not print and rescan documents; submittals made as such will be immediately rejected.

.5 Submit a schedule of shop drawings within one week after award of contract. Group submittals by specification division as appropriate.

.6 Shop Drawings

.1 Submit for review, properly identified shop drawings showing in detail the design and construction of all equipment and materials as requested in sections of the specification governed by this Section.

.2 Obtain and comply with the manufacturer's installation instructions.

.3 Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS", stamp each copy with your company name, date each copy with the submittal date, and sign each copy. Shop drawings which are received and are not endorsed, dated and signed will be returned for re-submittal.

.4 The Consultant will stamp shop drawings as follows:

.1 Reviewed ( )

.2 Reviewed as Modified ( )

.3 Revise and Re-Submit ( )

.4 Not Reviewed ( )

.5 If "REVIEWED" is checked-off, the shop drawing is satisfactory. If "REVIEWED AS MODIFIED" is checked-off, the shop drawing is satisfactory subject to requirements of remarks put on shop drawing copies. If "REVISE AND RE-SUBMIT" is checked-off, the shop drawing is entirely unsatisfactory and must be revised in accordance with comments written on shop drawing copies and resubmitted. If "NOT REVIEWED" is checked-off, the shop drawing is in error of submission, not applicable for this project.

.6 This review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor, and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the contract documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co-ordination of the work as well as compliance with codes and inspection authorities such as CSA, etc.

.7 Confirm layouts of major electrical equipment rooms with the dimensions of as-procured equipment, and submit a layout sketch to the Consultant showing the major equipment and required clear spaces. The contractor may, at their option, revise the layout of the major electrical equipment rooms, but take responsibility for these new layouts and meeting the requirements of the local electrical utilities. Capture final room layouts on as-built drawings.

1.11 SUBMITTALS

.1 The Contractor is to submit dimensioned drawings or sketches that indicates the dimensions of the procured equipment, demonstrates that the equipment will fit in the allocated spaces, and demonstrates that manufacturer and code required clear spaces are provided.

.2 Include sketches for the following locations that includes at minimum, major equipment such as switchboards, panelboards, splitters, transformers, generators, transfer switches, major wall mounted or floor mounted telecommunications equipment, and fire alarm panels, passive graphics, and annunciator panels.

.1 Electrical rooms.

.2 Electrical closets.

.3 Telecommunications rooms.

.4 Mechanical rooms (layouts to be coordinated with mechanical trade).

.5 Area around outdoor generator enclosure.

1.12 SAFETY REQUIREMENTS

.1 Refer to Division 01.

.2 Be responsible for the safety of workers and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations prevail.

1.13 REGULATORY REQUIREMENTS

.1 Refer to Section 01 40 00.

.2 Codes and Standards

.1 Ontario Electrical Safety Code including all bulletins and amendments.

.2 Ontario Building Code and its referenced standards.

.3 Applicable CSA and ULC standards.

.4 All work shall be in accordance with Owner’s Design Guidelines.

.3 Permits and Fees

.1 Obtain and pay for all permits and fees required for the execution and inspection of the electrical work and pay all charges incidental to such permits. Submit to Electrical Inspection Department and Supply authority necessary number of drawings and specifications for examination and approval prior to commencement of work. Arrange and pay for any special inspection of equipment specified if and when required.

.2 Apply, pay and obtain all permits as required for the electrical work.

.3 Upon substantial completion of your work, supply and turn over to the Consultant all required inspection certificates from governing authorities to certify that the work as installed conforms to the rules and regulations of the governing authorities.

.4 Patents

.1 Pay all royalties and licence fees, and defend all suits or claims for infringement of any patent rights, and save the Owner, Architect, Project Manager and Consultants harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the work, in violation or infringement or such letters patent or rights.

1.14 REFERENCES

.1 CSA Group

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 CSA C235:19, Preferred voltage levels for AC Systems up to 50 000 V.

.3 Do underground systems in accordance with CSA C22.3 No. 7-15, Underground systems, except where specified otherwise.

.4 Ontario Electrical Safety Code (28th edition/2021), and all bulletins.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.4 Electrical utility requirements and local applicable codes and regulations.

.5 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.6 2012 Ontario Building Code.

.7 CAN/ULC-S1001-11, Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.15 DEFINITIONS

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.16 QUALITY ASSURANCE

.1 Refer to Section 01 40 00.

.2 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.

.3 Ensure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.

.4 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.

.5 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Consultant. Any unsatisfactory workmanship will be replaced at no extra cost.

.6 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this specification. Electrical Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all electrical equipment and materials in dry locations.

.7 Provide foreman in charge of this work at all times.

.8 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker’s Compensation, and Employer’s Liability Insurance.

.9 Governing Federal, Provincial and Municipal codes and regulations will be considered minimum standards for the work and where these are at variance with the drawings and specification, the more stringent ruling will apply.

.10 Where any code, regulation, bylaw, or standard is quoted it shall mean the current edition including all revisions or amendments at the time of the tender.

.11 In case of conflict, the codes and regulations take precedence over the Contract Documents. In no instance reduce the standard or scope of work or intent established by the drawings and specifications by applying any of the codes referred to herein.

1.17 QUALITY CONTROL

.1 Refer to Section 01 40 00.

.2 Provide a full time Superintendent to oversee and coordinate all sub-trades in these divisions.

1.18 TEMPORARY UTILITIES

.1 Refer to Section 01 50 00.

.2 Do not use any of the permanent facility systems during construction except as may be specified, or unless written approval is obtained from the Consultant.

.3 The use of permanent facilities for temporary construction service will not affect in any way the commencement day of the warranty period.

.4 Temporary heating during the construction period will be provided as described in Division 01.

1.19 TEMPORARY FACILITIES AND CONTROLS

.1 Refer to Section 01 50 00.

.2 Prior to start of each work period in occupied area, install temporary protection to prevent damage to any personal property or furnishing. Coordinate with Owner’s representative if any furniture must be relocated to facilitate work.

.3 Take necessary steps to ensure that required firefighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

1.20 PRODUCT REQUIREMENTS

.1 Refer to Section 01 61 00.

.2 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.

.3 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical inspection Services, or other government agency.

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

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

.6 Materials shall be of Canadian manufacture where obtainable. Materials of foreign manufacture, unless specified, shall be approved before being used.

.7 Equipment items shall be standard products of approved manufacturers. Identical units of equipment shall be of same manufacturer. In any unit of equipment, identical component parts shall be of same manufacturer, but the various component parts comprising the unit need not be of one manufacturer.

.8 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.

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

.10 Install materials in strict accordance with manufacturer's recommendations.

.11 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.

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

.13 Unless otherwise noted, equipment and material specifications in Sections of the Specification governed by this Section are based on products of a manufacturer selected by the Consultant for the purpose of setting a standard of quality, size, performance, capacity, appearance and serviceability.

.14 In most instances the names of acceptable manufacturers are also stated for materials and equipment, and you may base your tender price on equipment and materials produced by either the specified manufacturer or a manufacturer listed as acceptable.

.15 For any items of equipment, material, or for any system where acceptable manufacturers are not stated, you must provide only the equipment, material or system specified.

.16 If materials or equipment manufactured and/or supplied by a manufacturer named in the specifications are used in lieu of products of the manufacturer noted as “basis of design”, be responsible for ensuring that the substituted material or equipment is equivalent in size, performance and operating characteristics to the specified materials or equipment, and it shall be understood that all costs for larger starters, additional space, larger power feeders, and changes to associated or adjacent work required as a result of providing materials and equipment named as acceptable in lieu of the specified product will be borne by the Contractor.

.17 In addition to the manufacturers specified or named as acceptable, the Contractor may propose substitute manufacturers of equipment and/or apparatus to the Consultant for acceptance, listing in each case a corresponding credit for each substitute proposed, however, the tender price must be based on apparatus or materials specified or named as acceptable. Certify in writing to the Consultant that the substitution meets all space, power, design, and all other required of the specified or equivalent material or apparatus.

In addition, it shall be understood that all costs for larger starters, space, power feeders, and changes to associated equipment, mechanical and/or electrical, required by acceptance of proposed substitutions, will be borne by the party making the proposal. Substitute equipment requiring greater than specified energy requirements or unduly limiting service space requirements will not be accepted.

.18 Where a manufacturer is not listed for a particular product, it will be deemed to mean that the Contractor will provide the specified manufacturer's product.

1.21 EXAMINATION AND PREPARATION

.1 Refer to Section 01 70 00.

.2 Examine the existing equipment, the site and surrounding areas and be fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably have been ascertained by an inspection prior to Tender closing.

.3 Examine work upon which your work depends. Report in writing defects in such work. Application of your work shall be deemed acceptance of work upon which your work depends.

.4 Drawings are, in part, diagrammatic and are intended to convey scope of work and indicate general and approximate location, arrangement and sizes of equipment, piping, and similar items. Obtain more accurate information about locations, arrangement and sizes from study and coordination of drawings, including shop drawings and manufacturers' literature and become familiar with conditions and spaces affecting these matters before proceeding with work.

.5 Where job conditions require reasonable changes in indicated locations and arrangements, make such changes with approval of the Consultant at no additional cost to the Owner. Similarly, where existing conditions interfere with new installation and require relocation, such relocation is included in work.

1.22 CUTTING AND PATCHING

.1 Refer to Section 01 70 00.

.2 The Electrical Contractor will be responsible for all cutting and patching required for the electrical installation. Structural members are not to be cut without the consent of the Consultant.

.3 All cutting and patching required under Division 26, Division 27, and Division 28 shall be in accordance with Division 01. Layout such work for approval before undertaking same.

.4 Cutting shall be kept to an absolute minimum and performed in a neat and workmanlike manner using the proper tools and equipment. Caution shall be exercised in all cutting and procedures to ensure that concealed services are not affected. Do not cut if in doubt. Request the Consultant's presence to determine if concealed services exist.

.5 Assume responsibility for prompt installation of Work in advance of concrete pouring or similar Work. Should any cutting or repairing of finished/unfinished Work be required because such installation was not done, employ the particular trade, whose Work is involved, to do such cutting and patching. Pay for any resulting costs. Layout such Work for approval before undertaking same.

1.23 CLEANING AND WASTE MANAGEMENT

.1 Refer to Section 01 74 00.

.2 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this trade. At the completion of this work, the electrical installation is to be left in a clean and finished condition to the satisfaction of the Consultant.

.3 Clean and repair existing materials and equipment which remain or are to be reused.

.4 Luminaires to be reinstalled: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

.5 Assume responsibility for removing tools and waste materials on completion of Work, and leave Work in clean and perfect condition.

1.24 STARTING AND ADJUSTING

.1 Refer to Division 01.

.2 Conduct acceptance tests to demonstrate that the equipment and systems actually meet the specified requirements. Tests may be conducted as soon as conditions permit, and consequently make all changes, adjustments, or replacements required as the preliminary tests may indicate prior to the final tests. Tests shall be as specified in various sections of this Division. Carry out tests in the presence of the Consultant. Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project. The Electrical Contractor shall be in charge of the plant during tests. He shall assume responsibility for damages in the event of injury to the personnel, building, equipment, and shall bear all costs for liability, repairs, and restoration in this connection. Submit test results.

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

.4 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.

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

.6 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.

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

.8 Submit all test results in report format.

.9 Trial Usage

.1 The Consultant reserves the right to use any system, piece of equipment, device, or material for such reasonable lengths of time and at such times as may be required to make a complete and thorough test of the same, or for the purpose of learning operational procedures, before the final completion and acceptance of the work. Such tests shall not be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the above due to the aforementioned tests, where such injuries or breakage are caused by a weakness or inaccuracy of parts, or by defective materials or workmanship of any kind. Supply all labour and equipment required for such tests.

.2 Perform and pay for all costs associated with any testing required on the system components where, in the opinion of the Consultant the equipment manufacturer's ratings or specified performance is not being achieved.

1.25 CLOSEOUT PROCEDURES

.1 Refer to Section 01 70 00.

.2 The Consultant will carry out inspections and prepare deficiency lists for action by the Contractor, during, and on completion of project.

.3 Building Permit Compliance

.1 Provide a minimum of 10 business days notice to the Consultant for scheduling of Consultant's occupancy inspection.

.2 Prior to requesting the Consultant's letter "Review of General Conformance" for submission to the municipal building department to allow occupancy, the following items must be complete and submitted to the Consultant, as applicable:

.1 General

.1 Submit all applicable inspection reports from Authorities Having Jurisdiction.

.2 Continuity of fire separations at service penetrations must be complete.

.2 Electrical

.1 Provide Certificate of Acceptance from Electrical Inspection Department.

.2 Any devices not installed must have the wiring made safe and terminated in an outlet box complete with cover.

.3 All outlets must have cover plates installed. All electrical equipment not located in service rooms must have covers and/or doors installed complete.

.4 Emergency lighting system must be operational and tested by Contractor. Where battery units and remote heads are indicated on the drawing, provide certification letter from equipment manufacturer indicating the system meets code requirements.

.5 If the building is provided with emergency power with CSA C282 equipment (emergency generator or similar), the contractor is to perform light meter measurements and submit a letter indicating the system meets code requirements.

.6 Simulate normal power failure within the premises in the presence of the consultant and the owner's representative. Test and verify exit lights and emergency lighting operations under emergency conditions. Submit letter of certification copy to the Consultant stating that the systems have been tested, witnessed by the Consultant or the Owner's representative, etc., and the methods of installation and performance are satisfactory to all parties.

.7 All exit lights must be installed and operational.

.3 Electronic Safety and Security

.1 Fire alarm system and devices must be operational. Submit fire alarm verification report per CAN/ULC-S537, and submit audibility test. Indicate tap settings of all signalling devices.

.2 Functional testing of the fire alarm system and all interconnected systems per CAN/ULC-S1001 must be complete.

.3 If any of the above items have not been completed at the time of Consultant's Inspection, and the letter of "assurance of professional field review and compliance" cannot be issued, any costs for subsequent Inspections will be charged to the Contractor.

1.26 CLOSEOUT SUBMITTALS

.1 Refer to Section 01 78 00.

.2 Project Record Documents

.1 Provide extra sets of white prints on which to make, as the job progresses, all approved changes and deviations from the original drawings. Complete as-built drawings, accurately marked up in red ink must be submitted for review by the Consultant before the contract is considered to be complete.

.2 Changes and deviations include those made by addenda, change orders, and supplemental instructions, and changes and deviations to be marked on the white print record drawings indicated on supplemental drawings issued with addenda, change orders, and supplemental instructions. Maintain the "as-built" white prints at the site for periodic inspection by the Consultant throughout the duration of the work.

.3 Upon substantial completion of the work, obtain a set of reproducible white prints of the drawings and neatly amend the print in accordance with the marked-up white prints to produce a true "as-built" set of drawings.

.4 As-built drawings are to indicate all circuiting as installed and all distribution junction box locations as well as conduit routes.

.5 As-built Revit drawings

.1 Request release form from the Consultant, complete form, and submit completed release form to the Consultant for release of Consultant's BIM files.

.2 Transfer the information from the "as-built" white prints to the files, and submit to the Consultant for review.

.3 Employ a competent computer draftsperson to indicate changes on the electronic set of record drawings. Provide drawings in PDF and Revit formats.

.4 Submit three (3) USB flash drives including as-built drawings in Revit format, one with each O&M manual.

.5 Provide three (3) sets of full size as-built drawings in hard copy format, one with each O&M manual.

.6 As-built Single Line Diagram

.1 Provide in Main Electrical Room one wall mounted copy of as-built Single Line Diagram on 6 mm (1/4 in) foam board.

.2 As-built Single Line Diagram to indicate manufacturer name and catalogue numbers of as-installed products.

.3 Operations and Maintenance (O&M) Data

.1 Submit two complete sets of Operation and Maintenance instruction manuals in hard copy, and one in electronic format. Include in each copy of the manual:

.1 Verification certificates for installation of life safety systems by the manufacturer's representative.

.2 A copy of "reviewed" shop drawings.

.3 Complete explanation of operating principles and sequences.

.4 Recommended maintenance practices and precautions.

.5 Complete wiring and connection diagrams.

.6 Certificates of guarantees.

.2 Ensure that operating and maintenance instructions are specific and apply to the model and types of equipment provided.

.3 Include attendance records for each training session in the O&M manual.

.4 Warranties

.1 Submit a written guarantee to the Owner for one year from the date of acceptance. This guarantee shall bind the contractor to correct, replace or repair promptly any defective equipment workmanship without cost to the Owner.

.2 All equipment, materials and workmanship shall be unconditionally guaranteed for a minimum period of one year from the date of acceptance.

.3 Provide warranty certificates, wherever given or required, in excess of the normal warranty period showing the name of the firm giving the warranty, dated and acknowledged, on specific equipment and systems.

.4 Warranties for temperature controls and building automation systems will start on the date of verification of acceptance by the Consultant.

.5 Include these certificates with the maintenance and operating manuals in the appropriate sections.

2 Products – Not Used

3 Execution

3.01 CONCRETE WORK

.1 Refer to Division 03 – Concrete.

.2 Provide all concrete work required for the electrical work. Reinstall surfacing as per architectural requirements.

.3 Provide a 100 mm (4 inch) high concrete housekeeping pad for floor mounted electrical distribution equipment, such as the following:

.1 Transformers.

.2 Switchgear and switchboards.

.3 Distribution panelboards.

.4 Engine Generators.

.5 Uninterruptible Power Supplies and batteries.

.6 Transfer Switches.

3.02 LINTELS

.1 Refer to Division 04 – Masonry.

.2 Lintels for openings in masonry shall conform with requirements of by-laws, and as approved by the Structural Engineer.

.3 Pay all costs for lintels over openings, required solely by the electrical trades, not shown on architectural or structural drawings.

3.03 METALS

.1 Refer to Division 05 – Metals.

.2 Steel construction required solely for the work of this trade, and not shown on architectural or structural drawings shall be provided by this Division to the requirements of Division 05.

3.04 FLASHING AND SHEET METAL

.1 Refer to Section 07 62 00.

.2 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.

.3 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.

3.05 FIRESTOPPING

.1 Provide firestopping in accordance with Section 07 85 00.

.2 Ensure that fire ratings of floors and walls are maintained.

.3 Provide ULC classified firestopping products by 3M, Hilti, STI, or approved equal which have been tested in accordance with CAN/ULC-S115.

.4 Pack clearance spaces, fill all spaces between openings, pipes and ducts passing through fire separations and install firestopping systems in accordance with the appropriate ULC system number for the products and type of penetration.

.5 Install firestopping systems using personnel trained or instructed by the product manufacturer.

3.06 ACCESS DOORS

.1 Provide access doors in accordance with Section 08 31 00.

.2 Before commencing installation of work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange the work to suit.

.3 Group conduit work to ensure the minimum number of access doors is required.

.4 Access doors are to be installed by the trade responsible for the particular type of construction in which the doors are required.

3.07 PAINTING AND FINISHES

.1 Refer to Section 09 91 00.

.2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

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

.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.

.5 Primary and final painting for Work, other than items specified as factory primed or finished, will be performed as described in Division 09 – Finishes.

.6 All electrical fittings, supports, hanger rods, pull boxes, channel frames, conduit racks, outlet boxes, brackets, clamps etc., to have galvanized finish or paint finish over corrosion-resistant primer.

.7 All panelboards, motor starters etc., to be factory finished with baked on enamel. All enamel to be baked on gloss over corrosion resistant primer.

.8 Touch up minor damage to finish on factory finished equipment. Items suffering major damage to finish shall be replaced at the direction of the Consultant.

.9 Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.

.10 Provide all exposed ferrous metal work on equipment with at least one factory prime coat, or paint one prime coat on job. Clean up or wire brush all equipment, etc., before painting.

.11 For factory applied finishes, repaint or refinish surfaces damaged during shipment, erection or construction work.

3.08 LOCATION OF OUTLETS

.1 Refer to Architectural drawings for dimensions denoting exact locations.

.2 The Consultant reserves the right to change the location of outlets to within 3 m from the point indicated on the plans without extra charge providing the Contractor is advised before installation is made.

.3 Location of lighting, convenience, telephone, power and communication outlets shall be subject to change, without extra cost to Owners, provided information is given prior to installation. No extra amount will be paid for extra labour and materials for relocating outlets up to 3000 mm from their original location nor will credits be anticipated where relocation up to 3000 mm reduces materials and labour. Other cases will be considered on their individual merits.

.4 Coordinate location of boxes with latest architectural drawings and instructions to suit door swings, millwork etc. prior to rough-in.

3.09 MOUNTING HEIGHTS AND DEVICE LOCATIONS

.1 Refer to architectural drawings for exact location of electrical equipment and devices.

.2 Architectural elevations take precedence over electrical elevations. If there are conflicts between architectural and electrical, adjust locations of electrical equipment at no additional cost to the owner.

.3 Prior to roughing-in, the contractor is to mark locations of electrical equipment and devices for conflicts with architectural, studs, etc. If conflicts are noted, inform the Consultant for a decision prior to commencing the rough-in.

.4 Mounting heights of equipment and devices listed below is from finished floor to centreline of equipment, unless specified or indicated otherwise.

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

.6 Install electrical equipment at following heights above finished floor (AFF). Dimensions are to centre of device unless indicated otherwise.

.1 Power door operator push buttons: 1000 mm.

.2 HVAC thermostats and manual HVAC controls: 1200 mm.

.3 Local switches, and manual lighting control devices:

.1 1100 mm.

.2 Locate on lock side of door.

.4 System furniture service fittings: to suit furniture layout.

.5 Wall receptacles:

.1 General: min. 400 mm AFF.

.2 Above top of counters: 175 mm.

.3 Above top of continuous baseboard heater, or mechanical heating/radiation units: 75 mm to bottom of device.

.4 In fan rooms, mechanical rooms, and electrical rooms: 1100 mm.

.5 For electric ranges: 130 mm.

.6 Outlets in raceways or millwork to be located as per Architectural details.

.7 Door bell pushbuttons: 1100 mm.

.8 Panelboards: as indicated in Section 26 24 16.

.9 Emergency lighting remote heads: 300 mm below finished ceiling, or 2400 mm AFF for exposed areas or areas with ceiling height above 2750 mm (9 feet).

.10 Communications:

.1 Typical communication outlets (voice and data): 400 mm.

.2 Communications outlets for wall mounted telephones, intercom, or similar: 1100 mm.

.3 Television outlets: 200 mm below finished ceiling.

.4 Wall mounted public address speakers: 2100 mm.

.5 Clocks: 2100 mm.

.11 Access control card readers and keypads: 900 mm.

.12 Fire alarm manual pull stations: 1200 mm.

.13 Wall mounted fire alarm audible devices, including bells or horns:

.1 2300 mm to the top of the device in areas of ceiling height 2450 mm or greater.

.2 150 mm below the finished ceiling for ceiling heights less than 2450 mm, measured to the top of the device.

.14 Wall mounted fire alarm visible signal devices, including strobes: 2300 mm.

.15 Fire Alarm emergency telephones: 1400 mm.

3.10 MANUFACTURER'S INSTRUCTIONS

.1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.

.2 Follow manufacturer's instructions where they cover points now specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.11 TESTS AND ACCEPTANCE

.1 The operation of the equipment and electrical system does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.

.2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.

.3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition, with raceway and conduit systems properly grounded, wiring free from grounds, shorts, and that the entire installation is free from any physical defects.

.4 Provide labour and material to conduct the integrated systems testing of interconnected life safety systems in accordance with CAN/ULC-S1001-11.

3.12 CLOSEOUT ACTIVITIES

.1 Refer to Section 01 70 00.

.2 In the presence of the Owner, demonstrate the proper operation of all systems.

.3 Instruct the Owner's designated representatives in all aspects of the operation and maintenance of systems and equipment listed in the trade sections governed by this Section. Obtain in writing from the Consultant a list of the Owner's representatives qualified to receive instructions.

.4 Arrange for and pay for the services of qualified service technicians and other manufacturer's representatives required for instruction of specialized portions of the installation.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Work in existing facilities.

.2 Electrical demolition.

1.02 RELATED REQUIREMENTS

.1 Section 02 41 19 – Selective Demolition.

1.03 SCHEDULING

.1 Refer to Section 01 14 00, and Section 01 73 00.

.2 All work in the existing building, other than minor works required to permit construction of the new Work, is to be performed in such a manner as to not disrupt the building operations.

.3 All systems are to be kept in full operation during normal building hours.

.4 Coordinate any noise generating works that disrupt the building operation to be carried out after/before normal operating hours.

2 Products

2.01 MATERIALS

.1 Materials and equipment for patching and extending work: As specified in individual sections.

3 Execution

3.01 EXAMINATION

.1 Verification of Conditions

.1 Verify field measurements and circuiting arrangements are as shown on Drawings.

.2 Verify that abandoned wiring and equipment serve only abandoned facilities.

.3 Demolition drawings are based on visual field observations and conditions derived from existing drawings, and do not assess the interiors of electrical equipment. Report discrepancies to the Consultant before disturbing existing installation.

.4 Beginning of demolition means installer accepts existing conditions.

.2 Tracing Existing Electrical Circuits

.1 Trace all circuits in the area of work listed as existing, and verify existing conditions prior to any modifications as indicated.

.2 Where drawings indicate “connect to existing circuit”, use a spare breaker, where available. Otherwise, verify existing load with a meter and advise the Consultant if the additional load will cause a circuit to trip.

.3 Where provided panelboard schedules indicate "Existing Circuit" or similar, provide the correct description for the circuit. Existing Circuit will not be acceptable in the final panelboard schedules submitted as part of closeout submittals.

.3 Existing Cabling in Return Air Plenums

.1 In ceilings being used as a return air-plenum, Contractor to review existing low-voltage cabling uncovered as part of the work.

.2 Immediately notify the Consultant if any cables identified are not plenum rated (i.e. CMP, or FT6 rated).

.4 Existing feeders to remain.

.1 Where the drawings call for the re-use of existing feeders and re-connection to new equipment, (such as when equipment is replaced like-for-like), confirm the size and quantity of conductors of the existing feeder, and provide lug kits on new equipment suitable for the existing feeder.

3.02 PREPARATION

.1 Coordinate utility service outages with utility company.

.2 Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

.3 Existing electrical service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switch overs and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

.4 Existing Telephone System: Maintain existing system in service. Notify Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

.5 Existing Fire Alarm System: Maintain existing system in service. Minimize outage duration. Provide fire watch as required. Make temporary connections to maintain service in areas adjacent to work area.

3.03 DEMOLITION

.1 Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

.2 Demolish and extend existing electrical work to Section 02 41 19, and this Section.

.3 Remove, relocate, and extend existing installations to accommodate new construction.

.4 Remove abandoned wiring to source of supply.

.5 When relocating or removing equipment, should any circuits be abandoned, the conductors to these circuits must be removed or properly terminated as detailed in Ontario Electrical Safety Code (OESC) bulletin 12-25-5, or latest revision.

.6 Provide knockout fillers when removing circuits from any panelboard or splitter.

.7 Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

.8 Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

.9 Disconnect and remove abandoned panelboards and distribution equipment.

.10 Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

.11 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

.12 Repair adjacent construction and finishes damaged during demolition and extension work.

.13 Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

.14 Maintain continuity of existing services for other circuits/devices serving areas outside the Work area. Provide additional wiring/conduits/boxes etc. to suit existing services to be maintained, and also implement new Work as detailed.

3.04 RESTORATION

.1 Install relocated materials and equipment under the provisions of Division 01.

3.05 CLEANING

.1 Clean and repair existing materials and equipment which remain or are to be reused.

.2 Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

.3 Waste Management

.1 Turn over designated equipment to the Owner.

.2 Dispose of unwanted materials and equipment.

3.06 PROTECTION

.1 Maintain access to existing electrical installations which remain active. Modify installation or provide access panels as appropriate.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Building wire and cable.

.1 Armoured cable.

.2 Metal clad cable.

.3 Wiring connectors and connections.

.2 Permitted voltage drop for feeder and branch circuits.

.3 Conductor sizes are based on copper unless indicated as aluminum or "AL".

1.02 REFERENCES

.1 CSA Group:

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.3 CSA C22.2 No. 0.3-09 (R2019), Test methods for electrical wires and cables.

.4 CSA C22.2 No. 48-15, Nonmetallic sheathed cable.

.5 CSA C22.2 No. 51-14, Armoured cables.

.6 CSA C22.2 No. 52-15, Underground secondary and service-entrance cables.

.7 CSA C22.2 No. 65-13, Wire connectors.

.8 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.

.9 CSA C22.2 No. 123-16, Aluminum sheathed cables.

.10 CSA C22.2 No. 131-14, Type TECK 90 cable.

.2 NECA (National Electrical Contractors Association) - Standard of Installation.

.3 NETA (International Electrical Testing Association) - ATS-2021 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

.4 CAN/ULC-S139:2017 – Standard Method of Fire Test for Evaluation of Integrity of Electrical Power, Data and Optical Fibre Cables.

1.03 COORDINATION

.1 Where wire and cable destination is indicated, and routing is not shown, determine exact routing and lengths required.

1.04 CLOSEOUT SUBMITTALS

.1 Record Documents: Indicate as-constructed feeder sizes on single line diagram.

.2 Megger test results.

1.05 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

2 Products

2.01 MANUFACTURERS

.1 American Wire Group.

.2 BICC Phillips.

.3 General Cable.

.4 Nexans.

.5 Prysmian.

.6 Southwire.

2.02 REGULATORY REQUIREMENTS

.1 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2.03 CONDUCTOR MATERIAL

.1 Submit bid based on copper conductors only.

.2 Aluminum: not permitted.

2.04 BUILDING WIRE

.1 RW90:

.1 Single copper conductor.

.2 Minimum #12 AWG for branch circuit wiring.

.3 Minimum #14 AWG for 120 V control wiring.

.4 Chemically cross-linked polyethylene insulation.

.5 Rated for 90 degrees C, (600 V).

.6 Suitable for handling to minus 40 degrees C.

.7 For interior installations in conduit.

.2 RWU90:

.1 Single copper conductor.

.2 Minimum 12 AWG for branch circuit wiring.

.3 Minimum 14 AWG for 120 V control wiring.

.4 Chemically cross-linked polyethylene insulation.

.5 Rated for 90 degrees C, 600 V.

.6 Suitable for handling to minus 40 degrees C.

.7 For exterior installations in conduit.

.3 T90 Nylon:

.1 Single copper conductor.

.2 Thin wall PVC insulation with nylon covering.

.3 Rated for 90 degrees C, 600 V.

.4 May be used up to size 10 AWG for interior installations.

.5 Base conduit fill on RW90 cable diameters.

2.05 ARMOURED CABLE

.1 General

.1 Connectors: standard as required, complete with anti-short rings.

.2 Runs to be limited to fixture drops and in walls, maximum exposed run 1.5 m.

.3 Do not daisy chain (leap frog) luminaires with armoured cable.

.2 Type AC.

.1 Two, three or four copper conductors rated RW90, 1000 V.

.2 Bare copper ground wire.

.3 Insulation Voltage Rating: 600 volts.

.4 Insulation Temperature Rating: 90 degrees C (194 degrees F).

.5 Insulation Material: Thermoplastic.

.6 Overall interlocked aluminum tape armour.

.3 Type SPC90:

.1 Use for LED lighting, fluorescent dimming controls, and other SMART building applications.

.2 Colour coded cable with power, control, and signal under one cable.

.3 12-2C Power with a 16-2C Control.

.4 Bare copper ground wire.

.5 Insulation Voltage Rating: 600 volts.

.6 Insulation Temperature Rating: 90 degrees C (194 degrees F).

.7 Insulation Material: Thermoplastic.

2.06 FIRE RATED CABLES

.1 General:

.1 2 hour fire rating to ULC S139 and to meet 2012 Ontario Building Code rule 3.2.7.10.

.2 Alternative means of compliance:

.1 Conduits encased in a minimum of (50 mm (2 in)) of concrete.

.2 Be protected by a fire rated assembly listed to achieve the minimum fire rating as indicated.

.2 Manufacturers:

.1 nVent Pyrotenax 1850 series Mineral Insulated (MI) cable.

.2 VITALink MC Brand Type MC RC90, manufactured by Marmon Wire & Cable Inc. (listed by ULC under ULC category code ‘FHIT7’ or ‘FHJR7’, dated 19 May 2015). This cable is not to be installed in conduit.

.1 Request quotation from manufacturer or manufacturer’s representative for field certification of installed Vitalink cables prior to requesting Consultant’s construction field review.

.2 Power cable must be installed according to UL protocol FHIT7.120 – Electrical circuit integrity systems certified in Canada.

.3 Substitution Limitations:

.1 “Lifeline” installed in conduit may only be considered if listed by ULC under ULC Category Codes ‘FHIT7’ or ‘FHJR7’.

2.07 TECK90 CABLE

.1 Single, three, or four conductors as indicated on drawings.

.2 Cable to CSA C22.2 No. 131.

.3 Conductors:

.1 Grounding conductor: copper.

.2 Circuit conductors: copper, size as indicated.

.4 Insulation: Cross-linked polyethylene (XLPE), type RW90, rating: 600 V.

.5 Inner jacket: polyvinyl chloride.

.6 Armour: interlocking aluminum.

.7 Overall covering: thermoplastic.

.8 Fastenings:

.1 One-hole steel straps to secure surface cables 50 mm diameter and smaller. Two-hole steel straps for cables larger than 50 mm diameter.

.2 Channel type supports for two or more cables at 1500 mm centres.

.3 Threaded rods: 6 mm diameter to support suspended channels.

.9 Connectors: Watertight, approved for TECK cable.

2.08 CONDUCTOR PULLING LUBRICANT

.1 Where pulling lubricant is required, use non-wax based cable lubricants compatible with cable manufacturer recommendations, such as American Polywater.

2.09 WIRING TERMINATION

.1 Lugs, terminals, or screws used for termination of wiring to be suitable for copper conductors. 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. Maintain phase sequence and colour coding throughout.

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

.1 Thomas & Betts – Marr Max Series

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

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

2.10 CONDUCTORS, WIRES, AND CABLES

.1 Indoor wiring installed in conduit, unless otherwise noted: 600 volt "RW90 XLPE".

.2 Wiring in channel back of fluorescent lighting fixtures: 600 volt type GTF or TEW.

.3 Lighting and power branch circuit wiring:

.1 Copper, minimum No. 12 gauge.

.2 Home runs to lighting and receptacle panels, which exceed 22 m (75 feet) in length: minimum No. 10 gauge.

.4 Size wires for 2 per cent maximum voltage drop to farthest outlet on a maximum 80 per cent loaded circuit.

.5 Outdoor wiring: “RWU90 XLPE”.

.6 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, except for neutrals which shall be white wherever possible.

.7 Colour coding as follows:

.1 Phase "A" - Red

.2 Phase "B" - Black

.3 Phase "C" - Blue

.4 Control - Orange

.5 Ground - Green

.6 Neutral - White

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

3 Execution

3.01 EXAMINATION

.1 Verify that field measurements are as indicated.

.2 Wire and cable routing indicated is approximate unless dimensioned.

.3 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

.4 Voltage Drop

.1 Ensure voltage drop in power and control conductors is in accordance with the requirements of the OESC.

.2 Size conductors accordingly when sizes are not identified.

.1 Feeder conductors: maximum voltage drop of 2 per cent.

.2 Branch circuit conductors: maximum voltage drop of 3 per cent.

.5 Verify that mechanical work likely to damage wire and cable has been completed.

.6 Verify that raceway installation is complete and supported.

3.02 PREPARATION

.1 Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

.1 Route wire and cable as required to meet project conditions.

.2 Install cable to CSA C22.1 and per manufacturer’s installation guidelines.

.3 Conduit and cable supports:

.1 All wiring to be installed in EMT at all exposed areas unless otherwise specified.

.2 All mechanical equipment to be connected with liquid tight flexible conduit.

.3 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.

.4 Conductors

.1 Provide separate neutral for each circuit. Common neutrals not permitted.

.2 Use solid conductor for feeders and branch circuits 10 AWG and smaller.

.3 Use stranded conductors for control circuits.

.4 Use conductor not smaller than 12 AWG for power and lighting circuits.

.5 Use conductor not smaller than 16 AWG for control circuits.

.6 Armoured cable (commonly referred to as BX) is only to be used for light fixture connections and limited to maximum 1830 mm in length.

.7 Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 25 m.

.5 Pulling conductors

.1 Pull all conductors into raceway at same time.

.2 Use suitable wire pulling lubricant for building wire 4 AWG and larger.

.3 Neatly train and lace wiring inside boxes, equipment, and panelboards.

.4 Protect exposed cable from damage.

.6 Connectors

.1 Use suitable cable fittings and connectors.

.2 Clean conductor surfaces before installing lugs and connectors.

.3 Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

.4 Use split bolt connectors for copper conductor splices and taps 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 per cent of insulation rating of conductor.

.5 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

.6 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

.7 Identification

.1 Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

.2 Where colour-coded tape is utilized, apply a minimum of 50 mm (2 inches) at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition.

.3 Utilize colour coding on bussing in panels and, switchgear, disconnects, and metering cabinets to match conductor colour coding.

3.04 SITE TESTS AND INSPECTIONS

.1 Perform continuity tests of all feeders, motor circuits, and branch circuits.

.2 Perform insulation-resistance test (megger test) on each feeder. Submit report to the Consultant.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Low-voltage control cabling.

.2 Control-circuit conductors.

1.02 REFERENCES

.1 CSA Group:

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.3 CSA C22.2 No. 0.3-09 (R2019), Test methods for electrical wires and cables.

.4 CSA C22.2 No. 48-15, Nonmetallic sheathed cable.

.5 CSA C22.2 No. 51-14, Armoured cables.

.6 CSA C22.2 No. 65-13, Wire connectors.

.7 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.

.8 CSA C22.2 No. 208-14, Fire alarm and signal cable.

.2 NECA (National Electrical Contractors Association) - Standard of Installation.

1.03 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.04 COORDINATION

.1 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

2 Products

2.01 REGULATORY REQUIREMENTS

.1 Conform to CSA C22.1.

.2 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2.02 LOW VOLTAGE WIRING

.1 LVT:

.1 Multi conductor PVC insulated.

.2 Bare copper ground conductor.

.3 Overall PVC jacket.

.4 Rated 30 V.

.5 CMP (FT6) rated if cable is exposed.

.6 CMR (FT4) rated if cable is installed in conduit.

.2 Category 5e Network Cabling.

.1 CMP (FT6) rated if cable is exposed.

.2 CMR (FT4) rated if cable is installed in conduit.

2.03 TERMINATIONS AND SPLICES

.1 All terminations and splices shall be of an approved type for the conductors being used.

.2 Where conductors are terminated or spliced, it shall be done in the following manner:

.1 Where a single solid conductor is terminated in a device under one screw or clamping mechanism, no additional terminating hardware is required.

.2 Where multiple or stranded conductors are terminated in a device under one screw or clamping mechanism, self insulated crimp-on cable ends or approved equal shall be used up to and including No. 10 sized conductors. Approved compression lugs shall be used for larger conductor sizes.

.3 Where multiple conductors are spliced, properly sized Wing Nut connectors, or approved equal, shall be used for up to two No. 8 or three No. 10 AWG conductors. Pressure type sleeve cable connectors, splices, tee's, etc., shall be used for all larger size connections and terminations.

.4 Insulate all bare surfaces of splices with heat shrink sleeving or equivalent.

.5 Conductors connected to ground rods for service or equipment grounding or to building structural or architectural elements shall be terminated, connected, and spliced using a thermoweld process or approved non-mechanical compression type connectors.

.3 Install all service and feeder conductors as continuous lengths without breaks, measured and cut based on site dimensions.

3 Execution

3.01 EXAMINATION

.1 Verify that mechanical work likely to damage wire and cable has been completed.

.2 Verify that raceway installation is complete and supported.

.3 Verify that field measurements are as indicated.

.4 Wire and cable routing indicated is approximate unless dimensioned.

3.02 PREPARATION

.1 Completely and thoroughly swab raceway before installing wire.

3.03 INSTALLATION

.1 Route control cabling as required to meet project conditions.

.2 Install cable to the CSA C22.1.

.3 Conduit and supports

.1 All wiring to be installed in EMT at all exposed areas and in partitions unless otherwise specified.

.2 All mechanical equipment to be connected with liquid tight flexible conduit.

.3 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.

.4 Conductors

.1 Use stranded conductors for control circuits.

.2 Use conductor not smaller than 16 AWG for control circuits.

.5 Pulling conductors

.1 Pull all conductors into raceway at same time.

.2 Neatly train and lace wiring inside boxes, equipment, and panelboards.

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

.4 Protect exposed cable from damage.

.6 Connectors

.1 Use suitable cable fittings and connectors.

.2 Clean conductor surfaces before installing lugs and connectors.

.3 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

.4 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

.7 Identification

.1 Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

.2 Where colour coded tape is utilized, apply a minimum of 50 mm (2 inches) at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Grounding electrodes and conductors.

.2 Equipment grounding conductors.

.3 Bonding.

.4 The terms “connect” and “bond” are used interchangeably in this Specification and have the same meaning.

1.02 RELATED REQUIREMENTS

.1 Section 27 05 26 – Grounding and Bonding for Communications Systems.

1.03 REFERENCES

.1 CSA Group

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.3 CSA C22.2 No.0.4-17, Bonding of electrical equipment.

.4 CSA C22.2 No. 41-13, Grounding and bonding equipment.

.5 CSA C22.2 No. 75-17, Thermoplastic insulated wires and cables.

.2 ANSI/TIA/EIA J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

.3 Institute of Electrical and Electronics Engineers, Inc.

.1 IEEE 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

1.04 ACTION SUBMITTALS

.1 Product Data: Provide for grounding electrodes and connections.

1.05 INFORMATIONAL SUBMITTALS

.1 Test Reports: Indicate overall resistance to ground and resistance of each electrode.

.2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 CLOSEOUT SUBMITTALS

.1 Project Record Documents: Record actual locations of components and grounding electrodes.

.2 Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.07 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years' experience.

1.08 REGULATORY REQUIREMENTS

.1 Products: Listed and classified testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2 Products

2.01 MANUFACTURERS

.1 B-Line by Eaton.

.2 Hubbell (Burndy).

.3 Panduit.

.4 Thomas & Betts.

2.02 PERFORMANCE CRITERIA

.1 Grounding System Resistance: 5 ohms.

.2 Provide all equipment grounding as required regardless of whether it has been shown on drawings or called for in this specification. Arrange grounds so that under normal operating conditions no injurious amount of current will flow in any grounding conductor.

2.03 GROUNDING AND BONDING CONDUCTORS

.1 Electrical grounding conductors shall be CSA C22.2 No. 75 insulated stranded copper, except that sizes #10 AWG and smaller shall be solid copper. Insulation colour shall be continuous green for all equipment grounding conductors.

.2 Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes #10 AWG and smaller shall be ASTM B1 solid bare copper wire.

2.04 ROD ELECTRODES

.1 Material: Copper-clad steel.

.2 Diameter: 19 mm.

.3 Length: 3000 mm.

2.05 GROUND RODS

.1 Copper clad steel, 19 mm (3/4 inch) diameter by 3000 mm (10 feet) long, conforming to CSA C22.2 No. 41.

.2 Quantity of rods shall be as required to obtain the specified ground resistance.

2.06 SPLICES AND TERMINATION COMPONENTS

.1 Components shall meet or exceed CSA C22.2 No. 41, and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.07 GROUND CONNECTIONS

.1 Below Grade: Exothermic-welded type connectors.

.2 Above Grade:

.1 Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.

.2 Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

2.08 GROUND TERMINAL BLOCKS

.1 At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.09 SPLICE CASE GROUND ACCESSORIES

.1 Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 6 AWG insulated ground wire with shield bonding connectors.

2.10 MECHANICAL CONNECTORS

.1 Material: Bronze.

2.11 WIRE

.1 Material: Stranded copper.

.2 Foundation Electrodes: 2/0 AWG.

.3 Grounding Electrode Conductor: Size to meet Ontario Electrical Safety Code requirements.

2.12 GROUNDING WELL COMPONENTS

.1 Well Pipe: 200 mm by 600 mm long concrete pipe with belled end.

.2 Well Cover: Cast iron with legend "GROUND" embossed on cover.

3 Execution

3.01 EXAMINATION

.1 Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

.1 General

.1 Ground in accordance with the Ontario Electrical Safety Code, as shown on drawings, and as hereinafter specified.

.2 System Grounding:

.1 Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.

.2 Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

.3 Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

.4 Ground electrical equipment and wiring in accordance with Ontario Electrical Safety Code and Local Inspection Authority's Rules and Regulations.

.5 Install grounding conductors, outside Electric Rooms and Electrical Closets in conduit and conceal where possible. Make connections to water mains, all metallic piping systems, neutral and equipment with brass, copper or bronze bolts and connectors or weld using Cadweld or Thermoweld processes.

.6 Provide grounding conductors, sized as per Code, and connect to grounding bus or water main wherever non-raceways are installed.

.2 Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.

.3 Provide bonding to meet Regulatory Requirements.

.4 Bond together metal siding not attached to grounded structure; bond to ground.

.5 Install ground grid under access floors indicated.

.6 Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use #6 AWG bare copper conductor.

.7 Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

.8 Ground Resistance

.1 Grounding system resistance to ground not to exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Owner. Final tests shall assure that this requirement is met.

.2 Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

.3 Services at power company interface points shall comply with the power company ground resistance requirements.

.9 Ground Rod Installation

.1 Drive each rod vertically in the earth, not less than 3000 mm (10 feet) in depth.

.2 Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

.3 Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.

.10 Inaccessible Grounding Connections

.1 Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

.11 Secondary Equipment and Circuits

.1 Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.

.2 Metallic Piping, Building Steel, and Supplemental Electrode(s):

.1 Provide a grounding electrode conductor sized per code between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to CSA C22.2 No 41.

.2 Provide a supplemental ground electrode and bond to the grounding electrode system.

.3 Conduit Systems:

.1 Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.

.2 Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.

.3 Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

.4 Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.

.5 Boxes, Cabinets, Enclosures, and Panelboards:

.1 Bond the equipment grounding conductor to each pull box, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).

.2 Provide lugs in each box and enclosure for equipment grounding conductor termination.

.3 Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

.6 Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

.7 Raised Floors: Provide bonding of all raised floor components.

.12 Corrosion Inhibitors

.1 When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

.13 Conductive Piping

.1 Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.03 FIELD QUALITY CONTROL

.1 Perform inspections and tests listed in NETA ATS, Section 7.13.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Conduit and equipment supports.

.2 Anchors and fasteners.

1.02 REFERENCES

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.3 CECA - Canadian Electrical Contractors Association.

1.03 CLOSEOUT SUBMITTALS

.1 Submit the following in the Operation and Maintenance Manual for products used over the course of the project:

.1 Product Data: Provide manufacturer's catalogue data for fastening systems.

.2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.04 REGULATORY REQUIREMENTS

.1 Provide products listed and classified by Canadian Standards as suitable for purpose specified and shown.

2 Products

2.01 MANUFACTURERS

.1 B-line by Eaton.

.2 Burndy Canada Ltd. (Hubbell).

.3 Erico Caddy.

.4 E. Myatt & Co. Inc.

.5 Hilti Canada.

.6 Thomas & Betts.

.7 Unistrut.

2.02 GENERAL

.1 All supporting devices, strut channel, threaded rod, anchors, etc. to be used shall be of the “hot dipped” galvanized type. Electrogalvanized components will not be accepted.

.2 Materials and Finishes: Provide adequate corrosion resistance.

.3 Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

.4 Anchors and Fasteners:

.1 Concrete Structural Elements: Use expansion anchor sand preset inserts.

.2 Steel Structural Elements: Use beam clamps and welded fasteners.

.3 Concrete Surfaces: Use self-drilling anchors and expansion anchors.

.4 Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.

.5 Solid Masonry Walls: Use expansion anchors and preset inserts.

.6 Sheet Metal: Use sheet metal screws.

.7 Wood Elements: Use wood screws.

2.03 ANCHORS AND HANGERS

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

.2 Perforated strapping: not permitted.

2.04 INSERTS

.1 Use only factory-made threaded or toggle type.

.2 Where inserts cannot be placed, use factory-made expansion shields for light weights, where approved by the Consultant.

.3 Do not use powder-activated tools except with the written permission of the Consultant.

2.05 SLEEVES

.1 Through interior walls, use standard weight steel pipes, conduit, or 18 gauge galvanized steel. Cut flush with finished surfaces. Check room finish schedules.

.2 Through exterior walls above grade, floors, and roof use standard weight steel pipes, machine cut, flush with finished surface inside and to suit flashing outside.

.3 Through exterior walls below grade, water-proofed floors, and other water-proof walls, use heavy weight cast iron pipes, machine cut. Extend sleeves 100 mm (4 inches) above finished floors, and cut flush with underside of floor.

2.06 STEEL CHANNEL

.1 Description: Painted steel.

2.07 SUPPORTS

.1 Steel supports in wet or dry locations to be galvanized after fabrication.

.2 Where galvanized members are bolted together use cadmium plated bolts.

.3 For hanger rods use minimum 10 mm (3/8 inch) diameter steel threaded rod. Use clevis type attachment.

.4 Provide minimum 100 mm (4 inch) high concrete bases for all floor mounted equipment.

2.08 SUPPORTS AND BASES

.1 Submit proposed method of attachment of hangers and beam clamps, to cellular steel deck for approval before proceeding with Work.

.2 Supply and erect special structural Work required for the 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 Electrical panels, 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 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.

2.09 CONCRETE BASES AND HOUSEKEEPING PADS

.1 Provide concrete bases of dimensions where indicated, but not less than 100 mm (4 inches) larger in both directions than supported unit, and 100 mm (4 inches) high, and so anchors will be a minimum of 10 bolt diameters from edge of the base. Chamfer edges.

.2 Use 20 MPa (3000 psi) 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 – Concrete.

.3 Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 450 mm (18 inch) centres around full perimeter of base.

.4 Anchor equipment to concrete base.

.5 Provide a housekeeping pad for floor mounted equipment, including but not limited to the following:

.1 Transformers.

.2 Switchgear and switchboards.

.3 Distribution panelboards.

.4 Engine Generators.

.5 Uninterruptible Power Supplies and batteries.

.6 Transfer Switches.

2.10 CONCRETE ANCHORS

.1 Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

.2 Drilled expansion anchors for anchors set in concrete block or poured concrete after the concrete has set. Size the insert and number of anchors so that the maximum load per anchor does not exceed the manufacturer's recommendation.

.3 U-channel concrete inserts shall be 12 gauge steel 1-5/8 in square with insert anchors 1 3/8 in long and 100 mm (4 in) on centre.

.4 Install anchor bolts to elevations required for proper attachment to supported equipment.

2.11 PLYWOOD EQUIPMENT BOARDS

.1 Plywood Equipment Boards: preservative treated, and kiln dried; thickness as indicated, or if not indicated, not less than 19 mm (3/4 inches) deep. Provide marine grade plywood where subject to moisture conditions.

.2 Paint plywood board white, or to match adjacent finishes. Leave the fire-retardant label unpainted for verification by the Consultant and by Authority Having Jurisdiction (AHJ).

.3 Unless otherwise noted, boards shall be painted with two coats of good grade weatherproof flat gray non-conductive fire-retardant paint on all sides and edges (prior to mounting) and plumbed in a true vertical position. Provide nominal 13 mm (1/2 in) rustproof spacers between back of plywood and wall. Cut, fit, and place plywood equipment boards accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members. Attach to substrates as required to support applied loads. Maintain at least 100 mm (4 inches) from bottom of plywood equipment boards and the finished floor surface.

.4 Unless directed otherwise in field, plywood equipment boards shall be 2440 mm (8 feet) high by 19 mm (3/4 inches) deep by length shown on drawings (as dimensioned or as scaled) or length as required to accommodate equipment if not indicated on drawings. Unless directed otherwise in field, provide plywood equipment boards for all indoor surface mounted panelboards and systems "head-end" equipment for all applications where located in mechanical or electrical rooms/areas and only where specifically shown on drawings for all other applications.

2.12 ROOF SUPPORTS

.1 High-density polyethylene platform and base, height adjustable with rounded corners and edges to reduce likelihood of roof penetration.

.2 Large surface area to spread the weight of supported objects including conduits, and cable trays over a large surface footprint.

.3 No penetration of the waterproof membrane.

.4 Self drains water, rot proof, and sunlight resistant.

.5 Manufacturers:

.1 Thomas & Betts Superstrut Adjustable Universal Support.

.2 Eaton Dura-Blok series.

3 Execution

3.01 INSTALLATION

.1 Obtain permission from the Consultant before drilling or cutting structural members.

.2 Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

.3 Install surface-mounted cabinets and panelboards with minimum of four anchors.

.4 In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm (1 inch) off wall.

.5 Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

.6 Provide inserts, sleeves, equipment supports and hangers, sealing of sleeves and openings, as required for all electrical work. Ensure that the load onto structures does not exceed the maximum loading per square metre as shown on Structural Drawings or as directed by the Consultant.

.7 Provide insets, holes, anchor bolts and sleeves in time when walls, floors, and roof are erected.

.8 Place insets only in structural members and not in the finishing material.

.9 Secure all supports and hangers to the structure unless noted otherwise.

.10 Suspend hanger rods from approved concrete inserts and from beam clamps. Obtain Consultant's approval before welding to steel structural members.

.11 Secure supports to precast concrete members to inserts originally cast into the members or by rods passing between the members and connected to a steel plate bearing.

.12 Sealing of Sleeves and Openings to Maintain Fire Rating

.1 Use Dow-Corning #3-6548 'Silicone RTV' foam, Thomas & Betts "Flamesafe' firestopsystem, Electrovert 'Flameseal" firestop putty, or approved equal materials installed in accordance with the manufacturer's specifications and recommendations.

.2 Submit data sheets for review prior to installation.

.13 Supports

.1 All conduits, panels, etc. to be securely and adequately supported.

.2 Where more than three conduits run together, conduit racks to be used.

.3 Single runs of conduit to be supported by galvanized conduit straps or ring bolt type hangers. Tie wire or perforated metal strap hangers will NOT be accepted.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Rigid steel conduit.

.2 Flexible metal conduit.

.3 Liquid tight flexible metal conduit.

.4 Electrical metallic tubing (EMT).

.5 Electrical non-metallic tubing (ENT).

.6 Rigid PVC conduit.

.7 Fittings and conduit bodies.

1.02 REFERENCES

.1 CSA Group:

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.3 CSA C22.2 No. 45.1:22 – Electrical rigid metal conduit – steel.

.4 CSA C22.2 No. 56-17 (R2022), Flexible metal conduit and liquid-tight flexible metal conduit.

.5 CSA C22.2 No. 83.1:07 (R2022), Electrical Metallic Tubing – Steel.

.6 CSA C22.2 No. 211.1-06 (R2021), Rigid types EB1 and DB2/ES2 PVC conduit.

.7 CSA C22.2 No. 211.2-06 (R2021), Rigid PVC (unplasticized) conduit.

.8 CSA C22.2 No. 227.1:19 (R2023), Electrical nonmetallic tubing.

.9 CSA C22.2 No. 227.2.1 is a Trinational standard with NMX-J-764-ANCE and UL 1660.

.10 CSA C22.2 No. 227.2.1:19 (R2023), Liquid-tight flexible nonmetallic conduit.

.11 CSA C22.2 No. 2420-09 (R2019), Belowground reinforced thermosetting resin conduit (RTRC) and fittings.

1.03 RECORD DOCUMENTATION

.1 Accurately record actual routing of conduits larger than 51 mm (2 in).

.2 Accurately record actual routing of all conduits installed below grade, regardless of size, including whether direct buried or installed in concrete duct bank.

1.04 REGULATORY REQUIREMENTS

.1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for purpose specified and shown.

1.05 DELIVERY, STORAGE, AND HANDLING

.1 Accept conduit on site. Inspect for damage.

.2 Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.06 PROJECT CONDITIONS

.1 Verify that field measurements are as shown on drawings.

.2 Verify routing and termination locations of conduit prior to rough-in.

.3 Conduit routing, if shown on drawings, is approximate unless dimensioned. Route as required to provide a complete wiring system.

2 Products

2.01 MANUFACTURERS

.1 Where products are listed in this section based on a single manufacturer, the equivalent product from the following manufacturers is acceptable:

.1 Appleton.

.2 Columbia-MBF.

.3 Crouse-Hinds by Eaton.

.4 Hubbell.

.5 Thomas & Betts Ltd.

2.02 RIGID METAL CONDUIT

.1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel, threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Fittings and conduit bodies: Material to match conduit.

2.03 FLEXIBLE METAL CONDUIT

.1 Flexible metal conduit: to CSA C22.2 No. 56, interlocked steel construction.

.2 Fittings: CSA C22.2 No. 56.

2.04 LIQUID TIGHT FLEXIBLE METAL CONDUIT

.1 Description: Interlocked steel construction with PVC jacket.

.2 Fittings: CSA C22.2 No. 56.

2.05 ELECTRICAL METALLIC TUBING (EMT)

.1 Description: CSA C22.2 No. 83.1; galvanized tubing.

.2 Fittings and Conduit Bodies: CSA C22.2 No. 83.1; steel type.

2.06 ELECTRICAL NON-METALLIC TUBING (ENT)

.1 To CSA C22.2 No. 227.1.

2.07 NON-METALLIC CONDUIT

.1 Rigid Type EB1 PVC Conduit: to CSA C22.2 No. 211.1.

.2 Rigid Type DB2/ES2 PVC Conduit: to CSA C22.2 No. 211.1.

2.08 CONDUIT, FITTINGS, AND ACCESSORIES

.1 Conduit accessories, conduits and fittings conforming to CSA Standard C22.2 No. 18-1972.

.2 Provide rain tight connectors, couplings, fittings, junction boxes, pull boxes and surface outlet boxes shall be used for surface conduit installations exposed to moisture or in sprinklered buildings.

.3 Rigid conduit bushings:

.1 Thomas & Betts Ltd. - Series 5031.

.4 EMT Connectors:

.1 Thomas & Betts Ltd. - Steel City TC121A series.

.5 Ground Bushings:

.1 Thomas & Betts – Blackjack or 1220 series.

.6 Flexible conduit connectors:

.1 Thomas & Betts Ltd. - Series 3110.

.2 EMT couplings: steel concrete tight to match connectors.

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

.1 Thomas & Betts – 8125 series.

.8 Terminate EMT entering boxes or enclosures with nylon insulated steel concrete tight connectors.

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

.1 Thomas & Betts – 5332 series.

3 Execution

3.01 PREPARATION

.1 Produce layout sketches of conduit runs through mechanical and electrical service areas, through corridors, and other congested areas in order to resolve any interferences with other work, and to determine the most efficient route to run the conduit.

3.02 INSTALLATION

.1 Minimum size: 21 mm (3/4 inch) unless otherwise specified.

.2 Conceal all conduit except in mechanical rooms and electrical rooms, or unless otherwise indicated in this specification, or noted on the drawings. Surface conduit work is not permitted unless specifically noted.

.3 Install wiring in conduit unless otherwise specified. Where conduit sizes are not shown on drawings, provide conduits sized in accordance with Ontario Electrical Safety Code, CSA C22.1. When conduits are

indicated, they are the minimum size required, and must be increased to suit the length of run or voltage drop requirements.

.4 Conduit use:

.1 Unless otherwise specified below or shown on the drawings, all systems shall be installed in electrical metallic tubing (EMT).

.2 Equipment subject to vibration:

.1 Use liquid tight flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.

.3 Outdoor locations, above grade: use rigid steel.

.4 Underground: Use rigid PVC conduit for wiring in slabs on grade, and wiring below grade.

.5 Wet and damp locations:

.1 Use rigid steel.

.2 Use liquid tight flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.

.6 Dry locations:

.1 Concealed in metal stud partitions:

.1 Use electrical metallic tubing.

.2 Use of AC90 (Bx) as described in Section 26 05 19.

.2 Concealed in concrete: Use electrical non-metallic tubing or rigid PVC.

.3 Exposed areas: Use electrical metallic tubing.

.4 Use flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.

.5 Use liquid tight flexible metal conduit below raised floors for connections to all devices.

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

.7 Raceways installed less than 2 m above grade in an area where they are subject to mechanical damage, shall be of the rigid steel type or protected by a steel guard of not less than no. 10 MSG, adequately secured in place.

.8 Use epoxy coated conduit in corrosive areas.

.7 Equipment in sprinklered spaces:

.1 Provide CSA certified sealing rings for rigid steel galvanized conduit and CSA certified raintight connectors for steel galvanized electrical metallic tubing (EMT) where conduits enter the top or the sides of enclosures.

.8 Telecommunications conduits: in accordance with Section 27 05 28.

.5 Arrangement and supports

.1 Arrange supports to prevent misalignment during wiring installation.

.2 Arrange conduit to maintain headroom and present neat appearance.

.3 Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

.4 Group related conduits; support using conduit rack.

.5 Construct rack using steel channel; provide space on each for 25 per cent additional conduits.

.6 Fasten conduit supports to building structure and surfaces to Section 26 05 29.

.7 Do not support conduit with wire or perforated pipe straps.

.8 Remove wire used for temporary supports

.9 Do not attach conduit to ceiling support wires.

.10 Route exposed conduit parallel and perpendicular to walls.

.11 Route conduit installed above accessible ceilings parallel and perpendicular to walls.

.12 Route conduit in and under slab from point-to-point.

.13 In damp and unheated areas, avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

.14 Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.

.6 Clearances

.1 Maintain adequate clearance between conduit and piping.

.2 Maintain 300 mm (12 inch) clearance between conduit and surfaces with temperatures exceeding 40 degrees C.

.7 Conduit bends

.1 Install no more than equivalent of three 90 degree bends between boxes.

.1 Use conduit bodies to make sharp changes in direction, as around beams.

.2 Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 50 mm size or provide prefabricated conduit bends.

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

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

.10 Cut conduit square using saw or pipe cutter; de-burr cut ends.

.11 Bring conduit to shoulder of fittings; fasten securely.

.12 Use suitable caps to protect installed conduit against entrance of dirt and moisture.

.13 Use conduit hubs or sealing locknuts to fasten conduit and to cast boxes.

.14 Provide suitable pull string in each empty conduit except sleeves and nipples.

.15 Ground and bond conduit to Section 26 05 26.

.16 Identify conduit to Section 26 05 53.

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

3.03 CLEANING

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

End of Section

1 General

1.01 SECTION INCLUDES

.1 Wall and ceiling outlet boxes.

.2 Pull and junction boxes.

1.02 RELATED REQUIREMENTS

.1 Section 26 09 43 – Network Lighting Controls.

.2 Section 26 27 16 – Electrical Cabinets and Enclosures.

.3 Section 26 27 26 – Wiring Devices: Wall plates in finished areas, floor box service fittings, fire-rated poke-through fittings, and access floor boxes.

.4 Section 26 27 26.13 – Floor Box Assemblies.

1.03 REFERENCES

.1 CSA Group:

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.1 CSA C22.2 No. 18.1:13 (R2022), Metallic outlet boxes.

.2 CSA C22.2 No. 18.1-13 (R2022) – Metallic Outlet Boxes (Tri-national standard, with UL 514A and ANCE NMX-J-023/1).

.3 CSA C22.2 No. 40-17 - Junction and Pull Boxes.

.4 CSA C22.2 No. 85-14 (R2018) – Rigid PVC Boxes and Fittings.

1.04 CLOSEOUT SUBMITTALS

.1 Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.05 REGULATORY REQUIREMENTS

.1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

2 Products

2.01 OUTLET BOXES

.1 Sheet Metal Outlet Boxes: CSA C22.2 No. 18.1, galvanized steel.

.1 Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 13 mm male fixture studs where required.

.2 Concrete Ceiling Boxes: Concrete type.

.2 Non-metallic Outlet Boxes: CSA C22.2 No. 18.1.

.3 Cast Boxes: CSA C22.2 No. 18, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

.4 Wall Plates for Finished Areas: As specified in Section 26 27 26.

2.02 PULL BOXES AND JUNCTION BOXES

.1 Sheet Metal Boxes: CSA C22.2 No. 18.1, galvanized steel.

.2 Hinged Enclosures: As specified in Section 26 27 16.

.3 Surface Mounted Cast Metal Box: CSA C22.2 No. 18.1, Type 4; flat-flanged, surface mounted junction box:

.1 Material: Cast aluminum.

.2 Cover: Provide with ground flange, neoprene gasket, and stainless steel cover screws.

2.03 OUTLET BOXES

.1 Conform to CSA C22.2 No. 18.1.

.2 Where 103 mm (4 inch) square outlet boxes are installed in exposed concrete or cinder block finished areas, blocks will be cut as described in Division 04 as instructed under this Section. Cut openings to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Use of mortar to patch up openings that are cut too large or to patch ragged edges is not permitted.

.3 Ceiling boxes: 103 mm (4 inch) octagon or square, complete with fittings, where required to support fixtures.

.4 Switch and receptacle boxes:

.1 103 mm (4 inch) square with plaster ring, where flush mounted in plaster walls.

.2 Iberville 1104 series box, or equal, where flush mounted in wood or drywall, with stud fasteners as required.

.3 Masonry boxes in masonry walls.

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

.6 Standard outlet boxes manufactured from code gauge galvanized steel.

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

.8 Support outlet boxes independently of conduit and cable.

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

.10 Offset outlet boxes, shown back to back in partitions, horizontally a minimum 150 mm (6 inch) to minimize noise transmission between adjacent rooms.

.11 Use gang boxes at locations where more than one device, of the same system only, is to be mounted. Utilize separate boxes for each system.

.12 Use tile wall covers where 103 mm (4 inch) square outlet boxes are installed in exposed concrete or cinder block in finished areas.

.13 Provide flush mount boxes, panels, cabinets and electrical devices, which are installed in finished areas, with suitable flush trims and doors or covers, unless specifically noted otherwise.

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

3 Execution

3.01 EXAMINATION

.1 Verify locations of floor boxes prior to rough-in.

3.02 INSTALLATION

.1 Install boxes to CSA C22.1.

.2 Install in locations as shown on drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

.3 Set wall mounted boxes at elevations to accommodate mounting heights indicated.

.4 Electrical boxes are shown on drawings in approximate locations unless dimensioned. Adjust box location up to 3 m (10 feet) if required to accommodate intended purpose.

.5 Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

.6 Maintain headroom and present neat mechanical appearance.

.7 Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

.8 Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 150 mm (6 inch) from ceiling access panel or from removable recessed luminaire.

.9 Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods.

.10 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

.11 Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

.12 Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

.13 Use flush mounting outlet box in finished areas.

.14 Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

.15 Do not install flush mounting box back-to-back in walls; provide minimum 150 mm separation. Provide minimum 600 mm separation in acoustic rated walls.

.16 Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

.17 Use stamped steel bridges to fasten flush mounting outlet box between studs.

.18 Install flush mounting box without damaging wall insulation or reducing its effectiveness.

.19 Use adjustable steel channel fasteners for hung ceiling outlet box.

.20 Do not fasten boxes to ceiling support wires.

.21 Support boxes independently of conduit.

.22 Use gang box where more than one device is mounted together. Do not use sectional box.

.23 Use gang box with plaster ring for single device outlets.

.24 Use cast outlet box in exterior locations exposed to the weather.

.25 Use cast outlet box in wet locations.

.26 Set floor boxes level.

.27 Large pull boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.03 ADJUSTING

.1 Adjust floor box flush with finish flooring material.

.2 Adjust flush-mounting outlets to make front flush with finished wall material.

.3 Install knockout closures in unused box openings.

3.04 CLEANING

.1 Clean interior of boxes to remove dust, debris, and other material.

.2 Clean exposed surfaces and restore finish.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Metal Raceway is an enclosed pathway used for surface distribution of branch circuit electrical wiring, and cabling for voice, data, multi-media, low voltage, and optical fiber. Raceway is typically installed in existing building structures, or after construction is complete. A complete raceway system includes raceway, covers, mounting hardware, various fittings, and outlet boxes installed at specific locations. Specific codes and standards apply to electrical wires and telecommunications cables that are deployed within metal raceway. Compliance to codes and standards is required for installation, grounding and bonding, and cable deployment.

1.02 RELATED REQUIREMENTS

.1 Section 26 05 33.13 – Conduit for Electrical Systems.

.2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.03 QUALITY ASSURANCE

.1 Product free from defects in material or workmanship.

.2 Materials and work specified in this document shall comply with, and are not limited to the codes, standards, and regulations listed below.

.1 CSA C22.1 - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.

.2 National Electrical Manufacturer's Association (NEMA)

.1 ANSI/NEMA WD-6-2002: Wiring Devices – Dimensional Requirements

.2 NEMA 250-2003: Enclosures for Electrical Equipment.

.3 Performance Requirements:

.1 Metal raceway and fittings UL Listed and CSA certified.

1.04 SUBMITTALS

.1 Product Data Sheet.

.2 Manufacturer's Instructions.

.3 Product Catalog Literature.

.4 Product Drawings.

1.05 WARRANTY

.1 Product is warranted free of defects in material or workmanship.

.2 Product is warranted to perform the intended function within design limits.

2 Products

2.01 MANUFACTURERS

.1 Wiremold Legrand.

.2 Hubbell.

.3 Thomas & Betts Canada.

2.02 SURFACE MOUNTED RACEWAY, GENERAL

.1 The raceway and all system components must be UL Listed and exhibit non-flammable self-extinguishing characteristics tested to comparable specifications of UL94V-0. The raceway base and cover shall be manufactured by rigid compound, available in ivory or white colours, and allow for field painting.

2.03 METAL RACEWAY

.1 Metal raceway shall be a one-piece design with base and cover, factory assembled, with mounting hardware and instructions included.

.2 Metal raceway, cover, surface boxes, shall be a formed steel construction with a thickness of 0.040”, and zinc plated. Related fittings shall be galvanized on all surfaces.

.3 Metal raceway, cover, and related fittings shall have an Ivory colour powder coat paint finish on all external surfaces.

.4 Have tools available for field cutting and bending.

.5 Assembly and disassembly of raceway base, cover, and fittings requiring no special tools.

.6 Available fittings including couplings, internal and external elbows, tees, entrance fittings, conduit adapters and bushings.

.7 Available fittings including internal, external and flat elbows, and tee fitting, with a 1-½” radius to accommodate communications UTP and fiber cabling minimum bend radius requirements.

.8 Installed fittings designed to overlap the raceway to cover exposed or uneven edges from field cutting.

2.04 DEVICE BOXES

.1 Compatible device boxes shall have a removable knockout portion to permit metal raceway entry and exit.

.2 Device boxes available in standard NEMA single- and double-gang, and multiple gang up to six-gang. Device box depth shall range from 1.125” to 2.75”.

.3 Device boxes shall have a single seam construction with rounded corners to eliminate sharp edges.

.4 Assembled device box front face design to permit flush mounting of standard wall plates to minimize perimeter profile exposure.

.5 Device boxes shall have threaded standoff posts attached to the base, to facilitate mounting of covers with short screws for ease of alignment during installation.

3 Execution

3.01 PREPARATION

.1 Submit layout drawings of the raceway system for reviewed prior to installation.

.2 Installation of metal raceway in wet areas is not permitted.

.3 Manufacturer’s instructions for installing raceway and fittings shall be followed by the installer.

.4 All wall surfaces, or other permanent structures to which raceway is mounted shall be finished complete.

3.02 INSTALLATION

.1 Mount base and cover together to wall or structure using the appropriate fasteners and clips, per manufacturer's instructions.

.2 Securely support raceway in intervals not exceeding 3 m (10 feet) or per manufacturer's instructions.

.3 Install fittings and device boxes in the specified locations, per manufacturer's instructions and per contract drawing specifications.

.4 Completed raceway installation shall be mechanically continuous and connected to all electrical outlets, device boxes, and enclosures with no gaps or exposed cuts.

.5 Provide insulated ground wire for power raceways per OESC requirements. Raceway shall not be used as the primary ground path.

.6 Prior to wire and cable installation, the raceway system shall be installed complete, including insulating bushings, adapters, fittings, outlets, boxes, and enclosures. Unused raceway openings shall be closed.

.7 Make wiring connections with the proper approved insulated wire connectors or lugs. Exposed conductors at harness wiring junctions are not permitted regardless of connection method.

.8 Provide a physical barrier in raceway and boxes to separate power and communication wiring.

.9 Install covers on raceway, boxes and fittings after wiring is complete, or if wire and cable installation is to be done at a later date.

3.03 FIELD QUALITY CONTROL

.1 Verify layout of system to contract drawings.

.2 Raceway system shall be free of dents, scratches, bare metal edges, and exposed uneven cuts.

.3 Securely fasten all outlets, boxes, and enclosures walls or permanent structures.

.4 Verify that all wiring junctions or connections have no exposed conductors prior to energizing the circuits.

.5 Verify that all bonding locations are code and standards compliant.

.6 Verify that power and communications wiring are separated by a physical barrier in raceway and boxes.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Sleeves, sealing of sleeves and openings, as required for all electrical work.

1.02 SUBMITTALS

.1 Submit data sheets for firestopping in accordance with Section 01 30 00.

.2 Submit copies of firestopping drawings with ULC certificate and system number for each specific installation.

.3 Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.

.4 Submit dimensioned location drawings indicating required sleeves and formed openings in structural poured concrete or precast concrete construction or in roofing, and locations of cutting or drilling required for Electrical work.

2 Products

2.01 SLEEVES

.1 Galvanized steel sleeves:

.1 No. 24 gauge with an integral flange at one (1) end to secure sleeve to formwork construction.

.2 Schedule 40 pipe.

.2 Schedule 40 PVC sleeves.

2.02 SLEEVE SEALS

.1 Manufacturers

.1 Hilti Canada.

.2 Specified Technologies Inc.

.3 3M Canada Inc.

.4 Tremco.

.5 A/D Fire Protection Systems.

.6 Nelson.

.2 Asbestos-free, elastomeric materials and intumescent materials, tested, listed and labelled by ULC in accordance with CAN/ULC-S115, and CAN/ULC-S101 for installation in ULC designated firestopping, and smoke seal systems to provide a positive fire, water and smoke seal and a fire resistance rating (flame, hose stream and temperature) no less than fire rating for surrounding construction.

.3 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with firestopping manufacturer's recommendations and ULC tested assembly. Coordinate material requirements with trades supplying abutting areas of materials.

.4 Maintain fire rating of separation in accordance with architectural drawings.

3 Execution

3.01 INSTALLATION

.1 Where conduits and conductors pass through structural poured concrete, provide sleeves of type suitable for application, and approved by local governing codes.

.2 Sleeves in concrete slabs, except as noted below, are to be No. 24 gauge or equivalent, with an integral flange to secure sleeves for formwork construction.

.3 Sleeves in waterproof concrete slabs and in other slabs where waterproof sleeves are required are to be lengths of Schedule 40 pipe sized to extend 100 mm (4") above floor.

.4 Sleeves in poured concrete walls and foundation are to be Schedule 40 pipe.

.5 Through interior walls, use standard weight steel pipes, conduit, or galvanized steel. Cut flush with finished surfaces. Check room finish schedules.

.6 Through exterior walls above grade, floors, and roof use standard weight steel pipes, machine cut, flush with finished surface inside and to suit flashing outside.

.7 Through exterior walls below grade, water-proofed floors, and other water-proof walls, use heavy weight cast iron pipes, machine cut. Extend sleeves 100 mm (4") above finished floors, and cut flush with underside of floor.

.8 Size sleeves, unless otherwise noted, to leave 13 mm (1/2") clearance around conduit, duct, conductor, etc. Void between sleeves and conduit, duct, conductors, etc., to be packed and sealed for length of sleeves as in accordance with article entitled “Sleeve Seals” specified in this Section. Pack and seal sleeves set in exterior walls with governing authority approved materials suitable for application and pack both ends of sleeves watertight with approved permanently flexible and water tight materials. Coordinate exact responsibility of work with General Trades Contractor.

.9 Submit to concrete reinforcement detailer at proper time, drawings indicating required sleeves, recesses and formed openings in poured concrete work. Completely and accurately dimension such drawings and relate sleeves, recesses and formed openings to suitable grid lines and elevation datum.

.10 Supply sleeves of a water protecting type in accordance with detail found on drawings for installation in following locations:

- .1 in Mechanical and Fan Room floor slabs, except where on grade;
- .2 in slabs over Mechanical, Fan, Electrical and Telephone Equipment Rooms or closets;
- .3 in floors equipped with waterproof membranes.

.11 "Gang" type sleeving to be permitted only with approval of Owner and reviewed with the Consultant.

.12 Terminate sleeves for work which is exposed, so that sleeve is flush at both ends with wall, partition, or slab surface such that sleeve may be covered completely by escutcheon plates.

.13 Sleeves are not required in interior walls and dry area floors where conduit is installed ahead of floor construction.

.14 Seal all openings and sleeves after installation of equipment:

- .1 With an approved material to maintain fire rating where sleeves and openings pass through fire separations and floors.
- .2 With an approved material to maintain fire rating for sleeves and openings provided for future equipment.

.1 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.

.2 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.

.15 Provide all flashing and waterproofing for sleeves through roof and exterior walls to the requirements of Division 07.

.16 Firestop sleeves in accordance with the manufacturer's specifications and recommendations.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Tested firestop systems used in penetrations for the passage of cables, conduit, and other electrical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

1.02 RELATED REQUIREMENTS

.1 Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:

.1 Section 07 85 00 – Firestopping and Smoke Seals.

.2 Section 27 05 44 – Sleeves and Sleeve Seals for Communications Pathways and Cabling.

1.03 REFERENCES

.1 Underwriter's Laboratories (UL) and Underwriters Laboratories of Canada (ULC):

.1 Test Requirements: CAN/ULC-S115:2018, Standard Method of Fire Tests of Firestop Systems.

.2 Underwriters Laboratories of Canada (ULC) runs CAN/ULC-S115:2018 under their designation of ULC-S115:2018 and publishes the results in their "FIRE RESISTANCE RATINGS DIRECTORY" that is updated annually.

.3 Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually. UL tests that meet the requirements of ULC-S115-M are given a cUL listing and are published by UL in their "Products Certified for Canada (cUL) Directory.

.4 CAN/ULC-S102:2018, Standard Test Method for Surface Burning Characteristics of Building Materials and CAN/ULC-S101 Fire Endurance Tests of Building Construction and Materials.

.2 ASTM:

.1 Omega Point Laboratories runs ASTM E-814 and publishes the results annually in their "Omega Point Laboratories Directory".

.2 Inspection Requirements: ASTM E 2174, "Standard Practice for On-site Inspection of Installed Fire Stops.", and ASTM E2393 Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

.3 Test Requirements: ASTM E 2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus".

.4 ASTM D6904, "Standard Practice for Resistance to Wind Driven Rain for Exterior Coatings Applied on Masonry".

.5 ASTM C 679, "Standard Test Method for Tack-Free Time of Elastomeric Sealants".

.3 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.

.4 Ontario Building Code.

.5 Ontario Electrical Safety Code.

1.04 DEFINITIONS

.1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.05 SUBMITTALS

.1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 30 00.

.2 Manufacturer's engineering judgment identification number and drawing details when no ULC or cUL system is available for an application. Engineered judgment must include both project name and contractor’s name who will install firestop system as described in drawing.

.3 Submit material safety data sheets provided with product delivered to job-site.

.4 Submit shop drawings in accordance with Section 01 30 00:

.1 Submit complete cUL, ULC, or equivalent approved systems for all applications. Ensure the listing is clearly noted on the submittal.

1.06 CLOSEOUT SUBMITTALS

.1 On completion of firestopping and smoke sealing installation, submit a Letter of Assurance to the Consultant certifying the firestopping and smoke sealing installation has been carried out throughout the building to electrical service penetrations and that installation has been done in strict accordance with requirements of the Ontario Building Code, any applicable municipal bylaws, ULC requirements, and manufacturer’s instructions.

1.07 QUALITY ASSURANCE

.1 Fire-Test-Response Characteristics: Provide through-penetration fire stop systems and fire-resistive joint systems that comply with specified requirements of tested systems.

.2 Firestop System installation must meet requirements of CAN/ULC-S115 tested assemblies that provide a fire rating as shown in Section 2.1 Clauses 4, 5, 6, and 7 below.

.3 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.

.4 Firestop Systems do not re-establish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

.5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

1.08 INSTALLER QUALIFICATIONS

.1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary training to install manufacture’s products per specified requirements. A supplier’s willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

.2 Installation Responsibility: assign installation of through-penetration fire stop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor.

.3 The work is to be installed by a contractor with at least one of the following qualifications:

.1 FM 4991 approved contractor.

.2 UL approved contractor.

.3 Manufacturer’s accredited fire stop specialty contractor.

.4 Installer: Minimum 3 years experience with fire stop installation.

1.09 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.

.2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

.3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.

.4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

.5 Do not use damaged or expired materials.

1.10 PROJECT CONDITIONS

.1 Do not use materials that contain flammable solvents.

.2 Scheduling

.1 Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.

.2 Schedule installation of Drop-In firestop devices after placement of concrete but before installation of the pipe penetration. Diameter of sleeved or cored hole to match the listed system for the device.

.3 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.

.3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

.4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.

.5 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

2 Products

2.01 PERFORMANCE REQUIREMENTS

.1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

.2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

.3 Provide a round fire-rated cable management device whenever cables penetrate fire rated walls, where frequent cable changes and additions may occur. The fire-rated cable management device shall consist of a corrugated steel tube with zinc coating, contain an inner plastic housing, intumescent material rings, and inner fabric smoke seal membrane. The length of the sleeve shall be 315 mm (12.4 inches). The fire-rated cable management device shall contain integrated intumescent firestop wrap strip materials sufficient to maintain the hourly rating of the barrier being penetrated. The fire-rated cable management device shall contain a smoke seal fabric membrane or intumescent firestop plugs sufficient to achieve the L-Rating requirements of the barrier type. Install device per the manufacturer's published installation instructions.

.4 Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with CAN/ULC-S115. For penetrations through a Fire Wall or horizontal Fire Separation provide a firestop system with a "FT" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.

.5 W-ratings: in accordance with Section 07 85 00.

.6 Provide a firestop system with an Assembly Rating as determined by CAN/ULC-S115 which is equal to the time rating of construction joint assembly.

.7 Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with CAN/ULC-S115.

.1 L-Rating: Not exceeding 5.0 CFM/sqft of penetration opening at both ambient and elevated temperatures.

.8 Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of 0 as determined by ASTM G21.

.9 Rain and water resistance: provide perimeter joint sealant tested in accordance with ASTM D 6904 with less than 1 hour tack free time as tested in accordance with ASTM C 679.

2.02 MANUFACTURERS

.1 Manufacturer List:

.1 AD Fire Protection Systems.

.2 Hilti (Canada) Corporation

.3 3M.

.4 Specified Technologies, Inc. (STI).

.5 Tremco, Inc.

.2 Substitutions: Where a specific manufacturer is noted in this Section, equivalent products from the manufacturers listed above may be used, subject to compliance with through penetration firestop systems and joint systems listed in the ULC Fire Resistance Directory – Volume III, or UL Products Certified for Canada (cUL) Directory.

2.03 MATERIALS

.1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

.2 Accessories: provide components for each firestopping and smoke seal systems that are needed to install fill materials. Use only components specified by firestopping material manufacturer, and approved by the qualified testing agency. Accessories include, but are not limited to, the following items:

.1 Permanent forming, damming and backing material.

.2 Temporary forming material.

.3 Pre-formed firestop devices for use with non-combustible and combustible pipes (closed and open systems), conduit and/or cable bundles penetrating concrete floors and/or gypsum walls:

.1 Hilti Tub Box Kit (CP 681) for use with tub installations.

.2 Hilti Cast-In Place Firestop Device (CP 680-PX) for use with XFR pipe.

.3 Hilti Cast-In Place Firestop Device (CP 680-M) for use with non-combustible penetrants.

.4 Hilti Speed Sleeve (CP 653) for use with cable penetrations.

.5 Hilti Firestop Drop-In Device (CFS-DID) for use with non-combustible and combustible penetrants.

.6 Hilti Cast-in Firestop sleeve (CFS-CID MD P) and (CFS-CID MD M) for use with combustible and non-combustible pipes through metal deck.

.7 Hilti Firestop Block (CFS-BL).

.8 STI SpecSeal series SSC Firestop Collars.

.9 STI SpecSeal series LCC Firestop Collars.

.4 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT).

.1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).

.2 Hilti Fire Foam (CP 620)/CP 660.

.3 Hilti Flexible Firestop Sealant (CP 606).

.4 Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).

.5 Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).

.5 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe.

.1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).

.6 Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles.

.1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).

.2 Hilti Fire Foam (CP 620)/660.

.3 Hilti Flexible Firestop Sealant (CP 606).

.4 Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).

.5 Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).

.7 Firestop Putty Pads: Intumescent, non-hardening putty pads to be installed on metallic and non-metallic electrical switch and receptacle boxes to reduce horizontal separation between boxes to less than 610 mm (24 in):

.1 STI SpecSeal Series SSP Firestop Putty Pads.

.2 Hilti Firestop Putty Pad (CP 617).

.8 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.

.1 Hilti Firestop Block (CFS-BL).

.2 Hilti Composite Sheet (CFS-COS).

.3 Hilti Firestop Mortar (CP 637).

.4 Hilti Fire Foam (CP 620)/660.

.5 Hilti Firestop Board (CP 675T).

.9 Non-curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.

.1 Hilti Firestop Block (CFS-BL).

.2 Hilti Firestop Board (CP 675T).

.10 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls.

.1 Hilti Speed Sleeve (CP 653) with integrated smoke seal fabric membrane.

.2 Hilti Firestop Cable Collar (CFS-CC).

.3 Hilti Firestop Sleeve (CFS-SL SK).

.4 Hilti Retrofit Sleeve (CFS-SL RK) for use with existing cable bundles.

.5 Hilti Gangplate (CFS-SL GP) for use with multiple cable management devices.

.6 Hilti Gangplate Cap (CFS-SL GP CAP) for use at blank openings in gangplate for future penetrations.

.11 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected.

.1 Hilti CFS-BL Firestop Block (for walls and floors).

.2 Hilti CFS-PL Firestop Plug (for walls and floors).

.12 Cast-In-Place Firestop Device: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket. Device shall allow for a concrete floor thickness of minimum 63 mm (2-1/2 in) up to 914 mm (36 in) without the use of field applied extension tubing:

.1 STI SpecSeal CID Cast-In Firestop Device.

.2 Hilti CP 680 Cast-In Place Firestop Device (for floors only).

.13 For single or cable bundles up to one inch diameter penetrating gypsum, masonry, concrete walls or wood floor assemblies.

.1 Hilti CFS-D Firestop Cable Disc.

3 Execution

3.01 INSTALLERS

.1 Labour Use to Install Firestop Systems

.1 To ensure complete harmony on the project site, the installation of each scope of work is to be performed jurisdictionally correct per existing trade agreements.

3.02 PREPARATION

.1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

.1 Verify penetrations are properly sized and in suitable condition for application of materials.

.2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.

.3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

.4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.

.5 Do not proceed until unsatisfactory conditions have been corrected.

3.03 COORDINATION

.1 Coordinate construction of openings, penetrations to ensure that the fire stop systems are installed according to specified requirements.

.2 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems.

.3 Coordinate fire stopping with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems.

.4 Do not cover up through-penetration fire stop and joint system installations that will become concealed behind other construction until each installation has been examined by the building inspector.

3.04 INSTALLATION

.1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory or Omega Point Laboratories Directory.

.2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.

.1 Seal all holes or voids made by penetrations to ensure an air and water-resistant seal.

.2 Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.

.3 Protect materials from damage on surfaces subjected to traffic.

3.05 FIELD QUALITY CONTROL

.1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.

.2 Keep areas of work accessible until inspection by applicable code authorities.

.3 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, “Standard Practice for On-Site Inspection of Installed Fire Stops”, or other recognized standard.

.4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

.5 Manufacturer’s Field Services: During Installation, provide periodic destructive testing inspections to assure proper installation/application. After installation is complete, submit findings in writing indicating whether or not the installation of the tested system identified was installed correctly.

3.06 IDENTIFICATION AND DOCUMENTATION

.1 The firestop contractor is to supply documentation for each single application addressed. This documentation is to identify each penetration location on the entire project.

.2 The Documentation Form for through penetrations is to include:

.1 A Sequential Location Number.

.2 The Project Name.

.3 Date of Installation.

.4 Detailed description of the penetration location.

.5 Tested System or Engineered Judgment Number.

.6 Type of assembly penetrated.

.7 A detailed description of the size and type of penetrating item.

.8 Size of opening.

.9 Number of sides of assemblies addressed.

.10 Hourly rating to be achieved.

.11 Installer’s Name.

.3 Copies of these documents are to be provided to the general contractor at the completion of the project.

.4 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

.1 The words: "Warning-Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."

.2 Contractor's Name, address, and phone number.

.3 Through-Penetration firestop system designation of applicable testing and inspecting agency.

.4 Date of Installation.

.5 Through-Penetration firestop system manufacturer's name.

.6 Installer's Name.

3.07 ADJUSTING AND CLEANING

.1 Remove equipment, materials and debris, leaving area in undamaged, clean condition.

.2 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 This section provides minimum acceptance requirements for vibration isolation for all electrical equipment, conduit, and piping.

1.02 RELATED REQUIREMENTS

.1 Concrete work is described in Division 03.

1.03 SUBMITTALS

.1 All outdoor mounted equipment shall be restrained for the highest wind speed as specified by the project's structural engineer, the governing building code(s) or the authority having jurisdiction.

.2 Submit shop drawings for all devices specified herein and as indicated and scheduled on the drawings. Submittals shall indicate full compliance with the device specification in Part 2. Any deviation shall be specifically noted and subject to engineer approval. Submittals shall include device dimensions, placement, attachment and anchorage requirements.

1.04 CLOSEOUT SUBMITTALS

.1 Submit a letter from vibration isolation manufacturer to certify correct installation of products, as specified in Part 3 of this Section.

1.05 QUALITY ASSURANCE

.1 All vibration isolation systems shall be by one manufacturer.

.2 Unless otherwise directed by the local authority having jurisdiction, the following codes and standards will apply:

.1 International Building Code 2009.

.2 American Society of Civil Engineers 7-05.

.3 Ontario Building Code, Latest Edition.

.3 Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

2 Products

2.01 MANUFACTURERS

.1 Vibro-Acoustics.

.2 Kinetics Noise Control.

.3 BVA Systems.

.4 Vibron Limited.

.5 Mason Industries.

2.02 VIBRATION ISOLATION

.1 Springs: All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have kx/ky ratios of at least 0.9. All springs shall be fully colour-coded to indicate capacity – colour striping is not considered adequate.

.2 Corrosion Protection: All springs shall be powder-coated enamel. Housings shall be hot dipped galvanized, powder-coated enamel, or painted with rust-resistant paint.

.3 Isolators:

.1 Vibration Isolation Pads: Type N – Neoprene pad type isolators, 3/8" (10 mm) minimum thick, ribbed on both sides.

.1 Type NSN – Sandwich neoprene pad type isolators, with 3/8" (10 mm) minimum thick ribbed neoprene pads bonded to each side of a 10 ga (3.5 mm) minimum galvanized metal plate. Isolator pads shall be selected to ensure that deflection does not exceed 20% of isolator free height.

.2 Rubber-in-Shear Floor Mounts: Type RD – "Double-deflection" neoprene isolators, with neoprene-coated metal surfaces, and top and bottom surfaces ribbed. Isolators shall have bolt holes in the base.

.3 Restrained Spring Floor Mounted Isolators: Type CSR – Laterally stable, vertically restrained spring isolators with welded steel housings and heavy top plates for supporting equipment. Springs shall be supported either with a neoprene cup or a metal base plate complete with a ribbed neoprene pad, minimum 1/4" (6 mm) thick, bonded to the base plate. Housings shall include vertically restraining limit stops. Minimum clearance around the restraining bolts and between the housing and the spring shall be 1/2" (13 mm). Top plate and restraining bolts shall be out of contact with the housing during normal operation and neoprene grommets shall be incorporated to minimize short-circuiting of restraining bolts. For outdoor applications, housing must be hot-dip galvanized. For indoor applications, powder-coated finish for the housing is acceptable.

3 Execution

3.01 GENERAL

.1 Coordinate size, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation manufacturer to ensure adequate space and prevent edge breakout failures. Pads and piers must be adequately doweled into structural slab.

.2 Coordinate locations and sizes of structural supports with locations of vibration isolators (e.g., roof curbs, cooling towers, air-cooled chillers, etc.).

.3 Isolated equipment, duct and piping located on roofs must be attached to the structure. Intermediate supports between the restraint and structure that are not attached to the structure must be approved by the restraint manufacturer.

3.02 VIBRATION ISOLATION

.1 Ensure housekeeping pads have adequate space to mount equipment and isolator housings and shall also be large enough to ensure adequate edge distance for isolator anchors.

.2 Select and locate vibration isolation equipment to give uniform loading and deflection, according to weight distribution of equipment.

.3 Engine-generator set silencers and associated exhaust piping shall be supported with Type SHR isolators with a minimum 40 mm (1-1/2 inch) static deflection.

.4 Equipment Isolation:

						Floor Span								
			Slab on Grade			Up to 20 ft.			20 to 30 ft.			30 to 40 ft.		
Eqmt Type	HP and Other	RPM	Base Type	Isolator Type	Min. Defl., in.	Base Type	Isolator Type	Min. Defl., in.	Base Type	Isolator Type	Min. Defl., in.	Base Type	Isolator Type	Min. Defl., in.
Transformers and UPS's														
All	**All**	**All**	**N/A**	**NSN**	**0.12**	**N/A**	**NSN**	**0.12**	**N/A**	**NSN**	**0.12**	**NM**	**RD/NSN**	**0.25**
Engine-Driven Generators														
All	**All**	**All**	**N/A**	**CSR**	**0.75**	**N/A**	**CSR**	**1.50**	**N/A**	**CSR**	**2.50**	**N/A**	**CSR**	**3.50**
Notes:	**(1) Units that are suspended overhead shall use isolation hangers in place of floor mounted isolators with equal or greater deflection.** **(2) Floor spans are defined as the distance between structural support columns or walls.**													

.5 There shall be no rigid contact of isolated equipment with shaft walls, floor slabs, partitions, or non-flexible conduits connections.

.6 Where recommended by the manufacturer, isolator base plates shall be bolted to the structure or foundation. Bolting shall incorporate neoprene bushings and washers.

3.03 SITE TESTS AND INSPECTIONS

.1 After installation, arrange and pay for the vibration isolation product manufacturer, or representative, to visit the site to verify that the vibration isolation systems are installed and operating properly, and shall submit a certificate so stating. Verify that isolators are adjusted, with springs perpendicular to bases or housing, adjustment bolts are tightened up on equipment mountings, and hangers are not cocked.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Nameplates and labels.

.2 Wire and cable markers.

.3 Conduit markers.

.4 Receptacle labels.

.5 Signage.

1.02 RELATED REQUIREMENTS

.1 Section 27 05 53 – Identification for Communications Systems.

1.03 SUBMITTALS

.1 Product Data: Provide catalogue data for nameplates, labels, and markers.

.2 Provide shop drawings of nameplates for Consultant’s review prior to fabrication (scale 1:1).

.3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.04 REGULATORY REQUIREMENTS

.1 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2 Products

2.01 NAMEPLATES AND LABELS

.1 Nameplates:

.1 Engraved three-layer laminated plastic, letters on contrasting background.

.2 Colours to match existing building system, where applicable. If no building system exists, use the following:

.1 347/600 Volt system: White text on Blue background.

.2 120/208 Volt system: Black text on White background.

.3 Emergency power system: Red text on White background.

.4 120/208 Volt Uninterruptable Power Supply (UPS): White text on Orange background.

.5 Fire alarm system: White text on Red background.

.6 Communications systems: White text on Green background.

.7 Access Control, Intrusion Detection, CCTV: White text on Purple background.

.3 Confirm colours with the Consultant prior to ordering nameplates.

.2 Equipment Nameplates to indicate:

.1 Equipment/Panelboard ID

.2 Ampacity.

.3 Voltage

.4 Number of Phases

.5 Number of wires in system

.6 Interrupting Capacity

.7 Size, number of poles, Panelboard ID, and circuit number of upstream overcurrent protection device.

.1 Location of upstream device if not in the same room.

.3 Coordination Study Labels to Section 26 05 73.16.

.4 Arc Flash Study Labels to Section 26 05 73.19.

.5 Locations:

.1 Distribution panelboards, and individual distribution panelboard branch breakers.

.2 Receptacle panelboards.

.3 Each electrical distribution and control equipment enclosure.

.4 Uninterruptible Power Supply.

.5 Mechanical Equipment.

.6 UPS receptacles.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets, junction boxes, and pull boxes: indicate system and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages.

.6 Letter Size:

.1 Use 3 mm letters for identifying individual equipment and loads.

.2 Use 6 mm letters for identifying grouped equipment and loads.

.7 Labels:

.1 Mechanically fastened with sheet metal screws, with 5 mm white letters on black background.

.2 White letters on red background for UPS and equipment, and devices downstream of UPS.

.3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.4 Wording on nameplates and labels to be reviewed by the Consultant prior to manufacturing.

.5 Allow for minimum of twenty-five (25) letters per nameplate and label.

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

.7 Terminal cabinets and pull boxes: indicate system and voltage.

2.02 WIRING IDENTIFICATION

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

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

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

2.03 WIRE MARKERS

.1 Description: tape, split sleeve, or tubing type wire markers.

.2 Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.

.3 Legend:

.1 Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

.2 Control Circuits: Control wire number indicated on shop drawings.

2.04 CONDUIT AND BOX MARKERS

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

.2 Location: Provide markers for each conduit longer than 2 m.

.3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.4 Colours to match equipment nameplate background colour:

.1 347/600 Volt system: Blue.

.2 120/208 Volt system: Black.

.3 120/208 Volt Uninterruptable Power Supply (UPS): Orange.

.4 Emergency Power system: Red/White.

.5 Fire Alarm system: Red.

.6 Communications systems: Green.

.7 Access Control, Intrusion Detection, CCTV: Purple.

.5 Confirm colours with the Consultant prior to commencing rough-in.

2.05 JUNCTION AND PULL BOXES

.1 Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting outside of covers.

.2 Spray painting: not permitted.

.3 Paint colours to be in accordance with following schedule:

.1 Lighting: yellow.

.2 Normal power: blue.

.3 Emergency power: orange.

.4 Fire alarm: red.

.5 Communications systems including telephone and data: green.

.6 Miscellaneous signals: brown.

.4 In addition to painting miscellaneous signal boxes, clearly identify specific system in which box is installed. Identify source panelboard for power circuits.

2.06 BRANCH BREAKER LABELS

.1 General:

.1 Legibly identify every circuit and circuit modification as to its clear, evident, and specific purpose or use. Include sufficient detail to allow each circuit to be distinguished from all others.

.2 Label spare positions that contain unused overcurrent devices or switches.

.3 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

.2 Switchboards, distribution panelboards, enclosed breakers, and disconnect switches:

.1 Locate identification at each switch.

.2 Branch breaker nameplates on switchboards, distribution panelboards and switchboards, and generator load breakers to indicate:

.1 Locate identification at each switch on a switchboard.

.2 Identification of downstream equipment fed from the breaker.

.1 Location of downstream device if not in the same room.

.3 Breaker size and number of poles.

.4 Interrupting Capacity.

.5 Circuit number (where applicable).

.6 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

.3 Lighting and Receptacle Panelboards:

.1 Provide a circuit directory that is located on the face or inside of the panel door.

.2 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

2.07 RECEPTACLE LABELS

.1 Label all receptacles with the panelboard ID and circuit number.

.2 Use receptacle labels by electronic labeller Brother P-Touch, model PT-20/25, Dymo-Tape or approved equal.

.3 Location: On receptacle wall plate.

3 Execution

3.01 EQUIPMENT NAMEPLATES FROM MANUFACTURERS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

.2 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.

.3 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

3.02 CONDUIT AND BOX IDENTIFICATION

.1 Locate labels as follows:

.1 At every end of every conduit, duct or cable run, adjacent to item of equipment serviced.

.2 On each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall partition or floor).

.3 At intervals of 15 m (50'-0") along every exposed conduit, duct or cable run exceeding 15 m (50 feet) in length.

.4 At every access point on concealed conduit duct or cable.

.5 At each junction box.

.2 Place labels so as to be visible from 1500 mm (5'-0") above adjacent floor platform.

3.03 PREPARATION

.1 Degrease and clean surfaces to receive nameplates and labels.

3.04 APPLICATION

.1 Confirm colours prior to start of work.

.2 Install nameplate and label parallel to equipment lines.

.3 Secure nameplate to equipment front using adhesive.

.4 Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

.5 Identify conduit using field painting.

.6 Paint coloured band on each conduit longer than 2 m.

.7 Paint bands 6 m on centre.

3.05 LABELLING

.1 Colour code wiring consistently throughout the installation and generally match colour coding of internal wiring of pre-wired components.

.2 Label wiring with point name using Thomas & Betts 12 character polestar metalized labels with 3 rows of characters per label, or equal by Brady. Label to occur as a minimum at both ends and at pull boxes of the wiring run.

.3 Identify all pull boxes, junction boxes, etc. (installed as part of this project or used by this project) with the exact use of the box. Indelible felt pen marker is acceptable.

.4 Label light control items with point name using Thomas & Betts 12 character label, or equal by Brady. Label to be black lettering on clear backing.

.5 Label relays and controllers inside panels using Thomas & Betts 12 character label, or equal by Brady.

.6 Provide red, 13 mm (1/2 inch) diameter, sticker on emergency light fixture frame. Include circuit number on sticker with thin permanent black mark pen.

3.06 LABELS AND SIGNS

.1 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.

.2 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Provide a short circuit and coordination study for the electrical distribution system. The basic analysis shall include a protective device evaluation, and a protective device coordination study.

.2 The project shall begin at the point of utility service for the facility and continue down through the system to all downstream distribution and branch panelboards, motor control centres and significant motor locations.

.3 The project shall include any new generators and any associated emergency power distribution equipment, including automatic transfer switches and generator ground fault protection.

1.02 RELATED REQUIREMENTS

.1 Section 26 05 73.19 – Arc-Flash Hazard Analysis.

.2 Single Line Diagram.

1.03 REFERENCE STANDARDS

.1 Perform all studies in accordance with the latest applicable IEEE and ANSI standards.

.1 ANSI C38.010-1999.

.2 ANSI C37.5-1979.

.3 ANSI C37.13-1990.

1.04 SUBMITTALS

.1 Submit the following in accordance with Section 01 30 00:

.1 Submit for review three copies of the protection coordination study.

.2 Shop drawings for equipment affected by the coordination study will not be reviewed until the coordination study has been submitted and reviewed.

.3 Include a one-line diagram of the system.

.4 Bind the final report in a three-ring binder, as well as a soft copy.

.2 Projection System Coordination:

.1 Prepare a graph or coordination curves, prior to manufacture of service entrance and distribution equipment on K & E No. 336E Time-Current characteristic graph paper. Time-current characteristics shall be plotted of the following:

.1 Supply Authorities relays or fuses protecting incoming service (Contractor under this section shall obtain this information).

.2 Main and feeder protective devices at every voltage level used in distribution system.

.3 Protective devices associated with largest motor and/or refrigeration compressor.

.2 Preliminary submission of graph for comment will be accepted. Submit graph to Supply Authority for approval by them as providing satisfactory co-ordination. When curves have been approved by Supply Authority, they shall be submitted for approval. After approval has been obtained, order protective devices, and calibrate to conform with these curves.

.3 Each time-current characteristic curve sheet shall include:

.1 A single line diagram for the portion of the system involved.

.2 Transformer damage curves (where applicable).

.3 Cable damage curves (where applicable).

.4 Available fault levels for the portion of the system involved.

.4 Consult manufacturer of the refrigeration compressors and obtain recommendations for settings on starters. Incorporate information in co-ordination curves and submit the associated curves to Compressor Manufacturer and obtain approval from the manufacturer.

.5 Compressor manufacturer and mechanical trade contractor will determine and calibrate proper protection on motor starters and will ensure that it coordinates with protective devices on switchboard.

.6 Co-ordination curves, mentioned above, shall be prepared by distribution equipment manufacturers as soon as possible after award of contract.

.7 At the option of this contractor under this section, these co-ordination curves may also be prepared by an independent testing organization. In this case, the independent testing organization shall determine the proper settings of all protective relays and devices and pass them on to the switchboard manufacturer for incorporation into the switchboards. Include all associated costs in the tender.

.8 Distribution Equipment manufacturers shall examine drawings and specifications prior to award of contract to ensure that relays and devices being supplied by them will co-ordinate satisfactorily to Supply Authority requirements. Payment will not be allowed, after award of contract, for extra charges due to device changes to comply with recommended practices, due to oversight or negligence by distribution equipment manufacturers.

1.05 CLOSEOUT SUBMITTALS

.1 The Engineer who prepared the report shall visit the site and confirm that the feeder sizes as installed are consistent with the report as submitted.

.2 Submit final version of the report with as-constructed feeder lengths and feeder sizes.

1.06 QUALITY ASSURANCE

.1 Preparer Qualifications: Firm experienced in the analysis, evaluation, and coordination of electrical distribution systems and similar to the system for this project.

.2 The study shall be prepared in accordance with the latest edition of NETA ATS, the Canadian Electrical Code, as well as manufacturer’s recommendations.

.3 Short-Circuit Analysis and Coordination Study shall be performed by a registered Professional Engineer. Study shall be signed and sealed by the Engineer. The Engineer shall have a minimum of eight years experience in the analysis, evaluation, and coordination of electrical distribution systems.

.4 The firm conducting the study shall have one million worth of Professional Liability Insurance in addition to standard general insurance.

2 Products

2.01 MANUFACTURERS

.1 Independent Testing Organizations

.1 AC Tesla.

.2 Brosz and Associates.

.3 C-INTECH.

.4 Eastenghouse.

.5 Enkompass.

.6 G.T. Wood.

.2 Electrical distribution manufacturers:

.1 Eaton.

.2 Schneider Electric.

2.02 PROTECTIVE DEVICE COORDINATION STUDY

.1 Prepare coordination time-current characteristic curves to determine the required settings/sizes of the protective devices to maximize selectivity. The utility upstream protective device feeding the facility shall be maintained as the upper limit for coordination. These settings shall be obtained by the preparer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and illustrate adequate clearing times between series devices. The curves shall be created through the use of the study software package, but must reflect actual protective devices to be installed. Adequate time-current curves shall be generated to depict coordination. In addition, protective device characteristics shall be suitably determined to reflect calculated short-circuit levels at the location.

.2 A narrative analysis shall accompany each coordination curve sheet and describe the coordination and protection in explicit detail. All curve sheets shall be multi-colour for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide solution to resolve situation. System coordination, recommended ratings, and setting of protective devices shall be accomplished by a registered professional electrical engineer with a minimum of eight years of current experience in the coordination of electrical power systems.

.3 The following information shall be provided on all curve sheets:

.1 Device identification and associated settings/size.

.2 Voltage at which curves are plotted.

.3 Current multiplier.

.4 ANSI frequent fault damage curve.

.5 Cable insulation damage curves.

.6 Transformer inrush point.

.7 Single-line for the portion of the system.

.8 Motor starting profiles (where applicable).

2.03 SINGLE LINE DIAGRAM

.1 The final report shall include a multi-colour single-line diagram of the electrical distribution system within the scope of the project. The single line diagram shall include:

.1 Transformer rating, voltage ratio, impedance, and winding connection.

.2 Feeder cable phase, neutral and ground sizes, length of cable, conductor material, and conduit size and type.

.3 Switchgear, switchboards, panelboards, MCC's, fuses, circuit breakers, ATS's and switches continuous current ratings.

.4 Protective relays with appropriate device numbers and CT's and PT's with associated ratios.

.5 Detailed legend indicating device type identification and other significant details.

3 Execution

3.01 EXAMINATION

.1 Obtain fault level and X/R ratio information from the utility.

3.02 SUMMARY

.1 The results of the system studies shall be summarized in a final report.

.2 Where required, copies of the final report shall be submitted to the Supply Authority for their review and approval. Submit approved copies of the report to the Consultant.

3.03 ADJUSTING

.1 The contractor shall engage the manufacturer's service group or alternately a qualified independent testing firm to perform field adjustments of the protective devices as required for placing the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study and protective device evaluation / coordination study.

.2 Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved protective device coordination study, shall be carried out by manufacturer's service group.

.3 Submit a final service report confirming that settings have been completed.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Provide an Arc Flash Hazard Analysis Study per the requirements described in CSA Z462 Standard for Electrical Safety in the Workplace.

.2 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are obtained in CSA Z462-08, Annex D, or more recent version of the standard as cited by this Section.

.3 The scope of the studies shall include all existing distribution equipment and all new distribution equipment supplied by the equipment manufacturer under this contract.

1.02 RELATED REQUIREMENTS

.1 Section 26 05 73.16 – Coordination Studies.

.2 Single Line Diagram.

1.03 REFERENCES

.1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.

.2 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.

.3 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.

.4 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.

.5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

.6 IEEE 1584-2018 - Guide for Performing Arc-Flash Hazard Calculations.

.2 American National Standards Institute (ANSI):

.1 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.

.2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.

.3 ANSI C37.010-2016 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.

.4 ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

.3 CSA Group:

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.3 CSA Z462:21, Workplace electrical safety.

1.04 SUBMITTALS

.1 Submit the protective device coordination study to the Consultant prior to receiving final review of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.05 CLOSEOUT SUBMITTALS

.1 The results of the protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Three (3) bound copies of the complete final report shall be submitted. Additional copies of the complete report with input and output data shall be provided on CD in PDF format.

.2 The report shall include the following sections:

.1 Executive Summary.

.2 Descriptions, purpose, basis and scope of the study.

.3 Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.

.4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.

.5 Fault current calculations including a definition of terms and guide for interpretation of the computer printout.

.6 Details of the incident energy and flash protection boundary calculations.

.7 Recommendations for system improvements, where needed.

.8 Single Line Diagram.

.3 Arc flash labels (refer to CSA Z462 Annex Q) shall be provided in hard copy only.

1.06 QUALIFICATIONS

.1 Arc flash hazard analysis studies shall be conducted under the supervision and approval of a licensed Professional Electrical Engineer skilled in performing and interpreting the power system studies.

.2 The Licensed Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.

.3 The Licensed Professional Electrical Engineer shall have a minimum of eight (8) years of experience in performing power system studies.

.4 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.07 COMPUTER ANALYSIS SOFTWARE

.1 The studies shall be performed using the latest revision of the SKM or equivalent.

2 Products

2.01 MANUFACTURERS

.1 Independent Testing Organizations:

.1 AC Tesla.

.2 Brosz and Associates.

.3 C-INTECH.

.4 Eastenghouse.

.5 Enkompass.

.6 G.T. Wood.

.2 Electrical distribution manufacturers:

.1 Eaton.

.2 Schneider Electric.

2.02 STUDIES

.1 The contractor shall furnish an Arc Flash Hazard Analysis Study per CSA Z462, reference Section 4.1.8.2.2, 4.3.3.

2.03 DATA COLLECTION

.1 Contractor shall furnish all data as required by the power system studies. The Engineer performing arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

.2 Source combination may include present and future motors and generators.

.3 If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.04 ARC FLASH HAZARD ANALYSIS

.1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in CSA Z462 Annex D.

.2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, panelboards and splitters) where work could be performed on energized parts.

.3 The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 112.5 kVA where work could be performed on energized parts.

.4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 calories per square centimetre.

.5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not

be taken into consideration when determining the clearing time when performing incident energy calculations.

.6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

.7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

.1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.

.8 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

.9 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

.10 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

.11 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

.12 Arc Flash calculations shall be based on actual overcurrent protective device clearing time.

.13 Maximum clearing time will be capped at 2 seconds based on IEEE 1584.

.14 Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.05 REPORT SECTIONS

.1 Incident energy and flash protection boundary calculations:

.1 Arcing fault magnitude.

.2 Protective device clearing time.

.3 Duration of arc.

.4 Arc flash boundary.

.5 Working distance.

.6 Incident energy.

.7 Hazard Risk Category.

.8 Recommendations for arc flash energy reduction.

3 Execution

3.01 FIELD ADJUSTMENT

.1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

.2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

.3 Notify Owner in writing of any required major equipment modifications.

3.02 ARC FLASH WARNING LABELS

.1 The contractor of the Arc Flash Hazard Analysis shall provide a 3.5 inch by x 5 inch thermal transfer type label of high adhesion polyester for each work location analyzed.

.2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

.3 The label shall include the following information, at a minimum:

.1 Location designation.

.2 Nominal voltage.

.3 Flash protection boundary.

.4 Hazard risk category.

.5 Incident energy.

.6 Working distance.

.7 Engineering firm and issue date.

.8 Labels shall be machine printed, with no field markings.

.4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

.1 For each 600 volt, and applicable 208 volt panelboard, one arc flash label shall be provided.

.2 For each motor control centre, one arc flash label shall be provided.

.3 For each low voltage switchboard, one arc flash label shall be provided.

.4 For each switchgear, one flash label shall be provided.

.5 For medium voltage switches one arc flash label shall be provided.

.5 Arc Flash Warning Label General Instructions:

.1 Only qualified electricians who recognize and avoid the electrical and Arc Flash hazards are allowed to place the arc flash warning labels.

.2 Electricians should wear suitable PPE, such as electrical safety boots, Safety Glasses, etc. while performing labeling.

.3 Generally, arc flash label shall be put on a prominent pre-cleaned place on the front of the electrical equipment (such as switchgear, panel, disconnect switch, generator output breaker). Label should be visible and readable, displayed horizontally, attached flatly and securely, and not allowed to cover other signs or labels on the equipment.

.4 Under the special request of the client, labels could be put on the back of the panel door when the panel is located in clean and finished spaces such as an office area.

.5 When putting a label on small equipment with no space labeling on the wall just beside the equipment is allowed.

.6 Special request may be attached to this General Instruction. For examples, more than one identical label is applied for large equipment; different labels could be applied for different sections of one equipment; for a splitter with several disconnect switches only one label is placed on the splitter for this group.

.7 Take the pictures for each label to indicate both names of the label and equipment and labeling area of the equipment. Email these pictures to the Consultant for quality control and record.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Electrical connections to equipment specified in other sections.

1.02 RELATED REQUIREMENTS

.1 Division 08 – Openings.

.2 Division 11 – Equipment.

.3 Division 14 – Conveying Equipment.

.4 Division 20 – Common Mechanical Requirements.

.5 Division 21 – Fire Suppression.

.6 Division 22 – Plumbing.

.7 Division 23 – Heating, Ventilating, and Air Conditioning.

1.03 REFERENCES

.1 NEMA WD 1 - General Colour Requirements for Wiring Devices.

.2 NEMA WD 6 - Wiring Devices - Dimensional Requirements.

1.04 COORDINATION

.1 Coordinate work to Section 01 31 00.

.2 Obtain and review shop drawings, product data, and manufacturer's instructions for equipment provided under other sections.

.3 Determine connection locations and requirements.

.4 Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

.5 Sequence electrical connections to coordinate with start-up schedule for equipment.

1.05 SUBMITTALS

.1 Submit to Section 01 30 00.

.2 Product Data: Provide wiring device manufacturer's catalogue information showing dimensions, configurations, and construction.

.3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.06 REGULATORY REQUIREMENTS

.1 Provide products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

2 Products

2.01 COMMON MOTOR REQUIREMENTS

.1 Motors up to and including 1/3 HP, shall be 1 phase, 60 Hz, 120 volts.

.2 Motors 1/2 HP and above shall be 3 phase, 60 Hz, 575 volts or 208 volts.

2.02 CORDS AND CAPS

.1 Attachment Plug Construction: Conform to NEMA WD 1.

.2 Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

.3 Cord Construction: NFPA 70, Type SJO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

.4 Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

3 Execution

3.01 WIRING OF EQUIPMENT PROVIDED UNDER OTHER DIVISIONS

.1 Use the following procedure with regards to wiring of motors and equipment provided under other Divisions.

.2 The following equipment shall be responsibility of the trade supplying the equipment unless otherwise noted, in accordance with the requirements laid out in the individual section, or this division:

.1 Motors.

.2 Starters.

.3 Variable Frequency Drives.

.4 Motor Control Centres.

.5 Control wiring.

.3 In every instance, install starter, motor control centre, variable frequency drivers (VFD), etc. and wire to line side of the starter, the Motor Control Centre, or VFD. Extend wiring from starter, motor control centre or VFD to motor as indicated.

.4 Provide all wiring for starters and VFD’s from supply to starter to VFD and to motor. Coordinate requirements with the appropriate trade.

.5 Provide 500 mm of liquid tight flexible metal conduit for final connection to motor. Provide disconnect switches where required by code, and as indicated on the drawings.

.6 Where individual starters and controls are grouped together provide a panel for mounting this equipment. Provide a feeder, main fused disconnect and a splitter of adequate size and capacity and wire to line side of the starters on this panel and from starters to motors.

.7 Equipment, General

.1 Ascertain exact locations of starters, motor control centres, motors, etc. from drawings and coordinate exact locations with the supplying trade.

.2 Control wiring shall be the responsibility of the supplying trade.

.1 Control wiring shall be in accordance with Section 26 05 19, and Section 26 05 23.

.2 Control wiring shall be installed in conduit in accordance with Section 26 05 33.13.

.8 Doors

.1 Ascertain exact locations of door operators, push buttons, automatic sensors, and other door hardware.

.2 Provide branch circuit wiring for door operators.

.3 Provide control and control wiring for all low voltage door interconnections.

.9 Overhead Doors and Folding Vehicle Doors

.1 Ascertain exact locations of control panels, remote controls, safety equipment such as safety eyes, overhead door contacts, etc. from shop drawings and architectural drawings, and coordinate exact locations with overhead door trade.

.2 Provide branch circuit wiring for door controls.

.3 Provide control and control wiring for all low voltage door interconnections.

.10 Conveying Equipment (e.g. Elevators): in accordance with Section 26 05 83.14.

.11 Plumbing Equipment

.1 Ascertain exact locations of starters, motor control centres, motors, infra-red plumbing fixture controls from Mechanical Drawings and coordinate exact locations with plumbing trade.

.2 Provide branch circuit wiring and an outlet for each infra-red plumbing fixture control.

.3 Control wiring shall be the responsibility of the plumbing trade, as described above.

.12 HVAC Equipment

.1 Ascertain exact locations of starters, motor control centres, motors, motorized dampers, VAV boxes, and heating control valves from HVAC drawings and coordinate exact locations with HVAC Division.

.2 In the case of unit heaters, reheat coils and cabinet unit heaters, terminate wiring on terminals provided. Control wiring, thermostats, or other control devices shall be the responsibility of the HVAC trade, as described above.

.3 Provide branch circuit wiring and an outlet for each motorized damper, variable air volume (VAV) box, or heating control valve. Control wiring shall be the responsibility of the HVAC trade, as described above.

3.02 EXAMINATION

.1 Verify that equipment is ready for electrical connection, wiring, and energization.

3.03 ELECTRICAL CONNECTIONS

.1 Provide a local disconnect switch for all equipment, regardless of if a disconnect switch is shown or not shown on the plans.

.2 Make electrical connections to equipment manufacturer's instructions.

.3 Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.

.4 Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

.5 Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.

.6 Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

.7 Install disconnect switches, controllers, control stations, and control devices as indicated.

.8 Modify equipment control wiring with terminal block jumpers as indicated.

.9 Provide interconnecting conduit and wiring between devices and equipment where indicated.

.10 Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Common requirements for commissioning of all electric lighting, including interior, exterior, and emergency lighting.

.2 The party responsible for the functional testing shall not be directly involved in either the design or construction of the project.

1.02 RELATED REQUIREMENTS

.1 Section 26 09 43 – Network Lighting Controls.

.2 Section 26 51 19 – LED Interior Lighting.

.3 Section 26 52 13.13 – Emergency Lighting.

.4 Section 26 56 19 – LED Exterior Lighting.

1.03 REFERENCES

.1 ASHRAE

.1 ASHRAE Guideline 0-2005 – The Commissioning Process.

.2 ANSI/ASHRAE/IES 90.1-2013 – Energy Standard for Building Except Low-Rise Residential Buildings.

.2 Illumination Engineering Society (IES)

.1 IES DG-29-11 – Design Guide for the Commissioning Process Applied to Lighting and Control Systems.

.3 Ontario Building Code

.1 Supplementary Standard SB-10: Energy Efficiency Requirements, December 22, 2016 update.

1.04 ACTION SUBMITTALS

.1 Refer to Section 01 30 00.

.2 Submit sample commissioning forms.

1.05 CLOSEOUT SUBMITTALS

.1 Section 01 78 00: Submittals for project closeout.

.2 Submit commissioning reports.

.1 Submit a floor plan or spreadsheet table checklist that indicates each local lighting control device, occupancy sensors, daylighting controls, system component.

.2 Submit the system sequence of operation fully describing the equipment components and functionality, including set points and alarm functions.

.3 The detailed sequence of operation shall be provided regardless of the completeness and clarity of the sequences in the controls specification and/or drawings.

.3 The functional testing party shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.

2 Products – Not Used

3 Execution

3.01 SITE TESTS AND INSPECTIONS

.1 Sensor placement and orientation for all sensor types.

.2 Occupancy sensor function, sensitivity, and time delays.

.3 Daylight harvesting sensor calibration.

.4 Automated shade operation.

.5 Manual control placement and operation.

.6 Automated control operation, including scheduled on/off functions and dimming trims and presets.

.7 Override operation, access, and functionality.

.8 Centralized control interfaces and operation.

.9 Client education of operations.

.10 Documentation archived to client.

3.02 FUNCTIONAL TESTING

.1 Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions.

.2 When occupant sensors, time switches, programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed:

.1 Confirm that the placement, sensitivity and time-out adjustments for occupant sensors yield acceptable performance, lights turn off only after space is vacated and do not turn on unless space is occupied.

.2 Confirm that time switches and programmable schedule controls are programmed to turn the lights off.

.3 Confirm that photosensor controls reduce electric lights levels based on the amount of usable daylight in the space as specified.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Materials and installation for contactors for system voltages up to 600 V.

1.02 REFERENCES

.1 CSA Group:

.1 CSA C22.2 No. 14-18, Industrial Control Equipment.

2 Products

2.01 MANUFACTURERS

.1 Allen Bradley "500L" series

.2 Eaton.

.3 Schneider Electric.

.4 Siemens.

2.02 CONTACTORS

.1 Contactors: to CSA C22.2 No. 14.

.2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.

.3 Contactors shall be electrically held 60 Hz, 120 V coil; NEMA Type 1 general purpose enclosure.

.4 Fused switch combination contactor as indicated.

.5 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.

.6 Mount in CSA Enclosure 1 unless otherwise indicated.

.7 Include following options in cover:

.1 Red indicating lamp.

.2 Hand-Off-Auto selector switch.

.8 Provided complete with control transformer, in contactor enclosure.

3 Execution

3.01 INSTALLATION

.1 Install contactors and connect auxiliary control devices.

3.02 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 53.

.2 Size 4 nameplate indicating name of load controlled as indicated.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Occupancy and Vacancy sensors.

.2 Power packs, and auxiliary relays, momentary switches.

.3 Manual controls devices, including dimming switches and low voltage momentary switches.

1.02 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

.1 Line voltage manual control devices, as described in Section 26 27 26 – Wiring Devices.

1.03 RELATED REQUIREMENTS

.1 Section 26 08 50 – Commissioning of Lighting.

.2 Section 26 27 26 – Wiring Devices.

.3 Section 26 51 19 – LED Interior Lighting.

1.04 REFERENCES

.1 CSA Group:

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.3 CSA C22.2 No. 14-13 – Industrial Control Equipment.

.4 CSA C22.2 No. 42 - General Use Receptacles.

.5 CSA C22.2 No. 42.1 - Cover Plates for Flush Mounted Wiring Devices.

.6 CSA C22.2 No. 184 - Solid-State Lighting Controls.

.7 CSA C22.2 No. 184.1 - Solid State Dimming Controls.

.8 CSA C22.2 No. 156 - Solid-State Speed Controls.

.2 National Electrical Manufacturers Association (NEMA):

.1 WD1 (R2005) –- General Color Requirements for Wiring Devices.

.2 WD6 – Dimensional Specifications.

.3 Ontario Building Code.

.4 UL 924 - Standard for Safety of Emergency Lighting and Power Equipment.

1.05 SUBMITTALS

.1 In accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer’s descriptive literature and product specifications for each product.

.2 Manufacturer's product drawings.

.3 Manufacturer's installation instructions.

.3 Where the lighting controls include the option for custom engraving, or custom touchscreen user interfaces on control devices, switches, or scene controllers, the Contractor is to submit proposed engraving/labelling/graphics as part of the shop drawing submittal, for review by the Owner.

1.06 CLOSEOUT SUBMITTALS

.1 Documentation of all lighting control system setpoints, sensor sensitivities, occupancy sensor timeouts, and as-programmed sequences of operation to aid in future troubleshooting.

.2 Lighting controls functional test report.

1.07 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Products free of defects in material and workmanship.

1.08 WARRANTY

.1 Product is warranted free of defects in material and workmanship.

.2 Product is warranted to perform the intended function within design limits.

2 Products

2.01 MANUFACTURERS

.1 Wattstopper DLM (Basis of Design)]

.2 Cooper Lighting Solutions.

.3 Crestron.

.4 Current Lighting (formerly Hubbell/GE).

.5 Leviton.

.6 Lutron Vive.

2.02 GENERAL REQUIREMENTS OF ALL SENSORS AND POWER PACKS

.1 Manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1 per cent.

.2 Five year warranty and CUL listed.

.3 In the event of failure, provide a bypass manual "override on" feature on each sensor.

.4 When bypass utilized, lighting to remain on constantly, or control is to be diverted to a wall switch until sensor is replaced. The override feature is to be designed for use by building maintenance personnel and not be readily achieved by building occupants.

2.03 OCCUPANCY AND VACANCY SENSORS

.1 General:

.1 Sensors using passive infrared, ultrasonic, microphonic, and multi-technology adaptive technology.

.2 Sensor timeouts configurable by system software.

.3 Electrical: Rating: 24 VDC input voltage, up to 40 mA current draw.

.4 Mechanical: Mounting: Sensors for mounting on ceilings and walls, including corners, must be available.

.5 Environmental:

.1 Operating Temperature Range: 0 degrees C to 40 degrees C

.2 Relative Humidity: 0 per cent to 95 per cent non-condensing.

.2 Dual Technology Wall Switch Sensor, 24V

.1 Wattstopper DW-100-24-W series (Basis of Design).

.2 Sensor capable of detecting presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes.

.3 Utilize a dual sensing verification principle for coordination between ultrasonic and Passive Infrared (PIR) Technologies to reduce likelihood of false triggering.

.4 For best results, sensor shall feature a trigger mode where the end-user can choose which technology will activate the sensor from Off mode (initial), the type of detection that will reset the time delay (maintain), and the type of detection that will cause the sensor to be turned back on immediately after the lights are turned off due to lack of motion (re-trigger). Selection of technologies for initial, maintain, and re-trigger shall be done with DIP switches.

.5 Sensor shall have its trigger mode factory preset to allow for quick installation in most applications. In this default setting, both technologies must occur in order to initially activate lighting systems. Detection by either technology shall maintain the lighting on, and detection by either technology shall turn lights back on after lights were turned off for 5 seconds or less in automatic mode, and 30 seconds or less in manual mode.

.6 Robotic test method, as referred in the NEMA WD 7 Guide, shall be utilized for minor motion coverage verification.

.7 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 kHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.

.8 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall filter short wavelength IR, such as those emitted by the sun and other visible light sources. Face lens grooves in to avoid dust and residue build up which affects IR reception.

.9 Utilize zero crossing circuitry to reduce stress on relay, and therefore increase sensor life.

.10 Operate at 24 VDC and halfwave rectified and utilize a power pack or lighting control system input module to supply power.

.11 To blend in aesthetically, sensor protrusion not more than 3/8” from the wall and utilize colour-matched lens.

.12 To assure detection at desktop level uniformly across the space, sensor shall have a 28 segment, 2 level, Fresnel injection molded lens.

.13 Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds, set by DIP switch.

.14 To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.

.15 Coverage up to 1,000 sq. ft. for walking motion, with a field view of 180 degrees.

.16 Automatic-ON or manual-ON operation, adjustable with a DIP switch.

.17 Sensor shall have an adjustable time delay.

.18 Each sensing technology shall have an LED indicator that remains active at all times, in order to verify detection within the area to be controlled.

.19 Sensor shall have a service switch to allow end-users to operate the sensor in the unlikely event of a failure; set by a trim pot.

.20 Sensor shall have a built-in light level that features simple, one-step daylighting setup that works from 8 fc to 180 fc.

.21 The Dual Technology wall switch sensor shall be a completely self-contained control system that replaces a standard toggle switch

.3 Dual Technology Ceiling Mounted Sensor, 24V

.1 Wattstopper DT-300 series (Basis of Design).

.2 The Dual Technology sensor shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.

.3 Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic or microphonic and Passive Infrared (PIR) Technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either technology shall keep the lighting on.

.4 Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.

.5 Sensors shall be ceiling mounted with a flat, unobtrusive appearance, and provide 360 degree coverage.

.6 Ultrasonic sensing shall be volumetric in coverage, with a frequency of 40 kHz. It shall utilize Advanced Signal Processing that automatically adjusts the detection threshold dynamically to compensate for changing levels of activity and airflow throughout a controlled space.

.7 To avoid false ON activations, and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, in order to respond only to those signals caused by human motion.

.8 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.

.9 Sensors shall operate at 24 VDC, and halfwave rectified, and utilize a 24 V power pack.

.10 Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.

.11 The sensor shall have a built-in light level sensor that works from 10 fc to 300 fc.

.12 The sensors shall feature terminal style wiring.

.13 Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less sensor visibility.

2.04 POWER PACKS

.1 General:

.1 Self-contained transformer and relay module.

.2 Internal relay controlling up to 20A for 120, 230, 277VAC or 347VAC ballast loads and 120VAC incandescent loads.

.3 Provide a 24 VDC, 150 mA output.

.4 Capable of parallel wiring without regard to AC phases on primary.

.5 Power pack can be used as a standalone, low voltage switch, or can be wired to sensor for auto control.

.6 Construction: high impact, UL rated plastic case

.7 Power pack shall be UL/CUL Listed, FCC Certified, UL 2043 plenum rated and meets ASHRAE 90.1 requirements

.8 Shall at minimum meet the following environmental specifications:

.1 Operating Temperature Range: 0 degrees C to 40 degrees C

.2 Relative Humidity: 0 per cent to 95 per cent non-condensing

2.05 DECORATOR LOW VOLTAGE MOMENTARY SWITCHES

.1 Wattstopper DCC2 series (Basis of Design).

.2 Switch intended for use with power packs and sensors requiring a momentary contact switch that provides on/off signals.

.3 12 VAC/VDC, 24 V Rectified, 24 VAC/VDC

.4 50 mA Max. Internal Contact rating

.5 500 mΩ resistance when closed

.6 Single pole, double throw with centre position rest.

2.06 DIMMING SWITCHES

.1 Direct control of dimming luminaires up to the luminaire manufacturer’s specified rating.

.2 Coordinate dimming signal configuration (2-wire phase cut, 3-wire, 4-wire 0-10V, or 4-wire DALI) with the fixture ballast or driver per Section 26 51 19, lighting fixture schedule, and related sections.

.3 Compatible with related lighting control devices i.e. occupancy sensors.

.4 Submit luminaire manufacturer's dimmer compatibility documentation to demonstrate compatibility and limits of dimming level.

.5 Manufacturers:

.1 Lutron NovaT* style dimmers.

.2 Cooper

.3 Leviton.

.4 Approved Equal.

2.07 TIMER SWITCHES

.1 Digital time switch programmable to turn loads off after a preset time.

.2 Capable of operating as an ON/OFF switch.

.3 Five terminal, completely self-contained control system that replaces a standard toggle switch. Switching mechanism 30 V @ 1 A air gap relay.

.4 24 VAC when used in conjunction with power packs. For small rooms, or small localized loads, line voltage is permitted.

.5 No minimum load requirement.

.6 Time scroll feature permitting manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.

.7 Options available for user to enable:

.1 One second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).

.2 Beep warning sounding every five seconds once the time switch countdown reaches one minute.

.8 Manual timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.

.9 Liquid crystal display (LCD) that shows the timer's countdown.

.10 Incorporates two pulsed, open collector NPN transistor outputs for external latching relay coil drives or lighting control panel inputs.

.11 Fit behind a decorator style faceplate. Concealed calibration switch for setting time-out, time scroll, one second light flash, and beep warning to prevent tampering of adjustments and hardware.

.12 Time-out period adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.

.13 Operate with power packs in order to control additional loads.

.14 Utilize terminal style wiring.

.15 For safety, in the event there is an open circuit in the low voltage line, automatically switch to OFF mode.

.16 Warranty: 5 year warranty.

.17 CUL listed.

.18 Wattstopper TS-400 and TS-400-24 series (Basis of Design).

2.08 EMERGENCY LIGHTING CONTROL UNIT FOR 120 VOLT CIRCUITS

.1 Description:

.1 Sequence of Operation: activate emergency lighting in the event of loss of normal utility power, regardless of control status of the luminaire.

.2 Provide all required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

.2 Device shall be listed to UL 924 to meet the intent of Ontario Building Code for “fail-safe operation”, and be approved for use in Canada.

.3 Example Manufacturers

.1 Functional Devices Inc. ESR01P series.

.2 Douglas Lighting Controls WR-RIB2401B-EL.

.3 Philips Bodine BLCD-20B.

.4 Schneider Electric SLSERC1277.

.5 Wattstopper ELCU-200 series.

.6 Approved Equal.

.4 Mounting: Able to fit in a standard junction box knockout.

.5 Features:

.1 Senses local single circuit power failure.

.2 LED indication for emergency and normal power.

.3 Provides absolute fail-to-on emergency lighting.

.4 Emergency lights are controlled with normal lighting.

.5 Sequence of Operation: automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.

.6 Specifications:

.1 120 VAC; 60 Hz.

.2 Maximum Ballast Load: 10A @ 120 VAC.

.3 Housing: Fire rated V-0, 80 degrees C.

.4 Zero crossing circuitry to protect relay contacts from damaging effects of inrush current generated by switching electronic ballast loads.

.5 UL94 V-O plenum rated with compression wire terminals.

.6 UL, cUL listed Emergency Lighting and Equipment; five year warranty.

2.09 DAYLIGHT HARVESTING PHOTO SENSORS

.1 General:

.1 Class 2, low voltage.

.2 Ambient light sensor designed to interface directly with the analog input of the Lighting Control System.

.3 Supply an analog signal to the Lighting Control System proportional to the light measured.

.4 Sensor output shall provide for zero or offset based signal.

.5 Capable of a fully adjustable response in the range between 0 and 10,000 foot candles with a +/- 1 per cent accuracy at 21 degrees C.

.6 Input: 10 VDC.

.7 Output: 0 VDC to 10 VDC.

.8 Flame retardant housing and meet UL 94 HB standards.

.9 Operating temperature: -10 degrees C to 60 degrees C.

.2 Interior sensors: Fresnel lens, with a 60 degree cone of response. Range between 0 fc and 750 fc.

.3 Exterior sensors: Complete with hood over the aperture to shield the sensor from direct sunlight. Outdoor sensor circuitry completely encased in an optically clear epoxy resin. Sensor range between 0 fc and 750 fc.

.4 Atrium sensors: Translucent dome with a 180 degree field of view. Range from 2 fc to 2,500 fc.

.5 Skylight sensors: Translucent dome with a 180 degree field of view. Range between 10 fc and 7,500 fc.

2.10 SEQUENCES OF OPERATION

.1 In accordance with ASHRAE 90.1-2013.

3 Execution

3.01 INSTALLATION

.1 In accordance with manufacturer’s instructions.

.2 Minimum 14 AWG from the circuit control hardware relays.

.3 It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are

diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.

.4 It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at Owner's facility, to verify placement of sensors and installation criteria.

.5 Proper judgement must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

.6 Install manual control devices and sensors in accordance with manufacturer's instructions for Vacancy Operation.

3.02 SYSTEM STARTUP

.1 The lighting controls manufacturer's representative shall conduct system startup and submit startup report.

3.03 SITE TESTS AND INSPECTIONS

.1 The lighting controls manufacturer's representative and Contractor shall conduct functional testing and provide report as described in ASHRAE 90.1-2013:

.1 Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions.

.2 When occupant sensors, time switches, programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed:

.1 Occupant Sensors

.1 Certify that the sensor has been located and aimed in accordance with manufacturer recommendations.

.2 For projects with up to seven (7) occupancy sensors, all occupancy sensors shall be tested.

.3 For projects with more than seven (7) occupancy sensors, testing shall be done for each unique combination of sensor type and space geometry.

.4 For each sensor to be tested, verify the following:

.1 Status indicator (as applicable) operates correctly.

.2 Controlled lights turn off or dim down to the specified level within the required time (20 minutes, or as noted), as applicable to the space type.

.3 For auto-on occupant sensors (occupancy mode), the lights turn on to the permitted level when someone enters the space.

.4 For manual-on sensors (vacancy mode), the lights turn on only when manually activated.

.5 The lights are not incorrectly turned on by movement in nearby areas or by HVAC operation.

.2 Automatic Time Switches

.1 Confirm that the automatic time switch control is programmed with appropriate weekday, weekend, and holiday (as applicable) schedules.

.2 Document for the owner automatic time switch programming, including weekday, weekend, and holiday schedules, as well as all setup and preference program settings.

.3 Verify that correct time and date are properly set in the time switch.

.4 Verify that any battery backup (as applicable) is installed and energized.

.5 Verify that the override time limit is set to no more than two (2) hours.

.6 Simulate occupied condition. Verify and document the following:

.1 All lights can be turned on and off by their respective area control switch.

.2 The switch only operates lighting in the enclosed space in which the switch is located.

.7 Simulate unoccupied condition. Verify and document the following:

.1 All non-exempt lighting turns off.

.2 Manual override switch allows only the lights in the enclosed space where the override switch is located to turn on or remain on until the next scheduled shut off occurs.

.3 Daylight Controls

.1 All control devices (photocontrols) have been properly located, field-calibrated, and set for appropriate set points and threshold light levels.

.2 Daylight controlled lighting loads adjust to appropriate light levels in response to available daylight.

.3 The location where calibration adjustments are made is readily accessible only to authorized personnel.

.3 The individual(s) responsible for the functional testing shall not be directly involved in either the design or construction of the project and shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.

.2 Test lighting controls with fire alarm system in accordance with Section 28 08 46 and Section 28 46 51.

.3 Commissioning:

.1 Upon completion of the installation, the system shall be completely commissioned to verify all adjustments and sensor placement to ensure a trouble-free lighting control system.

.2 Submit commissioning report to the Consultant for review.

.3 Provide the Consultant with ten working days written notice of the scheduled commissioning date.

3.04 TRAINING

.1 Provide training session of minimum 4 hours duration in accordance with Section 01 79 00.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Power distribution panelboards – Circuit breaker type.

.2 Lighting and Appliance Branch Circuit Panelboards.

1.02 RELATED REQUIREMENTS

.1 Section 26 28 16.02 – Molded Case Circuit Breakers.

.2 Section 26 43 13 – Surge Protective Devices for Low-Voltage Electrical Power Circuits.

1.03 REFERENCES

.1 CSA Group:

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.3 CSA C22.2 No. 5-16 – Molded Case Circuit Breakers, molded-case switches, and circuit-breaker enclosures.

.4 CSA C22.2 No. 29-15 – Panelboards and Enclosed Panelboards.

.2 NEMA:

.1 NEMA ICS 2-2000 (R2020) – Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.

.2 NEMA KS 1-2013 – Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

.3 NEMA PB 1-2011 – Panelboards.

.4 NEMA PB 1.1-2013 – General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

.3 NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.04 SUBMITTALS

.1 Submit in accordance with Section 01 30 00.

.2 Work of this Section is to be submitted for review after Consultant's review of Coordination Study per Section 26 05 73.16 is completed.

.3 Shop drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

.4 Shop drawings

.1 Indicate the following:

.1 Outline and support point dimensions

.2 Voltage

.3 Main bus ampacity

.4 Integrated short circuit ampere rating

.5 Circuit breaker arrangement, types and sizes.

.2 The following information shall be submitted to the Consultant:

.1 Breaker layout drawing with dimensions indicated and nameplate designation

.2 Component list

.3 Conduit entry/exit locations

.4 Assembly ratings including:

.1 Short-circuit rating

.2 Voltage

.3 Continuous current

.5 Cable terminal sizes

.6 Product data sheets

.3 Where applicable, the following additional information shall be submitted to the Consultant:

.1 Key interlock scheme drawing and sequence of operations

.5 Submittals for Construction

.1 The following information shall be submitted for record purposes:

.1 Installation information

1.05 CLOSEOUT SUBMITTALS

.1 Refer to Section 01 78 00.

.2 Record actual locations of panelboards and record actual circuiting arrangements in project record documents.

.3 Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

.4 Final as-built drawings and information shall incorporate all changes made during the manufacturing and installation process.

.5 Include a copy of each panelboard schedule in the Operation and Maintenance manual.

1.06 MAINTENANCE MATERIAL SUBMITTALS

.1 Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

.2 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

.3 Provide two of each panelboard key.

.4 Provide final panelboard schedules indicating panelboard data, phasing, breaker sizes, and loads served.

1.07 QUALITY ASSURANCE

.1 Regulatory Requirements

.1 Products: Listed and classified by CSA (Canadian Standards Association).

.2 Qualifications

.1 Company specializing in manufacturing of panelboard products with a minimum of 20 years' experience.

.2 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

.3 For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

.4 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Consultant, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.08 DELIVERY, STORAGE, AND HANDLING

.1 Inspect and report concealed damage to carrier within their required time period.

.2 Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.

.3 Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

.4 Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

1.09 WARRANTY

.1 Warrant specified equipment to be free from defects in materials and workmanship for eighteen (18) months from the date of purchase.

2 Products

2.01 GENERAL

.1 Description: CSA C22.2 No.29, circuit breaker type.

2.02 DISTRIBUTION PANELBOARDS – CIRCUIT BREAKER TYPE

.1 Manufacturers:

.1 Square D by Schneider Electric, I-LINE Series.

.2 Eaton Cutler-Hammer, PRL 3 and PRL4 Series.

.3 Equal by Siemens.

.2 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Consultant ten days prior to bid date.

.3 Panelboard Bus:

.1 Copper, ratings as indicated.

.2 Provide copper neutral bus for panelboards indicated for 4-wire systems.

.3 Provide copper ground bus in each panelboard.

.4 Short Circuit Ratings:

.1 Panelboards rated 600 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 65 000 amperes RMS symmetrical.

.2 Distribution panelboards with bolt-on devices contained therein shall have interrupting ratings as specified herein or indicated on the drawings.

.3 Panelboards shall be fully rated.

.4 Where indicated, provide circuit breakers ULC listed for application at 100 per cent of their continuous ampere rating in their intended enclosure.

.5 Minimum integrated short circuit rating: Panelboards rated 240 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10 000 amperes RMS symmetrical.

.6 Molded Case Circuit Breakers: To Section 26 28 16.02.

.7 Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

.8 Cabinet Front: Surface type, fastened hinge and latch, metal directory frame, finished in manufacturer's standard gray enamel.

.9 Enclosures: CSA type 2 sprinklerproof complete with drip hood, or as noted.

.10 Trims shall be equipped with a flush lock.

.11 Breaker positions labeled as “Spare” or “Space” shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.

.12 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.

2.03 BRANCH CIRCUIT PANELBOARDS

.1 Manufacturers:

.1 Square D by Schneider Electric, NQ or NQOD Series.

.2 Eaton Cutler-Hammer, POW-R-LINE 1, POW-R-LINE 2, POW-R-LINE 3 Series.

.3 Equal by Siemens.

.2 Description: CSA C22.2 No. 29, circuit breaker type, lighting and appliance branch circuit panelboard.

.3 Panelboard Bus:

.1 Copper, ratings as indicated.

.2 Provide copper neutral bus in each panelboard.

.3 Provide copper ground bus in each panelboard.

.4 Provide insulated ground bus where scheduled.

.4 Minimum Integrated Short Circuit Rating: 10 000 amperes RMS symmetrical for 240 volt panelboards, or as indicated.

.5 Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

.6 Current Limiting Molded Case Circuit Breakers where indicated: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

.7 Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

.8 Enclosure shall be CSA type 2 sprinklerproof complete with drip hood, or as noted.

.9 Trims shall be equipped with a flush lock

.10 Breaker positions labeled as “Spare” or “Space” shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.

.11 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.12 Panelboards rated 240 Vac or less shall have short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.

.13 Bus and breakers rated for symmetrical interrupting capacity, as indicated.

.14 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.15 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.16 Two keys for each panelboard and key panelboards alike.

.17 Copper bus with neutral of same ampere rating as mains.

.18 Mains: suitable for bolt-on breakers.

.19 Trim with concealed front bolts and hinges.

.20 Trim and door finish: baked grey enamel.

.21 The minimum short-circuit rating for branch circuit panelboards shall be as specified herein or as indicated on the drawings. Panelboards shall be fully rated.

.22 Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.

.23 Circuit breakers shall be thermal-magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame and through 100-ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be ULC listed as type SWD for lighting circuits.

.1 Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

.24 Circuit breakers shall have a minimum interrupting rating of 10 000 amperes symmetrical at 240 volts, and 14 000 amperes symmetrical at 480 volts, unless otherwise noted on the drawings.

.25 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.

.26 Lighting and receptacle panels shall be surface or flush-mounting type, as shown.

.27 Panels shall be dead front type in code gauge steel enclosures. All panels shall be sprinkler proof c/w drip hoods as required.

.28 Panels shall have mains of voltage and capacity, and main and branch breakers, as shown on the drawings. Spaces shall include necessary bus work such that Owners, at a later date, need buy only the breakers.

.29 Where branch circuit metering is used on a panelboard, provide 762 mm (30”) tub width to accommodate the metering devices within the panelboard.

.30 Where panels exceed 42 circuits, use multi-section panel with main cross-over solid bus bars unless noted otherwise on drawings. Main bus capacity of each section shall be full size to match cross-over bus.

.31 Breakers shall have bolted type connections. Multi-pole breakers shall be common trip type with a single handle, suitable for voltage applied and of same manufacture as single pole breakers.

.32 Panels for 120/208 volt, 3-phase, 4-wire systems shall be complete with full size breakers.

.33 Where shown on drawings or required by code, certain breakers shall include ground fault interrupter.

.34 Provide lighting and receptacle panels suitable for surface, or flush-mounting type, as shown.

.35 Provide locking bars on non-switched circuits where panels are used for switching lighting circuits.

.36 Panels for non-linear loads shall be complete with lugs for double neutrals.

.37 Panels shall be given a rust-resistant treatment to both tub and trim.

.38 Flush panels shall have concealed hinges and flush type combination lock latch. Locks shall be chrome plated. Doors shall open minimum 135 degrees. Trims shall have fasteners concealed and shall be prime coated to receive room finish paint.

.39 Surface mounted panels shall have manufacturer's standard surface door trim complete with lock and latch. Finish shall be grey.

.40 Recessed panels shall have standard flush trims.

.41 Co-ordinate panel finish with Room Finish Schedule.

2.04 MOLDED CASE CIRCUIT BREAKERS

.1 Breakers: to Section 26 28 16.02.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.4 Lock-on devices for 10 per cent of 15 A to 30 A breakers installed as indicated. Turn over unused lock-on devices to Owner.

.5 Lock-on devices for fire alarm, security, and sprinkler circuits.

.6 Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.

.7 Provide breakers for externally mounted Surge Protective Devices in accordance with Section 26 43 13.

2.05 CONSTRUCTION

.1 General:

.1 Interiors shall be completely factory assembled. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

.2 Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.

.3 A temporary directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.

.4 All locks shall be keyed alike. Key same as existing.

.2 Branch Circuit Panelboards:

.1 Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Door-in-door trim shall be provided. Both hinged trim and trim door shall utilize three-point latching. No tools shall be required to install or remove trim. Trim shall be equipped with a door-actuated trim locking tab. Equip locking tab with provision for a screw such that removal of trim requires a tool, at the owner’s option. Installation shall be tamper resistant with no exposed hardware on the panelboard trim.

.3 Distribution Panelboards:

.1 Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.

2.06 BUS

.1 Lugs: Copper and listed by CSA, or cUL, for use with copper conductors and sized to accept copper conductors of the ampacity specified.

.2 Main bus bars shall be copper sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.

.3 A copper system ground bus shall be included in all panelboards.

.4 Full-size (100 per cent rated) insulated copper neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200 per cent rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.

2.07 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 53.

.2 Nameplate for each panelboard size 4 engraved.

.3 Nameplate for each branch circuit in distribution panelboards size 2 engraved.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

.5 Provide an engraved nameplate for each panelboard section.

.6 Provide copies of all circuit directories in manuals.

2.08 SOURCE QUALITY CONTROL

.1 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and CSA standards.

3 Execution

3.01 INSTALLATION

.1 Install panelboards to CSA C22.1.

.2 Install panelboards plumb.

.3 Height: 1800 mm to top of panelboard; install panelboards taller than 1800 mm with bottom no more than 100 mm above floor.

.4 Provide filler plates for unused spaces in panelboards.

.5 Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

.6 Provide engraved plastic nameplates under the provisions of Section 26 05 53.

.7 Ground and bond panelboard enclosure according to Section 26 05 26.

.8 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.9 Install surface mounted panelboards on fire rated plywood backboards in accordance with Section 26 05 29. Where practical, group panelboards on common backboard.

.10 Connect loads to circuits.

.11 Connect neutral conductors to common neutral bus with respective neutral identified.

.12 Deliver five (5) duplicate keys for each panel lock to Owner.

.13 Mount electrical panels, where possible, with top of trim at uniform height of 2000 mm.

.14 Cap ends of conduits in accessible locations in ceiling spaces above panels, to allow for future wiring.

.15 The Contractors shall install all equipment per the manufacturer’s recommendations and the contract drawings.

.16 Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and Electrical Code requirements.

.17 After completion of wiring, type directory showing a clear description of each circuit being controlled from panel and place in metal frame inside door.

.18 Provide revised directories for existing panels if revised.

.19 Provide circuit breaker handle locks for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

.20 Provide minimum three 27 mm empty conduits from top of lighting, receptacle, telephone, signal and communication panels recessed in walls, to ceiling space.

3.02 FIELD QUALITY CONTROL

.1 Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.

.2 Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.

.3 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20 per cent of each other. Maintain proper phasing for multi-wire branch circuits.

.4 Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.03 ADJUSTING

.1 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other.

.2 Maintain proper phasing for multi-wire branch circuits.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.02 RELATED REQUIREMENTS

.1 Section 26 09 43 – Network Lighting Controls.

.2 Section 26 27 26.13 – Floor Box Assemblies.

1.03 REFERENCES

.1 CSA Group:

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.3 CSA C22.2 No. 14-13, Industrial control equipment

.4 CSA C22.2 No. 42-10 (R2015), General use receptacles, attachment plugs, and similar devices.

.5 CSA C22.2 No. 42.1-13, Cover plates for flush-mounted wiring devices.

.6 CSA C22.2 No. 55-15 (R2020), Special use switches.

.7 CSA C22.2 No.111-10 (R2015), General-use snap switches.

.8 CSA C22.2 No. 182.1-17, Plugs, receptacles, and cable connectors of the pin and sleeve type

1.04 INFORMATIONAL SUBMITTALS

.1 Submit shop drawings and product data in accordance with Section 01 30 00.

.2 Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.

.3 Submit manufacturer's installation instructions.

2 Products

2.01 MANUFACTURERS

.1 Eaton.

.2 Hubbell Bryant.

.3 Leviton.

.4 Molex.

.5 Pass & Seymour (Legrand).

2.02 WALL SWITCHES

.1 Single pole, double pole, three-way, four-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.

.2 Description: CSA C22.2 No. 111, Commercial Spec Grade, AC only general-use snap switch.

.3 Local switches shall be 20 ampere, silent, brown coloured, AC type and CSA certified, specification grade. Provide switches rated to suit system voltage 120 V or 347 V.

.4 Manually-operated general purpose AC switches with following features:

.1 Terminal holes approved for 10 AWG wire.

.2 Silver alloy contacts.

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

.4 Suitable for back and side wiring.

.5 Voltage: 120 volt or 347 volt, AC as indicated.

.6 Current: 20 amperes.

.7 Body and Handle: white plastic with toggle handle. Confirm finish colour prior to ordering.

.8 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.9 Example Products (Decorator style):

.1 120 volt:

.1 Hubbell HBL2121 series.

.2 347 volt:

.1 Pass & Seymour 2601-347 series.

.10 Example Products (Toggle style):

.1 120 volt:

.1 Hubbell HBL1221 (single pole).

.2 Hubbell HBL1222 (double pole).

.3 Hubbell HBL1223 (three-way).

.4 Hubbell HBL1224 (four-way).

.2 347 volt:

.1 Hubbell HBL18221 (single pole).

.2 Hubbell HBL18223 (three-way).

.3 Pass & Seymour PS372030I.

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

2.03 RECEPTACLES

.1 General

.1 Description: CSA C22.2 No. 42, Commercial Spec Grade general use receptacles.

.2 Device Body: white plastic.

.3 Configuration: Type as specified and indicated.

.4 Convenience Receptacle: Type 5-15, 5-20 where indicated.

.5 GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

.6 Data Room Receptacle Types: As indicated on drawings.

.7 Receptacles of one manufacturer throughout project.

.2 Receptacles shall be white coloured, specification grade, unless noted otherwise.

.3 Receptacles shall be as listed below:

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

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

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

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

.5 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No. 42 with following features:

.1 White urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Break-off links for use as split receptacles.

.4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and riveted grounding contacts.

.6 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:

.1 White urea moulded housing.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Four back wired entrances, 2 side wiring screws.

.7 Other receptacles with ampacity and voltage as indicated.

.8 Example Products (Decorator style duplex 5-15R):

.1 Pass & Seymour 26252 Series.

.2 Hubbell HBL2152 Series.

.9 Ground Fault Circuit Interrupter (GFCI or GFI) Receptacles

.1 Protected by a ground fault circuit interrupter of the Class A type.

.2 Any receptacle within 1.5 m of a sink must be GFCI protected.

.3 Any receptacle located outdoor must be GFCI protected.

.10 Isolated Ground (IG) Receptacles:

.1 Marked as such (green triangle).

.2 Example Products:

.1 Hubbell IG2152 (15A duplex decorator style, orange faceplate).

.11 Tamper-resistant receptacles.

.1 Marked as such (for example “TR”).

.2 To be used in the following spaces:

.1 Child care facilities and kindergarten classrooms.

.2 Guest rooms and suites of hotels and motels.

.3 Preschools and elementary education facilities, including kindergarten facilities.

.4 Dwelling units.

.3 Example Products:

.1 Hubbell BR15WHITR (15A duplex decorator style).

.2 Hubbell BR20WHITR (20A duplex decorator style).

.12 Wet location and weatherproof devices:

.1 Receptacles and cover plates suitable for wet locations, cover plates to provide shielding with and without a plug inserted into the receptacle in accordance with OESC rule 26-702. Cover plates to be marked “Extra Duty”.

.2 Receptacles shall be 20 A rated, GFI.

2.04 COVER PLATES

.1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Stainless steel, vertically brushed, cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.

.5 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

.8 Decorative Cover Plate: Polycarbonate.

.1 Pass & Seymour TP26W series.

.9 Switch, receptacle, telephone and other plates shall be stainless steel 18-8 chrome metal alloy, Type 302, non-metallic in finished areas and pressed steel in unfinished areas. Finish brush marks shall be run in a vertical direction.

.10 Wet Location and weatherproof devices: receptacles and cover plates shall be suitable for wet locations, and provide shielding with and without a plug inserted into the receptacle in accordance with 2021 OESC rule 26-710.

2.05 PENDANT RECEPTACLES

.1 Pendant cord mounted single receptacles complete with strain relief device.

.2 Strain relief system: Hubbell Kellems Grips, Molex, or equal.

2.06 RECEPTACLE CORD REELS

.1 Retractable cable reel, mounted to structure above. 125 V, 5-20R complete with 12 m (40 feet) of cabtire (or equal).

.2 Provide framing bracket to support reel at underside of structure above.

.3 Connect to GFCI breakers.

.4 Manufacturers:

.1 Hubbell HBL-C40-123TT.

.2 Woodhead (Molex) 997 series.

.3 Approved equal.

2.07 SPECIAL WIRING DEVICES

.1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel flush type.

2.08 PIN AND SLEEVE DEVICES

.1 Manufacturers:

.1 Crouse-Hinds by Eaton.

.2 Hubbell.

.3 Meltric.

.4 Mennekes.

.5 Russellstoll (Thomas & Betts).

.6 Walther Electric.

.2 Refer to equipment schedule and plans for locations and specific requirements.

2.09 REGULATORY REQUIREMENTS

.1 Provide products listed and classified by CSA (Canadian Standards Association).

3 Execution

3.01 EXAMINATION

.1 Verify that outlet boxes are installed at proper height.

.2 Verify that wall openings are neatly cut and will be completely covered by wall plates.

.3 Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 PREPARATION

.1 Provide extension rings to bring outlet boxes flush with finished surface.

.2 Clean debris from outlet boxes.

3.03 INSTALLATION

.1 Install to CSA C22.1.

.2 Mounting heights in accordance with Section 26 05 00.

.3 Install devices plumb and level.

.4 Install switches with OFF position down.

.5 Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.

.6 Do not share neutral conductor on load side of dimmers.

.7 Install receptacles with grounding pole on bottom.

.8 Connect wiring device grounding terminal to outlet box with bonding jumper.

.9 Install decorative plates on switch, receptacle, and blank outlets in finished areas.

.10 Connect wiring devices by wrapping conductor around screw terminal.

.11 Use jumbo size plates for outlets installed in masonry walls.

.12 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

.13 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

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

.14 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

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

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

.4 Receptacles for maintenance of HVAC and similar equipment located on rooftops.

.1 Provide weatherproof GFI 5-20R receptacles on roof, installed at 750 mm (30 inches) above finished roof level, complete with wet location cover plate.

.2 Locate within 7500 mm (25 feet) of new HVAC equipment, and at least 2000 mm (6.5 feet) away from roof line.

.3 Refer to 2018 OESC rules 2-316, 26-708, and 26-710, and OESC bulletin 26-27-0, or latest edition.

.15 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

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

.16 Circuit identification: in accordance with Section 26 05 53.

3.04 FIELD QUALITY CONTROL

.1 Inspect each wiring device for defects.

.2 Operate each wall switch with circuit energized and verify proper operation.

.3 Verify that each receptacle device is energized.

.4 Test each receptacle device for proper polarity.

.5 Test each GFCI receptacle device for proper operation.

3.05 ADJUSTING

.1 Adjust devices and wall plates to be flush and level.

3.06 CLEANING

.1 Clean exposed surfaces to remove splatters and restore finish.

End of Section

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1 General

1.01 SUBMITTALS

.1 Provide submittals in accordance with Section 01 30 00.

.2 Product Data:

.1 Provide fuse performance data characteristics for each fuse type and size above 200 amps. Performance data to include: average melting time-current characteristics.

.3 Shop Drawings:

.1 Provide shop drawings in accordance with Section 01 30 00.

1.02 DELIVERY, STORAGE, AND HANDLING

.1 Ship fuses in original containers.

.2 Do not ship fuses installed in switchboard.

.3 Store fuses in original containers in storage cabinet.

.4 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00.

1.03 MAINTENANCE MATERIAL SUBMITTALS

.1 Provide maintenance materials in accordance with Section 01 78 00.

.2 3 spare fuses of each type and size installed above 600 A.

.3 6 spare fuses of each type and size installed up to and including 600 A.

2 Products

2.01 MANUFACTURERS

.1 Bussman by Eaton.

.2 GEC.

.3 Littelfuse.

.4 Mersen.

.5 Substitutions: not permitted.

2.02 FUSES - GENERAL

.1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

.2 Fuses: product of one manufacturer.

.3 Fuses shall be sized as shown, time delay type, and of the same type throughout.

.4 Fuses shall be CSA certified Class-J for 1-600A or Class-L for 650 Amps and above.

2.03 FUSE TYPES

.1 Class J fuses.

.1 Type J1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.

.2 Type J2, fast acting.

.2 Class L fuses.

.1 Type L1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.

.2 Type L2, fast acting.

.3 Class R fuses.

.1 Type R1, (UL Class RK1), time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum, to meet UL Class RK1 maximum let-through limits.

.2 Type R2, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.

.3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

2.04 FUSE REQUIREMENTS

.1 Dimensions and Performance: CSA C22.2 No. 248 Series, Class as specified or indicated.

.2 Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.

.3 Power Load Feeder Switches: HRC-1 Class J time delay type.

.4 Other Feeder Switches: HRC-1 Class J time delay type.

2.05 SPARE FUSE CABINET

.1 Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified.

.2 Doors: Hinged, with hasp for Owner's padlock.

.3 Finish: Prime finish for field painting.

.4 Dimensions: Minimum 914 mm by 914 mm by 305 mm (3 foot by 3 foot by 1 foot).

3 Execution

3.01 INSTALLATION

.1 Install fuses to manufacturer's instructions.

.2 Install fuse with label oriented such that manufacturer, type, and size are easily read.

.3 Install spare fuse cabinet in electrical room.

.4 Provide a complete set of fuses in each fusible device supplied under this Division and provide 3 spare fuses for each size used in spare fuse cabinet.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Molded-case circuit breakers.

.2 Molded-case switches.

.3 Accessories.

1.02 RELATED REQUIREMENTS

.1 Section 26 24 13 – Switchboards.

.2 Section 26 24 16 – Panelboards.

1.03 REFERENCES

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.3 CSA C22.2 No. 5-16, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

.4 NEMA AB1 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit - Breaker Enclosures.

.5 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.04 SUBMITTALS

.1 Submit product data in accordance with Section 01 30 00.

.2 Include time-current characteristic curves for breakers with ampacity of 400 A and above, or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

.3 Include termination temperature rating in degrees C.

.4 Certificate of Origin

.1 Prior to any installation of circuit breakers in either a new or existing installation, Contractor must submit three (3) copies of a certificate of origin from the manufacturer, duly signed by the factory and the local manufacturer’s representative, certifying that all circuit breakers come from this manufacturer, they are new and they meet standards and regulations. These certificates must be submitted to the Consultant for review.

.2 A delay in the production of the certificate of origin won’t justify any extension of the contract and additional compensation.

.3 Any work of manufacturing, assembly or installation should begin only after acceptance of the certificate of origin by the Consultant. Unless complying with this requirement, Consultant reserves the right to mandate the manufacturer listed on circuit breakers to authenticate all new circuit breakers under the contract, and that, to Contractor’s expense.

.4 In general, the certificate of origin must contain:

.1 The name and address of the manufacturer, and the person responsible for authentication. The responsible person must sign and date the certificate;

.2 The name and address of the licensed dealer, and the person of the distributor responsible for the Contractor's account.

.3 The name and address of the Contractor, and the person responsible for the project.

.4 The name and address of the local manufacturer's representative. The local representative must sign and date the certificate.

.5 The name and address of the building where circuit breakers will be installed:

.1 Project title

.2 End user's reference number

.3 The list of circuit breakers

2 Products

2.01 GENERAL

.1 Molded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters, Fused circuit breakers, and Accessory high-fault protectors: to CSA C22.2 No. 5

.2 Bolt-on Molded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Plug-in Molded case circuit breakers: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.4 Common-trip breakers: with single handle for multi-pole applications.

.5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.6 Circuit breakers with interchangeable trips.

2.02 INTERRUPTING CAPACITY

.1 Protective devices shall be fully rated, for required available fault current. Series rated shall not be used on this installation.

.2 Refer to Section 26 24 13, and Section 26 24 16.

2.03 MOLDED CASE CIRCUIT BREAKERS – GENERAL

.1 Molded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

.2 NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

.3 Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

.4 1-, 2-, or 3-pole bold on, single-handle common trip voltage as indicated on drawings.

.5 Overcentre toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.

.6 Calibrate for operation in 40 degree C ambient temperature.

2.04 MOLDED CASE CIRCUIT BREAKERS – UP TO 150 AMPERE

.1 Permanent trip unit containing individual thermal and magnetic trip elements in each pole, unless noted otherwise on drawings.

2.05 MOLDED CASE CIRCUIT BREAKERS – 151 TO 224 AMPERE

.1 Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.

2.06 MOLDED CASE CIRCUIT BREAKERS – 225 AMPERE AND ABOVE

.1 Electronic trip type with adjustments for long-time, instantaneous, and short-time functions.

.2 Provide ground fault function for breakers greater than 400 Amps.

.3 1000 Amp and Above:

.1 Modbus Communications

.1 Breaker status.

.1 Open.

.2 Closed.

.3 Tripped.

.2 Cause of trip.

.3 Time of trip.

.4 Current at time of trip.

.5 RMS currents per phase and ground.

.6 Peak demand.

.7 Present demand.

.8 Energy consumption.

.4 1200 Amp and Above:

.1 Provide handle mechanisms that are lockable in the open (off) position.

2.07 ADDITIONAL FEATURES

.1 Provide as indicated on drawings:

.1 Shunt trip

.2 Auxiliary switch

.3 Motor-operated mechanism.

.4 Under-voltage release

.5 On-off locking device

.6 Handle mechanism

2.08 MOLDED-CASE SWITCHES

.1 Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

.2 Accessories:

.1 Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.

.2 Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.

2.09 ENCLOSED BREAKERS AND ENCLOSED MOLDED-CASE SWITCHES

.1 Molded case, front operated, automatic circuit breakers sized as specified on drawings each secured in a NEMA 1, flush wall mounting enclosure with steel front panel.

.2 Voltage rating suitable for circuit phase to phase voltage as indicated on drawings.

.3 Units to include solid state adjustable trip units and contactors. Contactors to be of rating and type to suit application.

3 Execution

3.01 INSTALLATION

.1 Install circuit breakers as per related sections.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Fusible and non-fusible enclosed low-voltage disconnect switches from 30 to 800 amps.

1.02 RELATED REQUIREMENTS

.1 Section 26 28 13 – Fuses.

1.03 REFERENCES

.1 Canadian Standards Association

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th Edition/2021).

.3 CSA C22.2 No. 4-16, Enclosed and Dead-Front Switches.

.4 CSA C22.2 No. 248 series, Low-voltage fuses.

.2 NETA (International Electrical Testing Association) ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 SUBMITTALS

.1 Product Data: Provide switch ratings, and enclosure dimensions.

1.05 CLOSEOUT SUBMITTALS

.1 Record actual locations of enclosed switches in project record documents.

2 Products

2.01 MANUFACTURERS

.1 Eaton Cutler-Hammer.

.2 Siemens.

.3 Square D by Schneider Electric.

2.02 REGULATORY REQUIREMENTS

.1 Products: Listed and classified by CSA or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2.03 DISCONNECT SWITCHES

.1 Provide dedicated disconnect switches at electrical equipment.

.2 Fused or un-fused disconnect or safety switches: Type "A", quick-make, quick-break construction with provision for padlocking switches in either "ON" or "OFF" position.

.1 Quick-make, quick-break.

.2 Heavy duty industrial type.

.3 Lockable with up to 3 padlocks.

.4 Cover interlocked with switch mechanism.

.5 Viewing window for viewing blades.

.3 Fused switches equipped with fuse clips designed for Class "J" fuses and designed to reject standard NEC fuses.

.4 Enclosure: CSA Type 1 sprinkler-proof, or as noted.

.5 Switches throughout project of same manufacturer.

3 Execution

3.01 INSTALLATION

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

.2 Install disconnect switches complete with fuses, if applicable, to CSA C22.1.

.3 Apply neatly typed adhesive tag on inside door of each fusible switch indicating NEMA fuse class and size installed.

.4 Coordinate fuse ampere rating with installed equipment. Fuse ampere rating variance between original design information and installed equipment, size in accordance with Bussmann Fusetron 40 degree C recommendations. Do not provide fuses of lower ampere rating than motor starter thermal units.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Solid state, light emitting diode (LED) source interior luminaires.

.2 New, fully integrated luminaires for indoor applications.

1.02 RELATED REQUIREMENTS

.1 Section 26 09 43 – Network Lighting Controls.

.2 Section 26 52 13.13 – Emergency Lighting.

1.03 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th edition/2021).

.3 CSA C22.2 No. 250.0 - Luminaires (Bi-National Standard, with UL 1598).

.2 DesignLights Consortium (DLC).

.1 Technical Requirements Table v5.1, or latest edition.

.2 Where the specifications do not explicitly call for DLC qualified LED luminaires, the technical criteria provided in the DLC Technical Requirements provide the basis of the requirements for this section of the Specification.

.3 Energy Star

.1 Program Requirements for Luminaires - Eligibility Criteria, Version 1.2, or latest edition.

.4 Illuminating Engineering Society (IES):

.1 IES HB-10-11 – The Lighting Handbook, 10th Edition.

.2 IES LM-79-08 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.

.3 IES LM-80-08 – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.

.4 IES TM-21-11 – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.

.5 IEEE 1789-2015 – IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers.

.6 National Electrical Manufacturer's Association (NEMA):

.1 SSL-1-10 – Electronic Drivers for LED Devices, Arrays, or Systems.

.2 WD 6 - Wiring Devices - Dimensional Requirements.

1.04 DEFINITIONS

.1 CCT: Correlated colour temperature.

.2 CRI: Colour-rendering index.

.3 LED: Light Emitting Diode.

.4 Lumen: Measured output of lamp and luminaire, or both.

.5 Luminaire: Complete lighting fixture, including ballast housing if provided.

1.05 ACTION SUBMITTALS

.1 Refer to Section 01 30 00.

.2 Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but not limited to):

.1 Maximum power in Watts.

.1 If a transformer is used in conjunction with a driver (for example on some 347 volt lighting circuits), the maximum power shall include the transformer losses.

.2 L70 in hours, when extrapolated for the worse case operating temperature. TM-21 report shall be submitted to demonstrate this.

.3 Product submittals shall be accompanied by performance data that is derived in accordance with appropriate IESNA testing standards and tested in a laboratory that is NVLAP accredited for Energy Efficient Lighting Products.

1.06 INFORMATIONAL SUBMITTALS

.1 Installation instructions.

1.07 CLOSEOUT SUBMITTALS

.1 Section 01 78 00: Submittals for project closeout.

.2 Submit manufacturer's operation and maintenance instructions for each product.

.3 Warranty information.

1.08 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.09 REGULATORY REQUIREMENTS

.1 Products shall be listed and classified by CSA (Canadian Standards Association), ULC (Underwriter’s Laboratories of Canada), or certified by recognized independent testing organizations that test to CSA standards.

.2 Products shall be certified by a recognized testing agency accredited by the Standards Council of Canada and bear a certification mark from that agency.

.3 All luminaires shall be listed and labeled for installation in fireproof or non-fireproof construction, dry, damp, or wet locations as required.

.4 Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

1.10 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.11 EXTRA STOCK MATERIALS

.1 Refer to Section 01 78 00.

.2 Provide the following additional equipment as listed herein.

.1 Provide an additional 2 per cent spare luminaires of each new type to be provided.

.2 Provide 1 per cent of each plastic lens type.

.3 Provide three of each type of any special tools required for system use and maintenance.

1.12 WARRANTY

.1 Refer to Section 01 78 00 and Section 26 05 00.

.2 The manufacturer shall provide a warranty against loss of performance and defects in materials and workmanship for the luminaires for a period of 5 years after acceptance of the luminaires. Warranty shall cover all components comprising the luminaire.

.3 All warranty documentation shall be provided to customer prior to the first shipment.

.4 LED Luminaires shall have a manufacturer’s warranty for a period of not less than five years.

.5 LED boards, drivers and associated components shall have a warranty of 5 years on the LEDs, 5 years on the driver, 10 years on the paint finish.

2 Products

2.01 MANUFACTURERS

.1 As noted on Lighting Fixture Schedule.

2.02 INDOOR LED LUMINAIRES, GENERAL

.1 Initial delivered lumens – thermal losses should be less than 10 per cent when operated at a steady state at an average ambient operating temperature of 25 degrees C, and optical losses should be less than 15 per cent.

.2 Average Delivered Lumens – Average delivered lumens over 50 000 hours should be minimum of 85 per cent of initial delivered lumens.

.3 All luminaires shall be tested per LM79/80 and published L70 data.

.4 Available in 3500 K correlated colour temperature, CRI greater than or equal to 80, or as indicated.

.5 Accessibility and Maintenance:

.1 All LED luminaires shall be field serviceable, with LED arrays, LED modules, drivers, etc. fully serviceable and easily accessible. In the case of recessed ceiling mounted, and in the case of

surface mounted ceiling fixtures, these components must be accessible from below. Luminaires in which any of these components are accessible only from above are not acceptable.

.2 Ballasts, drivers, LED arrays, LED modules, and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts or drivers shall not be mounted to removable reflectors or wireway covers unless so specified. In the case of ceiling mounted luminaires, the serviceable components must be accessible from below.

.6 Housings:

.1 Formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.

.2 Sheet steel housings to be minimum 20 gauge.

.3 Wireways and fittings: free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.

.4 When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.

.5 Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.

.6 Drivers shall not be mounted to removable reflectors or wireway covers unless so specified.

.7 Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

.8 Metal Finishes:

.1 Fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

.2 All metal components of fixtures shall be painted after fabrication to mitigate raw metal edges, and thus prevent premature corrosion.

.3 The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.

.4 Interior light reflecting finishes shall be white with not less than 85 per cent reflectance, except where otherwise shown on the drawing.

.9 Wiring:

.1 Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

.2 Supplied complete with a luminaire disconnect plug.

.10 Control of Visual Perceptions of Temporal Light Modulation (flicker):

.1 All electric lights (except decorative lights, emergency lights and other special-purpose lighting) used in regularly occupied spaces meet at least one of the following requirements for flicker:

.1 A minimum frequency of 90 Hz at all 10% intervals from 10% to 100% light output.

.2 LED products with a “low risk” level of flicker (light modulation) of less than 5%, especially below 90 Hz operation as defined by IEEE standard 1789-2015 LED.

2.03 DRIVERS, GENERAL

.1 Electronic LED drivers shall be integral to the luminaire, and be designed to be accessible in the field for replacement and servicing.

.2 Input Voltage:

.1 Driver with a voltage range of (120-277) +/- 10% or (347-480) +/- 10%.

.2 Refer to lighting fixture schedule.

.3 For luminaires connected to a 347 volt circuit and utilizing a natively 120-277 volt driver, provide an appropriately sized step down transformer.

.3 Input frequency 60 Hz.

.4 Load regulation: +/- 1 per cent from no load to full load.

.5 Output ripple less than 10 per cent.

.6 Output should be isolated.

.7 Case temperature: rated for -40 degrees C through +80 degrees C.

.8 Overheat protection, self-limited short circuit protection and overload protected.

.9 Primary fused.

.10 Driver life rating not less than 50 000 hours

.11 Power Factor and Total Harmonic Distortion

.1 Power factor of greater than or equal to 0.9 at full load.

.2 THD of less than or equal to 20 per cent at full load.

.12 Dimming Control:

.1 Coordinate with Section 26 09 43.

.2 0-10 V dimming control typical for all fixtures unless otherwise noted.

.3 Control range: 10 per cent to 100 per cent typical, unless noted otherwise.

.4 Provide a mock-up to demonstrate the luminaire is free of flicker throughout the dimming range when used with the dimming controllers described in related sections.

2.04 INTERIOR WALL-WASH LED LUMINAIRES

.1 Minimum Light Output: 575 lm.

.2 Zonal lumen density:

.1 Minimum 60 per cent between 0 degrees and 90 degrees from nadir.

.2 Minimum 60 per cent of the lumens must be produced in the “forward” hemisphere, towards the wall.

.3 Minimum luminaire efficacy: 45 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.05 TRACK OR MONO-POINT DIRECTIONAL LED LUMINAIRES

.1 Minimum Light Output: 250 lm.

.2 Zonal lumen density:

.1 Minimum 85 per cent between 0 degrees and 90 degrees from nadir.

.3 Minimum luminaire efficacy: 45 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.06 DOWNLIGHT LUMINAIRES

.1 Minimum Light Output: 500 lm.

.2 Zonal lumen density: Minimum 75 per cent between 0 degrees and 60 degrees from nadir.

.3 Minimum luminaire efficacy: 45 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.07 NOMINAL 610 MM BY 610 MM (2 FOOT BY 2 FOOT) LUMINAIRES FOR AMBIENT LIGHTING OF INTERIOR SPACES

.1 Minimum Light Output: 2 000 lm.

.2 Zonal lumen density:

.1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.

.3 Spacing Criteria:

.1 0 degrees to 180 degrees: 1.0 to 2.0

.2 90 degrees to 270 degrees: 1.0 to 2.0

.4 Minimum luminaire efficacy: 85 lumens per watt.

.5 Correlated Colour Temperature (CCT): 3500 K

.6 Colour Rendition Index (CRI): 80 CRI minimum.

.7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.08 NOMINAL 305 MM BY 1220 MM (1 FOOT BY 4 FOOT) LUMINAIRES FOR AMBIENT LIGHTING OF INTERIOR SPACES

.1 Minimum Light Output: 1 500 lm.

.2 Zonal lumen density:

.1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.

.3 Spacing Criteria:

.1 0 degrees to 180 degrees: 1.0 – 2.0

.2 90 degrees to 270 degrees: 1.0 – 2.0

.4 Minimum luminaire efficacy: 85 lumens per watt.

.5 Correlated Colour Temperature (CCT): 3500 K

.6 Colour Rendition Index (CRI): 80 CRI minimum.

.7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.09 NOMINAL 610 MM BY 1220 MM (2 FOOT BY 4 FOOT) LUMINAIRES FOR AMBIENT LIGHTING OF INTERIOR SPACES

.1 Minimum Light Output: 3 000 lm.

.2 Zonal lumen density:

.1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.

.3 Spacing Criteria:

.1 0 degrees to 180 degrees: 1.0 – 2.0

.2 90 degrees to 270 degrees: 1.0 – 2.0

.4 Minimum luminaire efficacy: 85 lumens per watt.

.5 Correlated Colour Temperature (CCT): 3500 K

.6 Colour Rendition Index (CRI): 80 CRI minimum.

.7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.10 LINEAR AMBIENT LUMINAIRES: INDIRECT

.1 Minimum Light Output: 500 lm per foot.

.2 Zonal lumen density:

.1 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.

.3 Minimum luminaire efficacy: 85 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.11 LINEAR AMBIENT LUMINAIRES: INDIRECT/DIRECT

.1 Minimum Light Output: 500 lm per foot.

.2 Zonal lumen density:

.1 Minimum 25 per cent between 0 degrees and 60 degrees from nadir.

.2 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.

.3 Minimum luminaire efficacy: 85 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.12 LINEAR AMBIENT LUMINAIRES: DIRECT/INDIRECT

.1 Minimum Light Output: 500 lm per foot.

.2 Zonal lumen density:

.1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.

.2 Minimum 35 per cent between 90 degrees and 150 degrees from nadir.

.3 Minimum luminaire efficacy: 85 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.13 LINEAR AMBIENT LUMINAIRES: DIRECT

.1 Minimum Light Output: 375 lm per foot.

.2 Zonal lumen density:

.1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.

.3 Minimum luminaire efficacy: 85 lumens per watt.

.4 Correlated Colour Temperature (CCT): 3500 K

.5 Colour Rendition Index (CRI): 80 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.14 HIGH-BAY LUMINAIRES FOR COMMERCIAL AND INDUSTRIAL BUILDINGS

.1 Minimum Light Output: 10 000 lm.

.2 Zonal lumen density:

.1 Minimum 30 per cent between 20 degrees and 50 degrees from nadir.

.3 Minimum luminaire efficacy: 80 lumens per watt.

.4 Correlated Colour Temperature (CCT): 4000 K

.5 Colour Rendition Index (CRI): 70 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.15 LOW-BAY LUMINAIRES FOR COMMERCIAL AND INDUSTRIAL BUILDINGS

.1 Minimum Light Output: 5 000 lm.

.2 Zonal lumen density:

.1 Minimum 30 per cent between 20 degrees and 50 degrees from nadir.

.3 Minimum luminaire efficacy: 80 lumens per watt.

.4 Correlated Colour Temperature (CCT): 4000 K

.5 Colour Rendition Index (CRI): 70 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.16 HIGH-BAY AISLE LUMINAIRES

.1 Minimum Light Output: 10 000 lm.

.2 Zonal lumen density:

.1 Minimum 30 per cent between 0 degrees and 20 degrees from nadir.

.2 Minimum 50 per cent between 20 degrees and 50 degrees from nadir.

.3 Minimum luminaire efficacy: 80 lumens per watt.

.4 Correlated Colour Temperature (CCT): 4000 K

.5 Colour Rendition Index (CRI): 70 CRI minimum.

.6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

3 Execution

3.01 VERIFICATION OF CONDITIONS

.1 Coordinate the lighting system installation with the relevant trades so as to eliminate interferences with hangers, mechanical ducts, sprinklers, piping, steel, etc.

3.02 INSTALLATION

.1 Install lighting equipment, including but not limited to luminaires, controls, auxiliary devices and the integration of same in strict conformance with all manufacturers' recommendations and instructions the securing of which shall be the responsibility of the Contractor.

.2 Integrate luminaires with controls in accordance with respective luminaire manufacturers' and controls manufacturers' recommendations and instructions and to provide a complete, trouble-free operation without compromising safety, code and CSA requirements.

.3 Seal all luminaires for wet locations (i.e. all knock-outs, all pipe and wire entrances, etc.) as is standard industry practice to prevent water from entering luminaires.

.4 Luminaire Alignment

.1 Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Install recessed luminaires to permit removal from below. Include accessories and materials to meet applicable codes and regulatory requirements.

.2 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.3 Align luminaires mounted individually parallel or perpendicular to building grid lines.

.4 Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

.5 Locate and install luminaires as indicated. Mounting heights and configuration of the luminaires shall be as specified in the Luminaire Schedule portion of the Specification or indicated on the drawings, and where conflicts exist, as approved by the Consultant.

.6 Installed all luminaires plumb and true and level as viewed from all directions unless specifically identified otherwise in the Lighting Fixture Schedule. Luminaires shall remain plumb and true without continual adjustment or visibly obvious means beyond what is shown on luminaire submittal drawings.

.7 For installation in suspended ceilings, ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling system greater than 1/360 of the length of the total span of the ceiling member.

.5 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

.6 Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, use a finishing ring painted to match the ceiling to conceal the junction box.

.7 Suspended Luminaires:

.1 Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

.2 Suspended luminaires shall be installed plumb and true and level unless specifically identified otherwise in the Luminaire Schedule portion of this Specification and at a height from finished

floor as specified on the drawings, details and Luminaire Schedule. In cases where this is impractical, refer to the Consultant for a decision. All appurtenances shall be consistently organized for a neat, uniform appearance.

.8 Install wall mounted luminaires at height as indicated.

.9 Accessories:

.1 Reflector cones, louvers, baffles, lenses, trims and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.

.2 Install accessories provided with each luminaire.

.3 All accessories shall be properly installed and adjusted by Contractor in accordance with specification and installation instructions. Any spare items shall be clearly labeled (indicate type of accessory and associated luminaire types).

3.03 TESTING AND ADJUSTMENT

.1 As required, all adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Consultant. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor.

.2 For luminaires with field selectable lumen output and/or CCT, ensure the correct setting matches the intended set points.

.3 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.

.4 Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night.

3.04 LUMINAIRE SUPPORTS

.1 Provide adequate support to suit ceiling system.

.2 Support luminaires independently of ceiling framing, unless ceiling is certified by the manufacturer to support weight of installed devices. Confirm if T-bar ceilings are metric or imperial and provide luminaires to suit ceiling dimensions.

.3 Provide chain hangers for new and existing luminaires.

.4 Install clips to secure recessed grid-supported luminaires in place.

.5 Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Ceiling framing members must be securely attached to each other and to the building structure as required by all applicable codes and standards. Use of integral clips is not acceptable.

3.05 WIRING

.1 Use SPC90 conductors for final connections to luminaires (including 0-10 V dimming conductors for applicable luminaires).

.2 Install luminaire disconnect plugs on all new luminaires not provided as such from the manufacturer.

.3 Connect luminaires to branch circuit outlets provided under Section 26 05 33.13 using flexible conduit.

.4 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

.5 Bond products and metal accessories to branch circuit equipment grounding conductor.

3.06 FIELD QUALITY CONTROL

.1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.

.2 Make wiring connections to the branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

.3 Occupancy Sensors.

.1 Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas.

.2 Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room.

.3 Exercise proper judgment in executing the work to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

3.07 CLEANING

.1 Thoroughly clean all luminaires and accessories after installation. All fingerprints, dirt, tar, smudges, drywall mud, dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens or louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufacturers' instructions.

.2 Clean electrical parts to remove conductive and deleterious materials.

.3 Remove dirt and debris from enclosures.

.4 Clean photometric control surfaces as recommended by manufacturer.

.5 Clean finishes and touch up damage.

.6 Luminaire finishes which are disturbed in any way during construction shall be touched up or refinished in a manner satisfactory to the Consultant.

3.08 COMMISSIONING

.1 In accordance with Section 26 08 50.

End of Section

1 General

1.01 CONDITIONS AND REQUIREMENTS

.1 Refer to the General Conditions, Supplementary General Conditions, and General Requirements.

.2 Provisions of this Section shall apply to all Sections of Division 27.

.3 Refer to Consultant's drawings for exact location of electrical equipment and devices. Refer to Designer drawings for additional notes which complement these specifications.

.4 The Division 26 specification documents shall be followed in conjunction with the specification in this section.

.5 Coordinate with the Division 26 contractor (hereafter referred to as the "electrical contractor").

1.02 RELATED DIVISIONS

.1 Division 25 – Integrated Automation.

.2 Division 26 – Electrical.

.3 Division 28 – Electronic Safety and Security.

1.03 INTENT

.1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter. Sections of this specification are not intended to delegate functions nor to delegate work and supply to any specific Trade. It shall be your responsibility to ensure that the systems specified hereafter are complete and operative.

1.04 CODES AND STANDARDS

.1 The equipment, material and installation shall conform to the latest version of the applicable Codes, Standards (including technical service bulletins and addenda) and regulations of authorities having jurisdiction.

.2 BICSI

.1 Telecommunications Distribution Methods Manual

.2 Cabling Installation Manual

.3 Outside Plant Manual

.3 Canadian Standards Association (CSA)

.1 CSA C22.1 – Canadian Electrical Code, Part 1

.2 CSA T529 – Commercial Building Telecommunications Cabling Standard (ANSI/EIA/TIA-568-B).

.3 CSA T530 – Commercial Building Standard For Telecommunications Pathways And Spaces (TIA/EIA 569-A).

.4 CSA T528 – Administration Standard For The Telecommunications Infrastructure Of Commercial Buildings (ANSI/EIA/TIA-606).

.5 CSA T527 – Commercial Building Grounding And Bonding Requirements For Telecommunications (ANSI/EIA/TIA-607).

.6 CSA C22.2 No. 214 – Communications Cables.

.7 CSA C22.2 No. 232-M – Fibre Optic Cables.

.8 CSA C22.2 No. 182.4-M90 – Plugs, Receptacles, and Connectors for Communication Systems.

.4 TIA

.1 TIA/EIA-568-B.1 – Commercial Building Telecommunications Cabling Standard

.2 TIA/EIA-568-B.2 – Balanced Twisted Pair Cabling Components

.3 TIA/EIA-568-B.3 – Optical Fibre Cabling Components Standard

.5 ISO

.1 ISO/IEC IS 11801A – Generic Cabling for Customer Premises.

.6 CENELEC EN 50173 – Performance Requirements for Generic Cabling Schemes.

.7 IEC

.1 IEC 603-7, PART 7 – Detailed Specification For Connectors, 8-Way, Including Fixed And Free Connectors With Common Mating Features.

.2 IEC 807-8 – Rectangular Connectors For Frequencies Below 3 MHz, Part 8: Detailed Specification For Connectors, Four-Signal Contacts And Earthing Contacts For Cable Screens, First Edition.

.8 FIPS PUB 174 – Commercial Building Telecommunications Wiring Standard. Federal Information Standard Publication.

.9 UL 444 and 13 – Adopted Test and Follow-Up Service Requirements For the Optional Qualification of 100Ω Twisted-Pair (Cables).

.10 NEMA WC 63 – Performance Standard For Field Testing Of Unshielded Twisted-Pair Cabling System.

.11 ANSI/EIA/TIA

.1 ANSI/EIA/TIA-492AAAA – Detailed Specification For 62.5µm Core Diameter / 125µm Cladding Diameter Class 1a Multimode, Graded-Index Optical Waveguide fibres.

.2 ANSI/EIA/TIA-492BAAA – Detailed Specifications For Class Iva Dispersion-Unshifted Singlemode Optical Waveguide Fibres Used In Communication Systems.

.3 ANSI/EIA/TIA-472CAAA – Detailed Specifications For All Dielectric (Construction 1) Fibre optic Communications Cable For Indoor Plenum Use, Containing Class 1a, 62.5µm Core Diameter / 125µm Cladding Diameter Fibre optic(s).

.4 ANSI/EIA/TIA-472DAAA – Detailed Specifications For All Dielectric Fibre optic Communications Cable For Outdoor Plant Use, Containing Class 1, 62.5µm Core Diameter / 250µm Cladding Diameter Fibre optic(s).

.5 ANSI/EIA/TIA-455 – Test Procedures For Fibre optics, Cables And Transistors.

.6 ANSI/EIA/TIA-598 – Colour Coding of Fibre Optic Cables.

.7 ANSI/EIA/TIA-604-3 – FOCIS 3 Fibre Optic Connector Intermateability Standard.

.8 ANSI/EIA/TIA-606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

.9 ANSI/EIA/TIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.

.12 ANSI Z136.2 – American Standards For The Safe Operation of Fibre optic Communication Systems Utilizing Laser Diode And LED Sources.

.13 ANSI/CEA

.1 ANSI/ICEA S-83-640 – Fibre Optic Outside Plant Communications Cable.

.2 ANSI/ICEA S-83-596 – Fibre Optic Premises Distribution Cable.

1.05 WORK SEQUENCE

.1 Prior to start of each work period in occupied area, temporary protection shall be installed to prevent damage to any personal property or furnishing. Coordinate with Owner's representative if any furniture must be relocated to facilitate work.

.2 Owner's representative shall approve temporary protection plan prior to use.

.3 Necessary steps shall be taken by contractor to ensure that required fire fighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

1.06 INSPECTIONS

.1 The Engineer and/or the Project Manager will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.

1.07 DRAWINGS AND SPECIFICATIONS

.1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a ruling is to be obtained from the Engineer in writing before submitting Tender. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.

.2 All drawings and all Divisions of these specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.

.3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of cabling is not assured. Exact requirements shall be governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull and junction boxes, etc. necessitated by such conditions shall be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.

.4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job.

.5 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

.6 Before ordering any conduit, cable tray, cables, fittings, etc., this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.08 MATERIAL

.1 This contractor is responsible to ensure that all items submitted meet all requirements of the drawings and specification, and fits in the allocated space. The final determination of a product being acceptable shall be determined by the Engineer.

1.09 TESTING DATA

.1 The contractor shall provide a complete testing report utilizing a testing device as specified in the applicable TIA/EIA standard with the correct adapter and test. All copper tests shall be compliant to the current TIA/EIA standards: Perm Link or Channel.

.2 The Summary report shall provide be provided to the end user in a universal format so that there is no need to purchase any software to read and print the report.

.1 Utilizing Adobe Acrobat is an acceptable manner.

1.10 PAINTING AND FINISHES

.1 Minor damages to finish on factory finished equipment shall be touched up to the Engineer's satisfaction. Items suffering major damage to finish shall be replaced at the direction of the Consultant. Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.

1.11 SAFETY

.1 The Contractor shall be responsible for the safety of his workmen and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations shall prevail.

1.12 WARRANTY

.1 Submit a written performance warranty to the Owner for one year for the complete installation for a period of no less than five years from the date of testing and acceptance. The system warranty shall be based on industry standards.

.2 The contractor shall also provide a one year labour warranty on the installation.

2 Products

2.01 MATERIAL APPROVAL

.1 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.

.2 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical Inspection Services, or other government agency.

2.02 SHOP DRAWINGS

.1 Before delivery to site of any item of equipment, the electrical contractor shall submit 6 copies of shop drawings c/w all data, pre-checked and stamped accordingly, for approval to the Engineer. Indicate project name on each brochure or sheet. Submit shop drawings within 1 week after award of contract, for the following:

.1 Copper Cabling

.2 Fibre Optic Cabling

.3 Fabric Innerduct

.4 Racks, managers

.5 Patch Panels

.6 Telecommunications Outlets, Faceplates

.7 Fibre Optic Routing System

.8 Rack Power Distribution Units

2.03 AS-BUILT DRAWINGS

.1 To Section 01 78 00.

.2 Red lines, mark-ups by this contractor.

2.04 OPERATION AND MAINTENANCE MANUALS

.1 Refer to Division 01.

3 Execution

3.01 WORKMANSHIP AND CONTRACTOR'S QUALIFICATIONS

.1 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Engineer. Any unsatisfactory workmanship will be replaced at no extra cost.

.2 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this Specification. This Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all equipment and materials in dry locations.

.3 Provide foreman in charge of this work at all times.

.4 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker's Compensation, and Employer's Liability Insurance.

3.02 COORDINATION

.1 Coordinate work with other trades.

.2 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report all necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.

.3 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Cooperate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other Trades.

3.03 MANUFACTURERS' INSTRUCTIONS

.1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.

.2 Follow manufacturer's instructions where they cover points now specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.04 QUALITY ASSURANCE

.1 See General Provisions of the Contract.

.2 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.

.3 The Contractor shall ensure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.

.4 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.

3.05 LABELS AND SIGNS

.1 Labelling shall be as per TIA/EIA-606.

3.06 ADJUST AND CLEAN-UP

.1 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this Trade. At the completion of this work, the installation is to be left in a clean and finished condition to the satisfaction of the Engineer.

3.07 TESTS AND ACCEPTANCE

.1 The operation of the equipment does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfils the requirements of the drawings and the specifications.

.2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.

.3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition. In the presence of the Owner, the Contractor shall demonstration the proper operation of all miscellaneous systems.

End of Section

1 General

1.01 SUMMARY

.1 Section Includes:

.1 Demolition and removal of selected portions of building or structure.

.2 Demolition and removal of selected site elements and/or Information Technology (IT), Security or other special systems or infrastructure.

.3 Salvage of existing items to be reused or recycled.

.2 Contractor shall include in the Bid all labour, materials, tools, plant, transportation, storage costs, equipment, insurance, temporary protection, permits, inspections, taxes, and all necessary and related items required to provide complete demolition and cutover of existing telecommunication systems shown and described in the Specifications.

.3 The Contractor is responsible for providing and coordinating phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.

.4 The Contractor shall coordinate interfaces to existing systems that are being demolished in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with Owner.

.5 The Contractor shall coordinate specialty electronic, IT data networks, common use, CCTV, public address, and any other IT infrastructure systems.

1.02 RELATED REQUIREMENTS

.1 Section 02 41 19 – Selective Demolition.

1.03 DEFINITIONS

.1 Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

.2 Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.

.3 Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

.4 Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.04 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Demolition Meeting

.1 Conduct a pre-demolition meeting at Project Site with Owner and all affected stakeholders.

.1 Inspect and discuss condition of construction to be selectively demolished.

.2 Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

.3 Existing telecommunications rooms that have demolition work may involve electrical, mechanical, and architectural demolition. Review and coordinate requirements of work performed by other trades.

.4 Review areas where existing construction is to remain and requires protection.

.5 Review procedures to be followed when critical systems are inadvertently interrupted.

1.05 SUBMITTALS

.1 Action Submittals

.1 Comply with all submittal procedures given in other Sections.

.2 Submit a Schedule of selective demolition and cutover activities which indicates the following as a minimum:

.1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's and tenants' on-site operations are uninterrupted.

.2 Duration of how long IT and security services will be interrupted and when systems cannot be disabled and temporary parallel service is required submit how this is proposed to be accomplished.

.3 The contractor’s plan for coordination of shutoff, capping, and continuation of IT and all other utility services.

.4 Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

.3 Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

.4 Pre-demolition Photographs or Video: Submit before Work begins.

.5 Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

.2 Closeout Submittals

.1 Submit a list of items that have been removed and salvaged.

.2 Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

.3 Submit as-built documentation of all remaining IT and security systems conduit and cabling that remains.

1.06 MATERIAL OWNERSHIP

.1 Unless otherwise indicated, demolition waste becomes property of Contractor.

1.07 FIELD/SITE CONDITIONS

.1 Owner will occupy portions of building immediately adjacent to selective demolition area.

.1 Conduct selective demolition so Owner's operations will not be disrupted.

.2 Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

.1 Before selective demolition, Owner will remove their equipment from the space.

.3 Notify Consultant of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

.4 Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

.1 Hazardous materials will be removed by Owner before start of the Work.

.2 If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer. Hazardous materials will be removed by Owner under a separate contract.

.5 Storage or sale of removed items or materials on-site is not permitted.

.6 Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.08 WARRANTY

.1 Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

2 Products – Not Used

3 Execution

3.01 EXAMINATION

.1 Verify that utilities have been disconnected and capped per Owner approved procedures before starting selective demolition operations.

.2 Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

.3 Survey existing condition of all IT related conduits and cables from origin to destination and correlate with requirements indicated to determine extent of selective demolition required.

.4 Label all conduits and cables with origin, destination and what system they serve.

.5 Consult with Owner to determine whether systems can be disabled or whether a new parallel system needs to be installed.

3.02 REMOVAL OF COMMUNICATIONS CABLING AND EQUIPMENT

.1 Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

.1 Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level. Remove all abandoned cables from origin to destination.

.2 Dispose of demolished items and materials promptly.

.2 Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

.3 For existing equipment cabinets with active components in them, provide an airtight dust seal around the cabinet and circulate cooling air with a portable air conditioning unit or other means to ensure equipment does not overheat.

.4 If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

.5 When removing communications outlets, remove all conductors back to patch panel in communications closet or IT rack. Provide blank faceplates where outlets are removed from walls or partitions to remain.

.6 Where communications cabling is to be re-used, coil the communications outlet cabling in the ceiling space for re-use.

.7 Turn over wireless access points to Owner.

3.03 DISPOSAL OF DEMOLISHED MATERIALS

.1 General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in accordance with the requirements of the Authority Having Jurisdiction.

.1 Do not allow demolished materials to accumulate on-site.

.2 Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

.3 Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

.2 Burning: Do not burn demolished materials.

.3 Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.04 CLEANING

.1 Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

End of Section

1 General

1.01 DESCRIPTION

.1 This section specifies general grounding and bonding requirements of telecommunication installations for equipment operations.

.2 “Grounding electrode system” refers to all electrodes required by Electrical Code, as well as including made, supplementary, telecommunications system grounding electrodes.

.3 The terms “connect” and “bond” are used interchangeably in this specification and have the same meaning.

1.02 RELATED REQUIREMENTS

.1 Section 26 05 26 – Grounding and Bonding for Electrical Systems.

.2 Section 27 11 16 – Communications Cabinets, Racks, Frames, and Enclosures.

1.03 REFERENCES

.1 Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.

.2 American Society for Testing and Materials (ASTM):

.1 B1-2001 - Standard Specification for Hard-Drawn Copper Wire

.2 B8-2004 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

.3 Institute of Electrical and Electronics Engineers, Inc. (IEEE):

.1 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

.4 Canadian Standards Association (CSA):

.1 CSA C22.1:21 - Canadian Electrical Code, Part I (25th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (28th Edition/2021).

.5 Telecommunications Industry Association, (TIA)

.1 J-STO-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

.6 Underwriters Laboratories, Inc. (UL):

.1 44-2005 - Thermoset-Insulated Wires and Cables

.2 83-2003 - Thermoplastic-Insulated Wires and Cables

.3 467-2004 - Grounding and Bonding Equipment

.4 486A-486B-2003 - Wire Connectors

1.04 SUBMITTALS

.1 Submit in accordance with Section 01 30 00.

.2 Shop Drawings:

.1 Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

.2 Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

.3 Test Reports: Provide certified test reports of ground resistance.

.4 Certifications: Two weeks prior to substantial performance, submit four copies of the following:

.1 Certification that the materials and installation is in accordance with the drawings and specifications.

.2 Certification, by the Contractor, that the complete installation has been properly installed and tested.

2 Products

2.01 GROUNDING AND BONDING CONDUCTORS

.1 Equipment grounding and bonding conductors shall be UL 83 insulated stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be solid copper. Insulation colour shall be continuous green for all equipment grounding conductors. Cable insulation shall be plenum rated (CMP).

.1 Example: American Insulated Wire Corp, Telcoflex III series.

.2 Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 6 mm² (10 AWG) and smaller shall be ASTM B1 solid bare copper wire.

.3 Telecom System Grounding Riser

.1 Telecom System Grounding Riser Conductor: Telecommunications Grounding Riser shall be in accordance with J STO-607A. Use a minimum 50mm² (1/0 AWG) insulated stranded copper grounding conductor unless indicated otherwise.

2.02 TELECOMMUNICATION AND EQUIPMENT GROUND BUSBARS

.1 Provide solid copper busbar, pre-drilled from two-hole lug connections with a minimum thickness of 6 mm (1/4 inch) for wall and backboard mounting using standard insulators sized as per details on the electrical drawings.

.2 Manufacturers:

.1 Newton Instrument Company.

.2 Panduit.

.3 Burndy.

.4 Thomas and Betts.

2.03 SPLICES AND TERMINATION COMPONENTS

.1 Components shall meet or exceed UL 467 and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.04 GROUND CONNECTIONS

.1 Above Grade:

.1 Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.

.2 Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

.3 Rack and Cabinet Ground Bars: two-hole compression-type lugs using zinc-plated or copper alloy fasteners.

3 Execution

3.01 GENERAL

.1 Ground in accordance with the Electrical Code, as shown on drawings, and as hereinafter specified.

.2 Equipment Grounding: IT cabinets, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

3.02 SECONDARY EQUIPMENT AND CIRCUITS

.1 Conduit Systems:

.1 Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.

.2 Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.

.3 Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

.2 Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.

.3 Boxes, Cabinets, Enclosures, and Panelboards:

.1 Bond the equipment grounding conductor to each pull box, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).

.2 Provide lugs in each box and enclosure for equipment grounding conductor termination.

.3 Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

.4 Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

3.03 CORROSION INHIBITORS

.1 When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.04 TELECOMMUNICATIONS SYSTEM

.1 Bond telecommunications system grounding equipment to the electrical grounding electrode system.

.2 Furnish and install all new wire and hardware required to properly ground, bond and connect communications raceway, cable tray, metallic cable shields, and equipment to a ground source.

.3 Ground bonding jumpers shall be continuous with no splices. Use the shortest length of bonding jumper possible.

.4 Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milliohms or less.

.5 Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding jumpers, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.

.6 Bonding Jumpers:

.1 Use insulated ground wire of the size and type shown on the Drawings or use a minimum of #6 AWG insulated copper wire.

.2 Assemble bonding jumpers using insulated ground wire terminated with compression connectors.

.3 Use compression connectors of proper size for conductors specified. Use connector manufacturer’s compression tool.

.7 Bonding Jumper Fasteners:

.1 Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.

.2 Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.

.3 Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.

.4 Unistrut and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

3.05 COMMUNICATIONS RACEWAY GROUNDING

.1 Conduit: Use insulated #6 AWG bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.

.2 Wireway: use insulated #6 AWG bonding jumpers to ground or bond metallic wireway at each end at all intermediate metallic enclosures and across all section junctions.

End of Section

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1 General

1.01 SUMMARY

.1 Provide a complete system of empty conduit, pull boxes, outlets, and sleeves for enclosure of communications cabling.

1.02 RELATED REQUIREMENTS

.1 Section 26 05 33.13 – Conduit for Electrical Systems.

.2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.03 REFERENCES

.1 BISCI Telecommunications Distribution Methods Manual.

1.04 CLOSEOUT SUBMITTALS

.1 Record documentation:

.1 Records of underground utility locates.

.2 Record as-constructed location of all underground conduits and telecommunications pathways on as-built drawings regardless of conduit size.

2 Products

2.01 OUTLETS

.1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.

.2 Provide 53 mm conduit through walls as noted.

2.02 CONDUITS

.1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.

.2 Minimum conduit size shall be 21 mm diameter.

.3 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.4 Plenum cables are permitted in accessible ceilings. Provide ‘J’ hooks in these locations for later cable installation under other sections of this Division.

.5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.

.6 Provide a minimum of two 5-15R duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 INSTALLATION

.1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

.2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 3.2 mm (1/8 in) nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.

.3 Conduit shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.

.4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 m (100 feet) in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by future installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Provide a complete system of empty conduits, pull boxes, outlets, and sleeves for enclosure of wiring for this system. Refer to General Requirements.

1.02 RELATED REQUIREMENTS

.1 Section 26 05 33.13 – Conduit for Electrical Systems.

.2 Section 26 05 33.16 – Boxes for Electrical Systems.

.3 Section 28 46 13 – Fire-Alarm Systems.

1.03 REFERENCES

.1 BISCI Telecommunications Distribution Methods Manual, 13th Edition (2014).

2 Products

2.01 OUTLETS

.1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.

2.02 CONDUITS

.1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.

.2 Minimum conduit size shall be 21 mm diameter.

.3 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.4 Plenum cables are permitted in accessible ceilings. Provide ‘J’ hooks in these locations for later cable installation by others.

.5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with two coats of fire retardant light grey enamel.

.6 Provide a minimum of two duplex receptacles on separate circuits at each backboard.

.7 Provide fire alarm over-ride feature at fire alarm control panel (FACP) to deactivate public address system when Fire Alarm System is in alarm.

3 Execution

3.01 INSTALLATION

.1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

.2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.

.3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.

.4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30,000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 SUMMARY

.1 Provide a complete system of empty conduits, terminal cabinets, plywood backboards, pull boxes and outlets for enclosure of access control and intrusion detection system.

1.02 RELATED REQUIREMENTS

.1 Section 26 05 33.13 – Conduit for Electrical Systems.

.2 Section 26 05 33.16 – Boxes for Electrical Systems.

2 Products

2.01 OUTLETS

.1 Wall and door outlets shall be single boxes, or 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted. Coordinate with Security Contractor.

2.02 CONDUITS

.1 Provide conduit in all walls, exposed areas and inaccessible ceilings. All conduit work shall be concealed.

.2 Minimum conduit size shall be 21 mm diameter.

.3 Provide J hooks in accessible ceilings for plenum rated wiring.

.4 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.5 Plywood backboards shall be minimum 1200 x 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.

.6 Provide a minimum of 2 duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 INSTALLATION

.1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

.2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.

.3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.

.4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30,000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

.5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by Security installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 SUMMARY

.1 The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the system of non-continuous cable supports ("J-Hooks") as described in this specification.

1.02 SCOPE

.1 Non-continuous cable supports.

.2 Adjustable non-continuous cable support sling.

.3 Multi-tiered non-continuous cable support assemblies.

.4 Non-continuous cable support assemblies from tee bar.

.5 Non-continuous cable support assemblies from drop wire/ceiling.

.6 Non-continuous cable support assemblies from beam, flange.

.7 Non-continuous cable support assemblies from C & Z Purlin.

.8 Non-continuous cable support assemblies from wall, concrete, or joist.

.9 Non-continuous cable support assemblies from threaded rod.

.10 Raised floor non-continuous cable support assemblies.

.11 Cantilever-Mounted Option for non-continuous cable supports.

.12 Installation accessories for non-continuous cable supports.

1.03 DEFINITIONS

.1 UTP: Unshielded twisted pair.

.2 ANSI: American National Standards Institute

.3 ASTM: American Society for Testing and Materials

.4 EIA: Electronic Industries Alliance

.5 TIA: Telecommunications Industry Association

.6 cULus: Listed by Underwriters Laboratories based on both Canadian and US (United States) standards requirements.

1.04 SUBMITTALS

.1 Submit product data on non-continuous cable support devices, including attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.

1.05 QUALITY ASSURANCE

.1 Non-continuous cable supports and cable support assemblies shall be listed by Underwriters Laboratories for both Canadian and US standards (cULus).

.2 Non-continuous cable supports shall have the manufacturers name and part number stamped on the part for identification.

.3 Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience in the industry, and certified ISO 9000.

2 Products

2.01 ACCEPTABLE MANUFACTURERS

.1 Subject to compliance with these specifications, non-continuous cable supports shall be as manufactured by ERICO, Inc or approved equal.

2.02 REFERENCES

.1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel

.2 ASTM B 695-90 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel

.3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

.5 ASTM A109 Standard Specification for Steel, Strip, Carbon, Cold-Rolled

.6 ASTM A167 Standard Specification for Stainless and heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

.7 ASTM A480/A480M Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

.8 ASTM A568 Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy Hot-Rolled and Cold-Rolled

.9 A653 G60-Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip process

.10 ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

.11 ASTM A682 Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality

.12 ASTM A879 Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

.13 ASTM B117 Standard Method of Salt Spray (Fog) Testing

.14 ASTM D610 Standard test Method for Evaluating Degree of Rusting on Painted Steel Surfaces UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

.15 ANSI/ TIA/ EIA 568 Commercial Building Telecommunications Cabling Standard, current revision level.

.16 ANSI/ TIA/ EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces, current revision level.

.17 NFPA 70 National Electrical Code®

2.03 NON-CONTINUOUS CABLE SUPPORT SYSTEMS

.1 Non-continuous cable supports

.1 Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.

.2 Non-continuous cable supports shall have flared edges to prevent damage while installing cables.

.3 Non-continuous cable supports sized 1 5/16” and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.

.4 Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.

.5 Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply.

.6 Non-continuous cable supports shall be ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CMTM Double J-Hook CAT100CM; CAT-CMTM U-hook series CAT200CMLN, CAT300CMLN; and CAT-CMTM retainer CATRT200CM, CATRT300CM or approved equal.

.2 Adjustable non-continuous cable support sling

.1 Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable; cULus Listed.

.2 Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.

.3 Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.

.4 If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.

.5 Acceptable products: ERICO CADDY CableCatTM CAT425; or approved equal.

.3 Multi-tiered non-continuous cable support assemblies

.1 Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; cULus Listed.

.2 If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.

.3 The multi-tiered support bracket shall consist of ERICO CADDY CATHBA and CableCatTM J-Hooks with screws; or approved equal.

.4 Non-continuous cable support assemblies from tee bar

.1 Tee bar support bracket with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CADDY CAT12TS, CAT21528, CAT32528; or approved equal.

.5 Non-continuous cable support assemblies from drop wire/ceiling

.1 Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CADDY CAT124Z34, CAT126Z34, CAT214Z34, CAT216Z34, CAT324Z34 or CAT326Z34; or approved equal.

.6 Non-continuous cable support assemblies from beam, flange

.1 Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY beam clamps and CADDY flange clips; or approved equal.

.7 Non-continuous cable support assemblies from C & Z Purlin

.1 Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.

.2 Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY Purlin hangers; or approved equal.

.8 Non-continuous cable support assemblies from wall, concrete, or joist

.1 Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.

.2 Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, with CADDY angle bracket; or approved equal.

.9 Non-continuous cable support assemblies from threaded rod

.1 Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.

.2 The multi-tiered support bracket shall have a static load limit of 300 lbs.

.3 U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.

.4 Acceptable products: ERICO CableCatTM J-hook, CAT12, CAT21, CAT32, CAT64 with CADDY CATHBA series; CAT-CMTM Double J-hook CAT100CM, CAT-CMTM Direct mount U-hook CAT200CMLN, CAT300CMLN; or AFAB series; or approved equal.

.10 Raised floor non-continuous cable support assemblies

.1 Fastener to raised (access) floor pedestal with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CADDY CAT12CD1B, CAT21CD1B or CAT32CD1B; CAT64CD1B; or approved equal.

.11 Cantilever-Mounted cable supports

.1 U-hook shall be able to be assembled to a wide variety of wall mount brackets.

.2 Spacing of individual U-hooks as needed, max of 4’ to 5’ apart.

.3 U-hooks may have the optional attachment of a cable roller for ease in pulling cables.

.4 Acceptable products: ERICO CAT-CMTM U-hooks CAT200CMLN, CAT300CMLN: CAT-CM roller assemblies CATRL200CM, CATRL300CM; CATWMCM bracket; or approved equal.

.12 Installation accessories for non-continuous cable supports

.1 Cable Pulley

.1 Non-continuous cable supports may be used as an installation tool when a removable pulley assembly is included. The pulley shall be made of plastic and be without sharp edges. The pin and bail assembly must be able to be secured to the J-Hook during cable installation. The pulley must remain secured while cables are being pulled.

.2 The pin and roller assembly must be removed after cables are installed.

.3 Acceptable products: ERICO CADDY CAT32PLR, CAT64PLR, or approved equal.

.2 Cable Protector

.1 The protective steel tube shall fit over threaded rod and be at least 4” in length.

.2 The tube shall prevent damage to cables placed in or pulled through CAT-CMTM U-hooks. The tube shall not inhibit the pulling of cables.

.3 Acceptable products: ERICO CAT-CMTM CATTBCM, or approved equal.

2.04 FINISHES

.1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel

.2 ASTM B 695 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel

.3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

.5 Non-continuous cable supports used where only mildly corrosive conditions apply shall be stainless steel, AISI type 304.

3 Execution

3.01 INSTALLATION

.1 Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer’s installation instructions.

.2 Install cables using techniques, practices, and methods that are consistent with Category 5 or higher requirements and that supports Category 5 or higher performance of completed and linked signal paths, end to end.

.3 Install cables without damaging conductors, shield, or jacket.

.4 Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.

.5 Pull cables without exceeding cable manufacturer’s recommended pulling tensions. Use pulling means that will not damage media.

.6 Do not exceed load ratings specified by manufacturer.

.7 Adjustable non-continuous support sling shall have a static load limit of 100 lbs.

.8 Follow manufacturer's recommendations for allowable fill capacity for each size non-continuous cable support.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Firestopping through penetrations in fire rated assemblies.

1.02 RELATED REQUIREMENTS

.1 Section 07 85 00 – Firestopping and Smoke Seals.

1.03 REFERENCES

.1 ASTM E 84, “Surface Burning Characteristics of Building Materials”.

.2 ASTM E 119, “Fire Tests of Building Construction and Materials”.

.3 ASTM E 814, “Fire Tests of Penetration Firestop Systems”.

.4 ANSI/UL263, “Fire Tests of Building Construction and Materials”.

.5 ANSI/UL723, “Surface Burning Characteristics of Building Materials”.

.6 ANSI/UL1479, “Fire Tests of Through Penetration Firestops”.

.7 Underwriters Laboratories Inc. (UL) – Fire Resistance Directory

1.04 PERFORMANCE REQUIREMENTS

.1 Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur, such devices shall:

.1 Meet the hourly rating of the floor or wall penetrated.

.2 Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.

.3 Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:

.1 Opening or closing of doors.

.2 Twisting an inner liner.

.3 Removal or replacement of any material such as, but not limited to, sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.

.4 Permit multiple devices to be ganged together to increase overall cable capacity.

.5 Allow for retrofit to install around existing cables.

.6 Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes.

.2 Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.

.3 Where non- mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.

.4 Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.

.5 Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

1.05 SUBMITTALS

.1 Submit under provisions of Section 01 30 00.

.2 Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.

.3 Shop Drawings: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.

.4 Certificates: Product certificates signed by firestop system manufacturer certifying material compliance with applicable code and specified performance characteristics.

.5 Installation Instructions: Submit manufacturer's printed installation instructions.

1.06 QUALITY ASSURANCE

.1 Products/Systems: Provide firestopping systems that comply with the following requirements:

.1 Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.

.2 Firestopping products bear the classification marking of qualified testing and inspection agency.

.2 Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

.1 Delivery:

.1 Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multicomponent products.

.2 Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.

.2 Storage and Protection:

.1 Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.08 PROJECT CONDITIONS

.1 Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.

.2 Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.

.3 Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.

.4 Do not use materials that contain flammable solvents.

.5 Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

.6 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

.7 Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

2 Products

2.01 MANUFACTURERS

.1 Specified Technologies Inc., 200 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.

.2 Substitutions: as approved by the Engineer prior to tender closing.

.3 Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

2.02 MATERIALS

.1 General: Use only firestopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

2.03 FIRE RATED CABLE PATHWAYS

.1 Steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:

.1 Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway.

3 Execution

3.01 EXAMINATION

.1 Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.

.2 Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.

.3 Provide masking and temporary covering to protect adjacent surfaces.

.4 Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

.1 General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.

.2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

3.03 FIELD QUALITY CONTROL

.1 Inspections: Engage qualified independent inspection agency to inspect through-penetration firestop systems.

.2 Keep areas of work accessible until inspection by authorities having jurisdiction.

.3 Where deficiencies are found, repair firestopping products so they comply with requirements.

3.04 ADJUSTING AND CLEANING

.1 Remove equipment, materials, and debris, leaving area in undamaged, clean condition.

.2 Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Labelling and identification requirements for communications systems.

1.02 REFERENCES

.1 ANSI/TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure.

.2 UL 969 – Marking and Labeling Systems.

.3 Reference Appendix A – KPRDSB Division 27 ICT Infrastructure Guidelines

2 Products

2.01 SUMMARY

.1 Adhesive cable labels to meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition, the labels shall meet the general exposure requirements in UL 969 for indoor use.

.2 Self-laminating vinyl construction cable labels with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.

.3 ANSI/EIA/TIA-606 for colour codes shall be followed. Labels are to be mechanically printed using a laser printer. Hand written labels will not acceptable.

2.02 LABEL PRINTER

.1 Thermal Transfer Printer shall print high quality, industrial labels on a wide variety of materials for electrical and network applications such as wire/cable, components, safety and facility identification.

.2 Laminated Adhesive Label Cassettes:

.1 For flat label applications.

.2 Polyester material.

.3 Non-Laminated Adhesive Label Cassettes:

.1 For marking wire and cable and flat label applications.

.2 Polyester material

.4 Example Products:

.1 Panduit LS7 series hand-held printer.

.2 Panduit LS8 series hand-held printer.

2.03 NAMEPLATES

.1 Engraved three-layer laminated plastic, letters on contrasting background:

.2 Rack and Cabinet ID labels: 25 mm (1”) high White Text on Black Background

3 Execution

3.01 INSTALLATION

.1 Cable identification labels should appear at the following locations with the numbers indicated on the cable schedule and drawings:

.1 300 mm (12 inches) from each end of the cable – after termination.

.2 Front of patch panels.

.3 Front of IDC termination blocks.

.4 Front of workstation/communications outlet faceplates.

.5 Each end of each Telecommunications Conduit.

.2 Fibre Optic safety labels shall appear at the following locations:

.1 Along the length of the conduit or innerduct at 3 m (10 foot) intervals.

.2 At all junction boxes

.3 At all pull boxes.

.4 On all fibre optic patch panels.

.3 Provide 25 per cent additional labels to be left in each telecommunications room on site for future growth.

.4 Provide two Rack/Cabinet nameplates. Mount one on the front, and one on the rear of the rack.

3.02 IDENTIFICATION CONVENTIONS

.1 For Data and Voice cables, labelling at the faceplate (or on keystone for Wireless Access Points) on the client end and the network rack patch panel to be in the format "ROOM# {dash} COMMUNICATIONS CLOSET LETTER {dash} DROP#". For example, a cable terminating in Room 101 wired to Communications Room ‘A’ into patch panel drop 12, is to be labelled as “101-A-12” at both ends.

.2 Labelling for backbone wiring will be preceded with BB followed by the wire number (i.e. BB-001 would be the first backbone.

.3 PA cables are to be labelled in the format "ROOM# {dash} COMMUNICATIONS CLOSET LETTER”. For example, a PA speaker terminating in Room 101 wired to Communications Room ‘A’ is to be labelled as “101-A” at both ends.

.4 BIX panels are to be labelled with corresponding room numbers.

.5 PA cabling for speakers in hallways may use “HallA” and “HallB” instead of a room number. For example, Hall1-A for the first chain of speakers going to Hub A, Hall2-A for the second chain.

.6 Port numbers within a room should be sequential and maintain sequential numbering across adjacent rooms.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Commissioning Requirements.

1.02 REFERENCES

.1 Refer to Section 27 05 00 for references.

1.03 SUBMITTALS FOR REVIEW

.1 Provide testing reports.

2 Products – Not Used

3 Execution

3.01 INSTALLATION

.1 Testing of all horizontal copper cables are to be completed in accordance with the follow test criteria:

- .1 Basic Link
- .2 Grounds
- .3 NEXT
- .4 ELFEXT
- .5 Continuity
- .6 correct polarity
- .7 PSNEXT
- .8 PSELFEXT
- .9 Shorts
- .10 Length
- .11 ACR
- .12 Return Loss
- .13 Opens
- .14 Attenuation
- .15 PSACR
- .16 Resistance

.2 Fibre strands in excess of 122m (400 ft) shall be tested with an Optical Time Domain Reflectometer for length and attenuation.

.3 Test each stand of fibre, bi-directionally, with a Power Meter / Light Source combination operating at wavelengths of 850 nm and 1300 nm for multimode fibres.

.4 Maximum multi-mode passive link loss (including patch cords) is not to exceed -2.35dB.

.5 Maximum single-mode passive link loss (including patch cords) is not to exceed -1.0dB.

3.02 DOCUMENTATION

.1 The Telecommunications Cabling Contractor is required to submit test results in native tester format or a format which can be read with a text reader (i.e. ".txt" extension). Paper results shall not be submitted for projects with 100 or more horizontal cable drops and/or fibre cables.

.2 The Telecommunications Cabling Contractor is required to provide the software required to view the results.

.3 The report should be divided into sections by Telecommunications Room.

.4 The report should indicate for each cable when it was tested successfully, the result, and the length.

.5 The Telecommunications Cabling Contractor shall sign off on the entire test report prior to submitting to the General Contractor/Construction Manager or The Consultant.

.6 The test result documentation is to be submitted to the General Contractor/Construction Manager or The Consultant for review no later than 10 working days following the completion of the installation.

.7 All deficiencies must be corrected before the General Contractor/Construction Manager or The Consultant will provide a certificate to release the Holdback on the project.

3.03 RECORD DRAWINGS

.1 The Telecommunications Cabling Contractor is required to maintain one set of correct and accurate record drawings on-site at all times. These drawings are to be made available to the General Contractor/Construction Manager or the Consultant for review during the project.

.2 The Telecommunications Cabling Contractor is required to provide record drawings of the telecommunication cabling installation in relation to the drawings provided in this specification.

.3 The record drawings shall be updated electronically and include, but are not limited to;

.1 Horizontal cable numbers on the floor plans

.2 Horizontal Cable Routing on the floor plans

.3 Changes on the floor plans

.4 Backbone cable Routing between Telecommunications Rooms

.5 Paging Speaker Locations including daisy chain cable run

.6 Wireless Access Points and Cell coverage

.7 Cabinet/Rack Elevation drawings

.8 Backboard Elevation Drawing

.4 The Telecommunications Cabling Contractor shall provide one soft copy in AutoCAD 2007 and one plotted copy for the Consultant to review prior to complete substantial performance and close-out documentation submission.

.5 After approval, the Telecommunications Cabling Contractor shall submit one plotted copy of the drawings for;

.1 The Main Computer Room

.2 Each Telecommunications Room

.3 The Consultant

.6 All close-out documentation must be submitted to the General Contractor/Construction Manager or The Consultant within 10 working days of the completion of the project before the documentation holdback will be released.

End of Section

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1 General

1.01 SUMMARY

.1 Supply, install and test complete data cabling system and accessories, based on physical star wiring topology, and as specified herein and indicated on drawings.

.2 Include data cabling system the following sub-systems:

.1 Backbone Terminal Systems, located in Communications Closets, to serve as connection points between backbone cables and horizontal distribution cables.

.2 Horizontal distribution system links backbone terminal system to telecommunications outlets.

.3 Contractor is to submit details on equipment types and locations for review and approval prior to installation.

1.02 RELATED REQUIREMENTS

.1 Reference Appendix A – KPRDSB Division 27 ICT Infrastructure Guidelines

1.03 ABBREVIATIONS AND ACRONYMS

.1 MTER Main Telecommunication Equipment Room

.2 TC Telecommunications Closet

.3 TCs Telecommunications Closets

.4 RCDD Registered Communications Distribution Designer

.5 BICSI Building Industry Consulting Service International

.6 MDTS Main Distribution Terminal System

.7 IDC Insulation Displacement Connection

.8 OTDR Optical Time-Domain Reflectometer

.9 BCS Backbone Cabling System

.10 IDT Intermediate Distribution Terminal

.11 BTS Backbone Terminal System

1.04 REFERENCE STANDARDS

.1 Conform to CAN/CSA-T530 for new buildings and areas of substantial renovations of telecommunications, spaces and pathways.

.2 Ensure that cabling system shall conform to current issue of industry standard CAN/CSA-T529. This standard is currently being revised and is available as document EIA/TIA SP-2840A (future CAN/CSA-T529). All requirements of this new document must be followed including: Structural Return Loss (section 10.2.4.5), Power Sum Testing (section 10.3.4.7) and End to End Link Performance and continuity, attenuation, cable open and shorts, NEXT; mutual capacitance, pair polarity and cable impedance, S/N ratio, and Pass/Fail status. Tests are to be conducted and recorded using a Penta Scanner. Fibre optic cables shall be tested in conformance to ISO/IEC IS 11801 standards using an EXFO Optical Time Domain Reflectometer. Test results such as; dB loss, cable length and fibre deficiencies (if any) shall be conducted. Verification, documentation, and warranty shall be provided.

.3 Where applicable, have performance of Category 6 cabling components used, verified by nationally recognized testing laboratory. Submit test results upon request.

.4 Conform to applicable Building and Electrical Safety Codes.

1.05 SUBMITTALS

.1 Shop Drawings

.1 Provide submittals in accordance with Section 01 30 00 prior to commencing installation.

.2 Submit complete cabling system layout for Consultant review for data, cable routing summary and cable outlet designation. Have cabling system layout performed by accredited RCDD (Registered Communications Distribution Designer) as defined by BICSI (Building Industry Consulting Service International). The Data Cabling system will not be accepted without this submission.

.3 Documentation proving compliance to End-to-End Link Performance test, as specified in Annex E of EIA/TIA SP-2840A shall be provided prior to structured cabling being installed.

.4 Submit detailed layout drawings, including termination racks prior to commencing this installation.

.5 Manufacturer's product information documents on all components of the cabling system, including horizontal and vertical cable management systems and all auxiliary components/devices and equipment prior to commencing this installation.

.6 The following documentation shall be submitted with a following cover letter listing attachments prior to commencement of work.

.1 A list of personnel for the project that will include the name of the Project Manager, Site Manager(s), Lead Hands, and Installers.

.2 Permits and notifications as may be required for the project.

1.06 CLOSEOUT SUBMITTALS

.1 Provide manufacturer’s certificate at completion of installation certifying the installation.

.2 Prepare and submit "As-built" drawings reviewed by an RCDD.

.3 "As-built" drawings are to detail the exact location of equipment indicating wiring runs and raceways, pull, junction and terminal boxes. Also to include outlet locations, cable numbers and equipment rack profiles.

.4 Upon completion of work and prior to final acceptance, the contractor will submit to the Owner the required copies of Network Certification and Documentation in the form of manuals that will include the following:

.1 Detailed information on types of materials and equipment used and their locations including: distribution frame equipment (rack), equipment types and locations; a detailed listing of cable and outlet types and locations.

.2 Accurately and neatly recorded test results.

.3 Accurately and neatly record locations including room numbers, of all network components in list form for easy reference.

.4 Identify drawings as ‘Project Record Copy’ and maintain in new condition making available for inspection by Owner.

.5 Bind all items listed above in a 3-ring hard covered binder suitably labelled with the names of each site/project.

1.07 QUALITY ASSURANCE

.1 Qualifications of Manufacturer

.1 Supply equipment manufactured by experienced reputable manufacturer, whose installations have rendered satisfactory service for at least 2 years and who would provide factory trained technicians fully experienced in telecommunications wiring. Submit information regarding number of employees, and proof of VAR/CSV certification, including length of time Contractor or employee(s) have been certified to install Cable systems.

.2 Provide certification that cabling solution offered will perform as a system as is defined in standards documents such as EIA-TIA SP-2840A and T568A configuration for Category 6 system standards. Provide certification supported by manufacturer of cabling components used.

.3 In addition to certificate of assurance, evidence of support by manufacturer for above items shall be provided upon request in writing with bidding response.

.4 Use components sourced completely from single manufacturer.

.2 Qualifications of Installer

.1 Provide installation and supervision work supervised by telecommunications technicians qualified to install voice and data cabling system and to perform related tests as required by manufacturer. Installers/company must have valid certification.

.2 Provide fully qualified telecommunications technicians, trained and certified by manufacturer in installation and testing of equipment specified. Provide evidence upon request in writing prior to work commencement of manufacturer's certification of supplier's ability to properly install structured cabling for building.

.3 Submit proven track record in cabling projects of similar size. Include details of minimum 3 projects of similar size involving Category 6 cabling, Multimode and Single-mode fibre optic cabling which have been completed in last 2 years. Include names, addresses, and phone numbers of references for 3 projects.

.3 Certifications

.1 UTP network wiring shall conform to T568A configuration, Category 6 system standards. All UTP cables shall provide minimum signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination at each end. The following tests will be conducted and recorded using a Penta Scanner:

.2 End to end continuity, attenuation, cable open and shorts; NEXT; mutual capacitance; pair polarity and cable impedance; S/N ratio and pass/fail status.

1.08 WARRANTY

.1 The structured cabling systems shall be warranted for 25 years, covering all system products manufactured and provided by the single source supplier. The warrantor shall guarantee the following:

.1 All passive system components, e.g. patch panels, UTP cable and outlet jacks are free from manufacturing defects in material or workmanship

.2 Approved cabling systems exceed the specifications of the T1A-568A standards and ISO/IEC IS 11801, if applicable.

.3 The installation exceeds attenuation and near end cross talk, loss and bandwidth requirements TIA Bulletin TIA TSB-67 and ISO/EIC IS 11801.

.2 General workmanship and apparatus installed under this contract shall be warranted against defects of workmanship and material for a period of one year after final acceptance of work by the Owner, unless otherwise specified. The contractor will make good any defects developed as a result of their work during such time without expense to the Owner.

2 Products

2.01 VOICE (VOIP) TELEPHONE SYSTEM

.1 New voice (VOIP) system shall be the Avaya IP Office 500V2 phone system with the following features (part numbers are listed in brackets):

.1 IP Office R10+ IP Endpoint LIC (383110, minimum 8 per school);

.2 IP Office R10+ 2Channels Lic (383127);

.3 IP Office R11 LIC (396445);

.4 Power Cord 18AWG (700289770);

.5 Rack Mounting Kit (700429202);

.6 V2 System SD Card (700479710);

.7 IP Office 500 Version 2 Control Unit (700501510);

.8 IP500 V2 Combo Card ATM4 V2 TAA (700504897);

.9 J139 IP Phone (700513916, minimum 4 per school);

.10 J179 IP Phone (minimum 3 per school).

.2 Contractor to coordinate with Owner to configure new phone systems.

.3 For VoIP systems, Avaya J179 handsets are to be used for Principals, VPs, and secretaries; with Avaya J139 handsets in all other locations.

.4 Provide an ‘emergency’ phone is to be installed on the wall near the secretary or principal’s desk. This is to be connected directly with an RJ11 cable back to dial tone from the provider, bypassing the phone system.

3 Execution

3.01 INSTALLATION

.1 Each equipment rack shall be anchored securely to the floor and grounded to the building ground with a #6 AWG Insulated Ground Wire in accordance with applicable code requirements (refer to CAN/CSA T5238).

.2 Ground all data cables shields and associated equipment in Telecommunications rooms to meet applicable code requirements.

.3 Supply vertical cables and backbone cabling using cable clamps or wiring harnesses.

.4 Conform to Telecommunications Industry Standards (refer to EIA/TIA 568A) for all cable termination and pinning assignments.

.5 Utilize cable trays in MTER and TCs to manage cable in orderly fashion.

.6 All sleeves containing cable or unused shall be fire sealed. Coordinate with Section 07 85 00 for provision and installation of fire barriers.

.7 Cabling is to be run at 90 degrees to the building grid except where the distance would exceed 90m in length if installed in this manner.

.8 The maximum horizontal run length is not to exceed 90 metres. If the 90 metre constraint cannot be met, the Cabling Contractor is to notify the Owners Designee of any cables that exceed 90 metres, prior to the installation.

.9 Ensure all grounding conductors are rated FT-6. Tie into bundles and support using j-hooks outside of tray or conduit and fasten to under-slab at intervals not to exceed 1500 mm.

.10 Route all cable in such a way as to ensure minimum separations are maintained from sources of EMI as defined in EIA/TIA SP-2840A.

.11 Place all exposed cabling in TC in neat and professional manner and route as per specifications and drawings. Cables are to be combed, bundled, and routed in a neat and organized manner. Tie-wrap all exposed cable bundles at maximum of every 200 mm using black ‘hook-and-loop- fastening ties.

.12 Securely mount voice outlets at all work area locations and locate so that cable required to reach work area equipment will be no more than 3 m long.

.13 Ensure that optical fibre splices, fusion or mechanical, do not exceed maximum optical attenuation of 0.3 dB when measured in accordance with EIA/TIA 455-34 and CSA Standard C22.2 No. 232.

.14 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and wall plates must be performed with no splices or cuts to ensure the elimination of reflections, discontinuities, impedance, mismatches, and egress/ingress of undesired signals. Cables must be installed at a specified distance (shown below) from any electrical equipment such as radios, televisions, fluorescent lights or fixtures, motors, transformers, or other significant sources of RFI/EMI interference

.15 Label all cables in accordance with Industry Standards and CAN/CSA T528 specifications. Number cables as per drawings.

.16 In cases where the routing may bring the cable in close proximity to the above mentioned sources of disruption, the following minimum distances must be maintained:

.1 125 mm (5 inches) from power lines of 2 kVA or less.

.2 305 mm (12 inches) from lighting (including fluorescent).

.3 914 mm (36 inches) from power lines of 5 kVA or greater

.4 40 inches from transformers and motors

.17 As well, cables must be routed to avoid direct contact with steam pipes or other heat sources so as to avoid thermal degradation of the cable insulation or other undesired effects.

.18 Cables shall be located in ceiling spaces neatly, tied in bundles and installed in cable management “trays”, J-hooks, and conduit as indicated on the drawings.

.19 All cables entering the wiring closets must be neatly dressed in bundles and run to the appropriate terminating location.

.20 Each cable sheath must be clearly and permanently identified with a labelling scheme acceptable to the owner. Each patch panel port a must be clearly and indelibly marked with a structured, user friendly numbering scheme. This numbering scheme must be capable of accepting cable additions so as not to disrupt the logical flow of the scheme. All testing documentation is to reference this numbering scheme.

.21 NOTE: The faceplate identification numbers/tags MUST be added to the electronic versions of the floor plans. This will be considered part of the As Built contract closeout submittals. The electronic version of the floor plan will be provided in ACAD 14 format by the consultant.

.22 The wiring closets shall be labelled C1 etc.

.23 Fibre optic cable installation procedures shall be as follows:

.1 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and must be performed with no splices or cuts to ensure the elimination of reflections, discontinuities, excess signal loss, or other undesirable problems.

.2 All fibre cables shall be installed in conduits from end-to-end.

.3 If, during the course of cable installation, it is necessary to bore holes through a firewall, the holes must be sealed with an acceptable sealing material of compound once the cables are in place.

.4 All cables entering the computer room must be neatly dressed in bundles and run to the appropriate terminating location.

.5 Cable runs shall be free of tension at both ends as well as over the length of the run.

.6 Each cable sheath must be clearly and permanently identified at each end using an appropriate labelling scheme accepted by the Owner.

.24 Elevator phone cables shall be installed as follows:

.1 “Elevator phone cables shall be installed as follows:

.1 Install phone cable (Cat6 cable with dark blue outer sheath) from elevator room directly to the main phone system.

.2 In coordination with Owner, connect elevator call number to an existing line with a line seizure device. This method will guarantee an outgoing connection for the elevator without requiring an additional phone line for the school.

.3 Owner’s preferred line seizure device is the Viking LSR-1.

.4 Owner requires two pauses before the number to allow the line seizure device time to seize the lines prior to starting to dial.

.5 Self-test of elevator is to be done only between 6pm and 6am. This prevents phone calls/lines in the school from being interrupted during regular operating hours.

.6 Elevator self-test to be configured to self-test once each day per TSSA requirements.”

3.02 CABLE IDENTIFICATION AND LABELS

.1 To section 27 05 53.

.2 All adhesive cable labels shall meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition the labels shall meet the general exposure requirements in UL 969 for indoor use.

.3 Cable labels shall be of self-laminating vinyl construction with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.

.4 All labels must be mechanically printed using a laser printer. Hand written labels are not permitted.

.5 Labels are to be attached to:

.1 front of the IDC connector or communication outlet faceplate

.2 each patch panel jack

.3 each end of the horizontal cable at maximum distance of 50mm from the end of the sheath

.6 Affix faceplate label printed with Workstation Identification number to faceplate cover of in-tile service box.

3.03 TESTING

.1 All UTP distribution cabling must be tested with a specialized UTP cable tester to measure the following characteristics:

.1 DC Resistance

.2 Characteristic Impedance

.3 Cable Length

.4 Pair Sequence Testing

.5 Hardcopy checklists indicating room number and faceplate ID, should be prepared, These results should be documented and form part of the Certification Report, Any documentation supplied in hardcopy form should also be supplied in electronic format (suitable word processing file, spread sheet, graphics file (e.g. AutoCAD, etc.).

.6 In addition to the above UTP testing, each cable and termination must be tested to 100 MBS standards.

.7 The specific tests to be performed, after all jack plates are mounted on boxes and labelled, are as follows,

.1 Mutual Capacitance

.2 Attenuation

.3 Near End Cross Talk

.2 Fibre Optic Cable Testing Procedure

.1 System acceptance tests must be performed to verify that the cable plant can be certified fully operational. All optical fibre strands must be properly measured with approved optical fibre test equipment for the following characteristics:

.1 End to end attenuation loss in dB as measured by a calibrated optical power meter.

.2 Splice loss (if any)

.3 Cable length

.2 The above results are to be obtained by the following test procedures:

.1 Power meter and light source.

.2 OTDR - provide hard copy of signature trace in report.

.3 Detailed results of these tests must be included as part of a Certification Report.

.4 No connector should exceed 0.5 dB loss. Splices shall not exceed 0-3 dB loss. Total attenuation of link including fibre cable, connectors and splices shall not exceed 5 dB.

.3 These test results must be documented and form part of the Certification Report.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Server Cabinets.

.2 Networking Cabinets.

.3 Blanking Panels.

.4 Rack Shelves.

.5 Combination Door Locks for Server Cabinets.

1.02 RELATED WORK BY OTHER TRADES

.1 Division 26 (Electrical)

.1 Permanent Power at Racks.

.2 Cable Tray.

.3 Fibre Optic Tray.

1.03 RELATED WORK IN OTHER SECTIONS

.1 Section 27 05 26 – Grounding and Bonding for Communications Systems: bonding of racks and cabinets.

1.04 REFERENCES

.1 Refer to Section 27 05 00 for references.

1.05 ACTION SUBMITTALS

.1 Conform with the requirements of Section 01 30 00.

.2 Product Data: Provide manufacturers catalogue information.

1.06 DELIVERY, STORAGE, AND HANDLING

.1 Refer to Division 01.

2 Products

2.01 MANUFACTURERS

.1 APC.

.2 Panduit.

.3 Belden.

.4 Commscope.

2.02 KEYING

.1 Unless otherwise noted, key all racks and cabinets identically.

.2 Install combination locks on server cabinets as directed by the Owner.

2.03 CABLE MANAGEMENT

.1 The Cable Management System shall be used to provide a neat and efficient means for routing and protecting fibre and copper cables and patch cords on telecommunication racks and enclosures. The system shall be a complete cable management system comprised of vertical cable managers, horizontal cable manager, and cable management accessories used throughout the cabling system. The system shall protect network investment by maintaining system performance, controlling cable bend radius and providing cable strain relief.

.2 Vertical Cable Management

.1 Vertical cable managers shall include components that aid in routing, managing and organizing cable to and from patch panels and/or equipment. Managers shall protect network equipment by controlling cable bend radius and providing cable strain relief. Managers shall be a universal design mounting to EIA 482.6 mm (19") or 584.2 (23") racks and constructed of a base with cable management fingers. The fingers shall include retaining tabs to keep cables in place during cover removal. The covers shall be hinged to open in either direction allowing for quick moves, adds, and changes.

.1 Panduit

.1 PRV12 – Front and Rear VCM, 45U, 300 mm (12”) max side extension.

.2 PRD12 – Hinged Door for PRV12, 45U, 300 mm (12”) max side extension.

.3 PRV8 – Front and Rear VCM, 45U, 200 mm (8”) max side extension.

.4 PRD8 – Hinged Door for PRV8, 45U, 200 mm (8”) max side extension.

.5 PREP – Vertical Manager End Panel

.2 APC.

.3 Belden.

.4 Commscope.

.3 Horizontal Cable Management

.1 Panduit

.1 NCMHAEF2 – 2U HCM

.2 NCMHAEF4 – 4U HCM

2.04 2-POST RACKS

.1 The Rack system shall meet all EIA requirements as defined in EIA-310-D.

.2 Dimensions:

.1 45 Rack U High

.2 482.6 mm (19”) Wide

.3 2134 mm (7’-0”) Total Height

.3 Construction: Steel

.4 Basis of design: APC AR201.

2.05 RACK SHELVES

.1 Weight capacity: 250 lbs.

.2 Finish: Black

.3 Basis of design: APC AR8122 series.

2.06 SERVER CABINET COMBINATION LOCK HANDLES

.1 3-tumbler combination lock handle with master key override.

.2 Shall utilize same mounting as standard swing-handle, and permit field retrofit.

.3 Basis of design: APC AR8132A series.

3 Execution

3.01 INSTALLATION

.1 Install cabinet side panels to cabinets at end of rows, or to cabinets not immediately adjacent (for example where separated by a column).

.2 Provide Rack Bonding Jumpers.

.3 Fill unused rack openings with blank panels, as specified elsewhere herein below.

3.02 VERTICAL CABLE MANAGEMENT

.1 Install vertical cable managers in accordance with manufacturer’s instructions.

3.03 SERVER CABINETS

.1 Install Patch Panels and Horizontal Cable Managers at rear of server cabinets.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Termination Blocks, Patch Panels, and Connectors.

1.02 RELATED REQUIREMENTS

.1 Section 27 13 13 – Communications Copper Backbone Cabling.

1.03 SUBMITTALS FOR REVIEW

.1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 COPPER TERMINATION BLOCKS

.1 Refer to Section 27 13 13.

.2 Copper IDC termination block to be wall mounted BIX type, 300 Pair, c/w wire management and cross-connect jumper wires.

2.02 COPPER PATCH PANELS AND TERMINATION BLOCKS

.1 Copper patch panels to be 19" rack mount, 24/48 port, Category 6, 8 pin modular jack (RJ45) with labels and icons, icon color to match field outlet color. Patch panel to have 2 types, angled type for the cabling rack and flat type for equipment cabinets and remote wall mounted telecom cabinets.

2.03 CATEGORY 6 1U-48 PORT FLAT PATCH PANELS

.1 Suitable for mounting to any standard 19" or 23" EIA rack or cabinet.

.2 Horizontal termination for data circuits shall consist of category 6 flat patch panels, which shall be 1U high and provide either 48 modular jack ports, as indicated on the drawings. Patch panels shall be configured with individually replaceable jacks.

.3 Each modular jack shall be provided with a bend-limiting strain relief. The strain relief shall provide cylindrical support to limit the bend radius at the point of termination.

.4 The front of each 6-port module shall be capable of accepting labels to TIA requirements.

.5 Each port shall be capable of accepting an icon to indicate its function. Patch panels shall meet the Category 6 performance requirements of ANSI/TIA-568-C.2.

.6 Panduit CPP48FMWBLY.

2.04 FIBRE PATCH PANELS

.1 Fiber patch panel to be 19” rack mount enclosure (in all 19” rack/cabinet) or wall mount enclosure, supporting optical fiber connector adapter panels (duplex LC Type), rear cable retention loops, entry cable strain relief supports, cable strength member clamps, D- grommets at cable entry, removable rear panel cover, accommodation and support for splice trays, removable front access cover, front space for patch cable storage, patch cable bend radius controls and identification labeling.

3 Execution

3.01 INSTALLATION

.1 Refer to Section 27 13 13 Copper Backbone Cabling.

.2 Refer to Section 27 15 13 Copper Horizontal Cabling.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Cable Management.

1.02 SUBMITTALS FOR REVIEW

.1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 NETWORK CABINET CABLE MANAGEMENT FINGER KIT

.1 Network cabinet cable management finger kit, nine RU sections. Kit includes five left and five right finger sections to complete 45 RU on one side of post.

.2 Panduit CNBRFK.

2.02 SLACK SPOOL SET

.1 Network Cabinet and 4 post rack end channel slack spools. Package includes one left and one right slack spool and mounting brackets.

.2 Panduit CNSPE.

2.03 3U HORIZONTAL CABLE MANAGER

.1 Horizontal Cable Manager High Capacity Front and Rear 3 Rack Units. 5.2"H x 19.0"W x 13.1"D (133 mm x 482 mm x 332 mm).

.2 Panduit NM3.

3 Execution

3.01 INSTALLATION

.1 Refer to Section 27 13 13 Copper Backbone Cabling.

.2 Refer to Section 27 15 13 Copper Horizontal Cabling.

End of Section

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1 General

1.01 SUBMITTALS FOR REVIEW

.1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 FACILITY NETWORK CABLING

.1 Minimum plenum rated (CMP) Category 6 UTP.

.2 Panduit TX6000 series.

2.02 JACKS AND MODULES

.1 Panduit Mini-Com TX6 series

3 Execution

3.01 INSTALLATION

.1 Install backbone cables in accordance with manufacturer's specifications ensuring that proper installation techniques are used and that the cable's maximum pull-force and maximum bend radii specifications are adhered to.

.2 Backbone cable/cable bundles shall be secured properly when fastened to backboards or termination cabinets/racks.

.3 For UTP cabling, maintain a minimum of four (4) times cable diameter as a bend radius if no bend radius is specified.

.4 The Contractor shall notify The Consultant immediately if UTP backbone cable run exceeds 90 m (295'-0").

.5 The Manufacturer and the Electrical Contractor shall ensure the maximum length of any zone cabling does not exceed the manufacturer's specifications.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Communications conductors and cables for fire detection, suppression, and alarm systems.

.2 Conduit for fire detection, suppression, and alarm systems.

1.02 RELATED REQUIREMENTS

.1 Section 28 46 13 – Fire-Alarm Systems.

.2 Section 28 46 31 – Fire-Alarm Initiating Devices.

1.03 DEFINITIONS

.1 ULC-S524: CLASS A CIRCUIT (Return Loop Circuit) – A circuit having one continuous path connecting all components on the circuit and terminating through an alternate connection path in the source enclosure.

.2 ULC-S524: CLASS B CIRCUIT (Terminated Circuit) – A circuit having one continuous path connecting all devices on the circuit and terminating at an end-of-line device.

1.04 REFERENCES

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CSA C22.2 No. 208-14 – Fire Alarm and Signal Cable.

.4 CAN/ULC-S139:2017 – Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables.

.5 CAN/ULC-S524-14 – Standard for the Installation of Fire Alarm Systems.

1.05 DELIVERY, STORAGE, AND HANDLING

.1 In accordance with Section 01 61 00.

1.06 WARRANTY

.1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one year from the date of acceptance.

2 Products

2.01 CONDUIT AND WIRE FOR FIRE ALARM SYSTEM

.1 Conduit:

.1 In accordance with Section 26 05 33.13.

.2 All wiring shall be installed in conduit or raceway.

.2 Terminal Boxes, Junction Boxes and Cabinets:

.1 All boxes and cabinets shall be listed for their purpose and use.

2.02 FIRE ALARM CABLE

.1 Wiring shall be in accordance with local, provincial and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as outlined in the Ontario Electrical Safety Code, and as recommended by the fire alarm system manufacturer.

.2 All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signalling system, as outlined in the Ontario Electrical Safety Code.

.3 Certified by CSA as fire alarm and signal cable type FAS 105 to CSA C22.2 No. 208.

.4 Conductors:

.1 300 V rated multiconductor, insulated, colour coded, copper conductor.

.1 Use solid conductors unless noted otherwise.

.2 Use stranded conductors for connections between closest junction box and vibrating equipment i.e. generator set supervisory connection.

.2 Minimum #16 AWG for initiation circuits.

.3 Minimum #12 AWG for strobe signal circuits.

.4 Minimum #14 AWG for horn signal circuits.

.5 Minimum #12 AWG for bell signal circuits.

.5 Non-Fire rated cable:

.1 Insulation: 105 degrees C flame retardant PVC.

.2 Outer Jacket: 105 degrees C flame retardant PVC Red.

.3 Armour: Interlocking aluminum without overall Jacket. For drops to devices in suspended ceilings from conduit system.

.6 Fire rated fire alarm cable:

.1 Pentair Pyrotenax 1850 series mineral insulated (MI) cable with 2 hour fire rating to ULC S139 and to meet Ontario Building Code Rule 3.2.7.10.

.2 Substitution: VITALink CIC Type FAS105, manufactured by Comtran (listed by ULC under ULC category code ‘FHIT7’ and ‘FHJR7’, dated 19 May 2015), installed in EMT conduit.

.3 Substitutions such as “Lifeline” installed in conduit may only be considered if listed by ULC under ULC Category Code ‘FHIT7’.

3 Execution

3.01 INSTALLATION

.1 All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

.2 The entire system shall be installed in accordance with the latest edition of CAN/ULC-S524 and the approved manufacturer’s manuals and wiring diagrams.

.3 The contractor shall furnish all labour, conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for installation of system devices.

.4 Provide all necessary power supply, interconnecting and remote signal wire in dedicated conduit throughout and installed in accordance with the manufacturer's wiring diagrams and the requirements of the Ontario Electrical Safety Code and the Inspection Authority.

.5 All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.

.6 Install all wiring in metal raceways.

.7 Provide wiring suitable for fire alarm circuits.

.1 Class A wiring for initiating circuits.

.2 Class B wiring for signalling circuits.

.8 Fire rated conductors:

.1 Install fire rated conductors in accordance with the manufacturer's installation guidelines.

.2 Install 2 hour fire rated cables for fire alarm circuits as required by the building code where transponders (data gathering panels) or annunciators are installed in a separate fire compartment from the main FACP CPU.

.3 Install 2 hour fire rated cables for fire alarm system branch circuits where the transponder or DGP is not within the same storey as the first initiation, signalling, or voice communication device in the loop for that storey.

.4 In lieu of fire rated cables for the above noted cases, Contractor may, when reviewed beforehand by the Consultant, install non rated conductors in be located in a service space that is separated from the remainder of the building by a fire separation that has a fire resistance rating of not less than 2 hours.

3.02 SITE TESTS AND INSPECTIONS

.1 The manufacturer's representative shall make an inspection of the fire alarm equipment. The inspection shall comprise an examination and test of such equipment for the following:

.1 That the type of conductors and cables installed are that designated by the specifications.

.2 That the specified equipment has been installed in accordance with the manufacturer's recommendations.

.3 That the supervisory wiring of all devices connected to a supervised circuit is operating and that the wiring has been met to the satisfaction of the inspecting officials.

.2 Testing to be done in the presence of the local building inspector, and the local fire inspector.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Category 6 copper unshielded twisted pair (UTP) communications cabling.

1.02 REFERENCES

.1 Refer to Section 27 05 00 for references.

1.03 SUBMITTALS

.1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 MANUFACTURERS

.1 Panduit TX6000 series.

.2 Commscope.

.3 Belden.

2.02 TERMINATION EQUIPMENT

.1 All termination mounts shall be fully loaded with the appropriate connectors.

.2 Blank labelling strips are required for connectors that are not in use.

.3 IDC block quantities shall accommodate the number of terminated cable pairs.

.4 Material and equipment shall be new, and conform to grade, quality and standards specified.

.5 Backboard layout will be as per manufacturer's recommendations unless expressly written otherwise by the General Contractor/Construction Manager or the Consultant.

3 Execution

3.01 INSTALLATION

.1 The Telecommunications Cabling Contractor shall ensure ANSI/EIA/TIA-568-B installation practices are followed.

.2 The Telecommunications Cabling Contractor shall terminate all pairs of cable. Terminate all spare cables at the Telecommunication Room end.

.3 The Telecommunications Cabling Contractor shall run all horizontal cables parallel to building grid lines with no splices.

.4 Provide 3 m (10'-0") of slack at the workstation end of the cable to permit future outlet relocation. Neatly coil slack in ceiling space or on the side of the cable tray.

.5 Provide 1 m (3'-0") of slack at the Telecommunications Room end of the cable to permit future relocation. Neatly coil the cable in the cable tray or in the ceiling space.

.6 Inform the Consultant immediately of any horizontal cable runs exceeding 90 m (295 feet).

.7 When terminating copper cables remove cable jacket only enough to perform termination and untwist pairs a maximum of 13 mm (1/2”) for Category 6 cables.

.8 The Consultant shall determine the quality of workmanship during installation. Cables that have not been properly installed will be reinstalled by the Telecommunications Cabling Contractor at no additional expense to the client.

.9 Maintain a minimum of four (4) times cable diameter as a bend radius if no bend radius is specified.

.10 All horizontal cables shall be bundled on the Telecommunications Racks using “Hook & Loop” fastener straps. Bundles shall be wrapped at a maximum of 203 mm (8”) separation.

.11 All exposed cabling at the workstation between wall/floor-input point locations and systems furniture are to be wrapped with Split Harness Wrap or Polyethylene Spiral Wrap, size and length as required to suit.

.12 Provide blank filler plates for all unused modular jack positions on faceplates.

.13 Supply and install Category 6 CMP cables to the outlets outlet indicated on the drawings. The Telecommunications Cabling Contractor shall refer to the legends on the drawing to determine the number of cables to each outlet location.

.14 Terminate, test and label each Category 6 cables in accordance to the parameters stated in this specification document.

3.02 PATCH CABLES

.1 Supply copper patch cords as per schedule in Section 27 16 19.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Twisted Pair Patch Cords.

.1 Schedule of copper patch cords to be supplied.

.2 Fibre Optic Patch Cords.

.3 Related Cross-connect components.

.4 Cross-connection and patching.

1.02 RELATED REQUIREMENTS

.1 Section 27 13 23 – Communications Optical Fiber Backbone Cabling.

.2 Section 27 13 13 – Communications Copper Backbone Cabling.

.3 Section 27 11 19 – Communications Termination Blocks and Patch Panels.

1.03 SUBMITTALS

.1 Product Data: For each type of product indicated.

.1 For Category-6 patch cords, include the following installation data for each type used:

.1 Nominal OD.

.2 Minimum bending radius.

.3 Maximum pulling tension.

.2 For Fiber Optic patch cords, include the following installation data for each type used:

.1 Nominal OD.

.2 Minimum bending radius.

.3 Maximum pulling tension.

.2 Source quality-control reports.

.3 Field quality-control reports.

1.04 QUALITY ASSURANCE

.1 Electrical Components, Devices, and Accessories: Listed and labeled by a qualified testing agency, and marked for intended location and application.

.2 Warranty: see Section 27 05 00.

1.05 DELIVERY, STORAGE, AND HANDLING

.1 Test cables upon receipt at Project site.

.1 Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set.

.2 Test each pair of UTP cable for open and short circuits.

1.06 PROJECT CONDITIONS

.1 Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2 Products

2.01 MANUFACTURERS

.1 Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

.1 Panduit (selection based on Owner's standard).

.2 No alternative will be accepted.

2.02 PATCH CABLES

.1 General Requirements: Comply with TIA/EIA-569-C.

.2 Category 6 Copper Patch Cords:

.1 Factory-made, four-pair cables terminated with eight-position modular plug at each end in lengths as indicated in pricing sheet.

.2 Patch cords shall have bend-relief-compliant boots to ensure Category 6 performance.

.3 UTP Patch Cords will be supplied in the following lengths:

Quantity	Length	Colour	Use	Panduit Part Number
450	5'	White	Desks	UTP28SP5
150	7'	White	Cabinet	UTP28SP7
150	10'	White	Cabinet	UTP28SP10
75	7'	Yellow	Internet	UTP28SP7YL
75	10'	Yellow	Internet	UTP28SP10YL

.3 Fibre Optic Patch Cords: Factor-made, dual-fibre cables with LC duplex connectors.

.1 Fibre patch cords will be available in the following lengths.

.4 Estimated Quantities

.1 The estimate of cable counts and lengths is given for bid purposed only; the final count and lengths will be provided in the integration phase of the project.

.2 Pricing should include single cable pricing and quantity discount pricing.

.5 Cable Connecting Hardware:

.1 Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA568-C.3.

.2 Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

2.03 IDENTIFICATION PRODUCTS

.1 Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, and inks used by label printers.

.2 Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

2.04 SOURCE QUALITY CONTROL

.1 Factory test UTP cables according to TIA/EIA-568-C.2.

.2 Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-C.3.

.3 Provide test and inspection reports.

3 Execution

3.01 FIELD QUALITY CONTROL

.1 Perform tests and inspections.

.1 Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling connections for compliance with TIA/EIA-568-C.1.

.2 Visually confirm Category 6a, marking of patch cables.

.3 Visually confirm Fiber patch coble marking.

.4 Visually inspect cable placement, and patch cords, and labeling of all components

3.02 SUPPLY OF PATCH CORDS

.1 Patch cords included in contract; all patch cords to be supply only, installation by the Owner.

.1 Supply two (2) copper patch cords per each telecom field outlet.

.1 7’-0” length at telecom room.

.2 10’-0” length at workstation.

.2 Supply one (1) duplex Fiber patch cord for every 12 strand fiber backbone cable.

.3 Supply one (1) duplex Fiber patch cord for every 2 strand fiber horizontal distribution cable.

.2 Patch cord colour to match colour of system cabling.

End of Section

This page is intentionally blank.

1 General

1.01 SECTION INCLUDES

.1 Wireless Access Points (WAPs) for WiFi network communications.

2 Products

2.01 OWNER-SUPPLIED PRODUCTS

.1 WAP (Wireless Access Points).

.1 Issued by Owner to this Contractor for installation at locations as indicated on the drawings.

.2 Power Over Ethernet (PoE) powered.

3 Execution

3.01 INSTALLATION

.1 Refer to drawings for WAP locations and provide CAT 6 cabling for each WAP unit.

.2 Allow for site wireless survey for the final locations of WAPs.

.3 Allow for 5 m cable slack at WAP outlets end for final location adjustment.

.4 Wireless access points shall be installed as follows:

.1 Wherever possible mount APs in middle of room on dropped ceiling.

.2 APs are not to be mounted greater than 4.5m (15ft) AFF, whether ceiling or wall mounted. Purpose is to allow for easy maintenance and optimal RF performance.

.3 When installing APs in a dropped ceiling, cut discrete hole for the data cable to come through, allowing the ceiling tile to lay flat.

End of Section

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1 General

1.01 SECTION INCLUDES

.1 Provide a complete system of conduits, pull boxes, outlets, sleeves and all components for a complete working system.

.2 Existing PA System is Carehawk/Dukane MCS350T/32-25-1.

1.02 RELATED REQUIREMENTS

.1 Section 26 05 33.13 – Conduit for Electrical Systems.

.2 Section 26 05 33.16 – Boxes for Electrical Systems.

.3 Section 10 25 19 – Classroom Control Panels.

1.03 REFERENCES

.1 CSA C22.1-18, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (27th edition/2018).

.3 CAN/CSA-C22 No. 214 M90 Communications Cables

.4 CAN/CSA-T530 Commercial Building Standards for Telecommunications Pathways and Spaces

.5 CAN/CSA-T529-95 Commercial Buildings Telecommunications Standards

.6 CAN/CSA-T527 Grounding and Bonding Requirements for Telecommunications in Commercial Buildings

.7 CAN/CSA-T528 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

.8 Ontario Building Code

1.04 SUBMITTALS

.1 Product Data.

2 Products

2.01 OUTLET BOXES

.1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.

2.02 CONDUIT

.1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.

.2 Minimum conduit size shall be 21 mm (3/4”) diameter.

.3 Plywood backboards shall be minimum 1200 x 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.

2.03 CABLING

.1 Provide twisted pair shielded cabling by Belden to building standard for each device.

.2 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations for cable installation.

2.04 EQUIPMENT

.1 Handset: Carehawk "Classroom Phone" black cycolac, dynamic transmitter, standard magnetic receiver, 6'(1.8m) coiled cord, c/w two-gang stainless steel face plate, and standard two-gang electrical back box.

.2 Call Switch: Edwards Signaling 620 Low Voltage Panel Mount Push Button, white.

.3 Speakers: McBride series 8229/25/25 (recess mounted in Modular Control Panel (MCP)), pre-assembled "call-in" speaker complete with 8'' dual cone speaker with magnet, 12.5'' square steel baffle (MC25A), 24 or 70 Volt to match existing, 4 Watt transformer and suitable back box.

3 Execution

3.01 INSTALLATION

.1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

.2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.

.3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.

.4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30,000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:-
	Width	Length	Depth	
21mm	150mm	300mm	100mm	50mm
27mm	200mm	400mm	150mm	75mm
35mm	250mm	450mm	200mm	75mm
41mm	300mm	600mm	250mm	100mm
53mm	350mm	750mm	300mm	125mm

.5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by Cash Allowance installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

.6 Install new devices in modular control panels.

End of Section

1 General

1.01 SECTION INCLUDES

.1 Modifications to existing fire alarm system, including provision of new zones as indicated, [relocating and] new fire alarm devices as indicated on the drawings, and system verification. Complete systems shall be left ready for continuous and efficient satisfactory operation.

.2 Update annunciators / passive graphic to include additions and renovated areas, as applicable.

.3 New devices connected directly to the existing fire alarm system shall of the manufacturer's current product selection, and to match the existing system.

1.02 RELATED REQUIREMENTS

.1 Section 26 05 33.13 – Conduit for Electrical Systems.

.2 Section 26 05 33.16 – Boxes for Electrical Systems.

.3 Section 26 05 33.23 – Surface Raceways for Electrical Systems.

.4 Latest fire alarm verification or annual inspection report.

1.03 REFERENCES

.1 The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only. Comply with latest edition/amendment referenced Code/Publication.

.1 2012 Ontario Building Code.

.2 2007 Ontario Fire Code.

.3 CAN/ULC-S524-14, Standard for Installation of Fire Alarm Systems.

.4 CAN/ULC-S537-13, Standard for Verification of Fire Alarm Systems.

.5 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.

.6 Ontario Electrical Safety Code (28th edition/2021).

.7 All requirements of the Authority Having Jurisdiction (AHJ).

1.04 SUBMITTALS

.1 Provide submittals to the Consultant for review in accordance with Section 01 33 00.

.2 Submit to the Fire Department, drawings showing bells, manual pull stations, complete wiring diagrams and annunciator details and obtain their approval.

.3 Shop Drawings

.1 Include sufficient information, clearly presented, to determine compliance with drawings and specifications.

.2 Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, and device arrangement.

.3 Show annunciator layout and main control panel module layout, configurations and terminations.

.4 Show device layout, complete riser diagram, and auxiliary functions.

.5 The supplier of the system shall prepare a complete zoning schedule and artwork layout for active graphic to be included with submittal package.

.4 Manuals

.1 Submit complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets (with model numbers to be used indicated).

.2 Wiring diagrams indicating terminals and the interconnections between the items of equipment.

.3 Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment.

1.05 CLOSEOUT SUBMITTALS

.1 Fire Alarm Verification Report.

.2 Operation and Maintenance Manual.

.3 Training session attendance list.

1.06 QUALITY ASSURANCE

.1 Approvals

.1 The system shall have proper listing and/or approval from the following nationally recognized agencies:

.1 ULC Underwriters Laboratories Canada.

.2 The fire alarm control, panel shall meet the modular listing requirements of ULC. Each subassembly of the FACP, including all printed circuit boards, shall include the appropriate ULC modular label.

.2 All devices/components shall be suitable for the locations, environment, temperatures in which they are to be installed.

1.07 WARRANTY

.1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance.

2 Products

2.01 EXISTING SYSTEM

.1 The existing Fire Alarm System is as indicated on drawings Mircom FX-2000 series single-stage fire alarm system.

.1 The location of the Fire Alarm Control Panel is as indicated on the drawings.

.2 There is one passive graphic annunciator to be updated.

2.02 MANUFACTURERS

.1 The system components shall be selected so as to match and be compatible with the existing Fire Alarm system.

2.03 EQUIPMENT AND MATERIAL, GENERAL

.1 Review latest verification report, and review existing system during tender walkthrough and note all required modifications.

.2 All equipment and components shall be new, and the manufacturer's current model.

.3 All equipment and components shall be installed in strict compliance with manufacturers' recommendations.

.4 All Equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.04 CONDUIT AND WIRE

.1 Existing conventional zone wiring is existing to remain.

.2 New conduit and wire for new zones and new devices to Section 27 15 01.19.

.3 Conduit

.1 Conduit shall be in accordance with the Electrical Safety Authority (ESA), local and provincial requirements.

.2 All wiring shall be installed in conduit or raceway to Section 26 05 33.13 and Section 26 05 33.23.

.4 Wire

.1 All fire alarm system wiring to suit new devices shall be new.

.2 Wiring shall be in accordance with local, provincial and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as outlined in the Ontario Electrical Safety Code and as recommended by the fire alarm system manufacturer.

.3 All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signalling system, as outlined in the Ontario Electrical Safety Code.

.5 Terminal Boxes, Junction Boxes and Cabinets:

.1 All boxes and cabinets shall be listed for their purpose and use.

2.05 MAIN FIRE ALARM CONTROL PANEL

.1 Add new zones, zone modules, etc., for new work as required, and connect all new devices to Fire Alarm Control Panel.

.2 Remote Annunciator and Passive Graphic

.1 Connect all new zones for the new work to annunciators.

.2 Provide new passive graphic, multicolour, under plexiglass with anodized frame and concealed tamperproof mounting.

2.06 COMPONENTS

.1 Programmable Electronic Sounders:

.1 Electronic sounders shall match existing system.

.2 Shall be flush mounted as required.

.3 Mini horns shall be provided in all [Classroom] areas etc. and where shown.

.2 Audible/Visual Combination Devices:

.1 Shall meet the applicable requirements of sounders listed above for audibility.

.2 Shall have a built-in strobe, 15 candela.

.3 Strobe Synchronizing Modules:

.1 Synchronize strobes at 1 Hz and horns at temporal over single wire pan.

.4 Manual Fire Alarm Stations

.1 Manual fire alarm stations shall be non-coded, non-breakable glass type.

.2 Stations must be designed such that after an actual activation, they cannot be restored to normal without the use of a special tool.

.3 An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of 30.5 m (100 feet) front or side.

.4 Manual stations constructed of metal, with operating instructions provided on the cover. The word FIRE shall appear on the manual station in letters 12.7 mm (1/2 inch) in size or larger.

.5 Manual stations shall be c/w polycarbonate vandal covers.

.5 Conventional Photoelectric Area Smoke Detectors

.1 Photoelectric smoke detectors shall be two wire, ceiling-mounted, light scattering type using an LED light source.

.2 Each detector shall contain a remote LED output and a built-in test switch.

.3 Detector shall be provided on a twist-lock base.

.4 It shall be possible to perform a calibrated sensitivity and performance test on the detector without the need for the generation of smoke. The test method shall test all detector circuits.

.5 A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs), on the detector, which may be seen from ground level over 360 degrees. These LEDs shall flash every 10 seconds, indicating that power is applied to the detector.

.6 The detector shall not go into alarm when exposed to air velocities of up to 914.4 m (3000 feet) per minute.

.7 The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.

.8 All field wire connections shall be made to the base through the use of a clamping plate and screw.

.6 Duct Smoke Detectors

.1 Duct smoke detectors shall be complete with visual alarm and power indicators, and a reset switch. Each detector shall be installed upon the with properly sized air sampling tubes.

.7 Automatic Conventional Heat Detectors

.1 Automatic heat detectors shall have a combination rate of rise and fixed temperature rated at 135 degrees F (57.2 degrees C) for areas where ambient temperatures do not exceed 100 degrees F (37.7 degrees C), and 200 degrees F (93.33 degrees C) for areas where the temperature does not exceed 150 degrees F (65.5 degrees C).

.2 Automatic heat detectors shall be a low profile, ceiling mount type with positive indication of activation.

.3 The rate of rise element shall consist of an air chamber, a flexible metal diaphragm, and a factory calibrated, moisture-proof, trouble free vent, and shall operate when the rate of temperature rise exceeds 15 degrees F (9.4 degrees C) per minute.

.4 The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft.

.5 Automatic heat detectors shall have a smooth ceiling rating of 2 500 square feet (762 square metres).

2.07 OPERATION SEQUENCES

.1 The fire alarm system shall be a [Zoned Single Stage Non-Coded System] as defined in the Ontario Building Code.

.2 Basic Performance:

.1 Initiation Device Circuits (IDC) shall be wired Class A.

.2 Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y).

.3 Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

.3 Basic System Functional Operation:

.1 An alarm is caused by actuation of any one of the following devices:

.1 Pulling a manual station

.2 Operation of an automatic fire alarm detector

.3 Operation of a sprinkler flow switch

.4 Operation of a smoke detector

.2 If, in any area of the building, an alarm is caused by actuation of the aforementioned devices, the following shall occur:

.1 Signals in the building shall sound.

.2 Annunciators shall indicate exact zone where alarm originated

.3 Fans shall be automatically turned off.

.3 Central station shall be automatically alerted via telephone lines connected for fire alarm system.

.4 If, in any area of the building, supervised valves of the sprinkler, systems are operated or exhibit short or open circuits, the following shall occur:

.1 The annunciator shall identify, as a separate zone, the item causing the trouble signal.

.2 The trouble buzzer on the annunciator(s) shall sound.

.3 The signals in the building shall not be sounded.

3 Execution

3.01 EXAMINATION

.1 Do not disturb any existing devices unless absolutely necessary to facilitate installation of a new device. No existing devices are to be disturbed without specific authorization by the Project Manager.

.2 Conduct an impedance test of initiation and signal circuits, and submit report to the Consultant. Report any discrepancies in circuit loading.

3.02 INSTALLATION

.1 Maintain continuity of the existing fire alarm system at all times. In the event that a shutdown is required of the fire alarm system, provide a fire watch.

.2 Install fire alarm system devices in accordance with applicable codes, and manufacturer's instructions.

.3 Entire installation shall be done under supervision of manufacturer. Upon completion of installation, check entire system to approval and correct any malfunction immediately.

.4 Standpipe System Connections.

.1 Refer to Section 21 12 00.

.2 Connect contact of supervisory switches to fire alarm zones indicated.

.5 Sprinkler System Connections.

.1 Refer to Section 21 13 00.

.2 Connect contact of sprinkler flow switches and supervisory switches to fire alarm zones indicated.

.6 Align alarm devices and signals, where grouped together, one above the other.

.7 Mount devices at the following heights unless otherwise shown:

.1 Signal devices:

.1 300 mm below finished ceiling

.2 2050 mm above floor in unfinished areas.

.2 Manual Pull Stations:

.1 1200 mm above finished floor level.

.3 In areas with separate signal devices for fire suppression and/or pre-action, provide a lamacoid nameplate for base building signalling devices.

.8 Manufacturer shall examine Drawings and Specifications prior to award of Contract to ensure that detectors, control panels and miscellaneous devices being supplied will provide a satisfactory working installation.

3.03 FIELD QUALITY CONTROL

.1 Testing and Verification

.1 Test each automatic detector to ensure correct wiring and zoning by setting off its rate of rise component and sounding the bells or by ringing it out. Test each smoke detector, sprinkler system and standpipe valves to ensure correct wiring.

.2 Provide the service of a competent, factory trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with CAN/ULC-S537.

.3 Check for correct connections and test for short circuits, ground faults, continuity, and insulation.

.4 Perform audibility test of space and provide annunciation devices to suit ambient sound levels. Ensure coverage for fire alarm signalling devices on base building fire alarm system. Provide audible test of signaling devices after other systems have been commissioned to verify operation at computer room ambient sound level.

.5 [Verify activation of all relocated devices, including flow switches, trouble, and supervisory signals from the relocated pre-action assembly.]

.6 Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.

.7 All initial testing shall be in accordance with CAN/ULC-S537. A representative of the electrical contractor shall be present to participate and assist the manufacturer representative during the course of the verification. The electrical contractor shall make good any deficiencies discovered during the verification. All devices, new and existing, shall be verified. The electrical contractor shall provide one person for assistance with the verification.

.8 Include associated costs in Tender Price.

.9 Carry out a complete audibility test and submit report.

.10 On completion of the verification the manufacturer shall supply a certificate, together with detailed inspection record sheets showing location of each device and certifying the test results per unit, confirming that the system is installed, supervised and operational.

.11 Provide functional testing of interconnected systems in accordance with CAN/ULC-S1001.

.2 Manufacturer Services

.1 The manufacturer(s) of the fire alarm shall make a complete inspection of all [existing and] new components installed for system(s), such as manual stations, horns, and annunciators and sprinkler and standpipe valves and smoke detectors to ensure the following:

.1 That the system is complete in accordance with Specifications.

.2 That the system is connected according to ULC requirements.

.3 That the system is connected in accordance with the Manufacturer's recommendations.

.4 That the regulations concerning the supervision of components have been adhered to (e.g. stations, detectors, supervised valves, bells), and are properly wired and supervised.

.5 That all valves are properly connected and displayed correctly on each annunciator.

.6 That any subsequent changes necessary to conform to the above will be carried out with technical advice supplied by the manufacturer.

.7 That all thermal detectors, smoke detectors and manual pull stations have been operated and are in good working order.

.8 That all sprinkler system and standpipe system valves have been operated and are in good working order.

.9 That all annunciators correctly pinpoint the origin of any fire alarm.

.10 That actual smoke concentration of sufficient density, have been applied to each smoke detector to cause the detector to be set off and that the sensitivity of each smoke detector has been set.

.11 That all existing devices are in good working order. Include for replacement of any defective/damaged devices at no extra cost to Owner.

.12 That signal audibility is acceptable in all areas. Submit audibility readings for every room.

.13 If existing audible signal devices have been discontinued by the manufacturer (for example mechanical horns), allow for replacement of all audible devices so that all devices generate similar sounds and sound patterns when activated.

3.04 CLOSEOUT ACTIVITIES

.1 At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.

.2 Provide instruction as required to the building personnel and fire and safety personnel. "Hands-on" demonstrations of the operation of the system shall be provided.

End of Section

1 General

1.01 SUMMARY

.1 Provide commissioning of fire alarm and interconnected systems to verify that installations are in accordance with project requirements, and to ensure proper system operation.

1.02 RELATED REQUIREMENTS

.1 Section 01 91 13 – Commissioning.

1.03 REFERENCES

.1 CAN/ULC-S1001-11 – Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.04 SUBMITTALS

.1 Commissioning plan.

1.05 CLOSEOUT SUBMITTALS

.1 Final commissioning and functional test report.

1.06 QUALIFICATIONS

.1 Commissioning Organizations:

.1 Certified member of Electrical Contractors Association of Ontario (ECAO) or Canadian Fire Alarm Association (CFAA).

2 Products – Not Used

3 Execution

3.01 SITE TESTS AND INSPECTIONS

.1 Perform Commissioning of integrated systems in accordance with CAN/ULC-S1001.

.2 Follow manufacturer's recommendations for testing.

.3 Inspect wiring connections to all devices comprising the system.

.4 Verify supervision of wiring at every device connection to a supervised circuit.

.5 Test operation of every device on a system to verify its function.

.6 Examine equipment for any apparent damage or tampering that may interfere with its intended operation.

.7 Test equipment with capabilities for field adjustment to establish that it functions as intended under the conditions prevailing at its point of installation.

.8 Examine devices for evidence of damage or obstructions which may interfere with their operating mechanisms.

.9 Test automatic devices by simulating an operating condition.

.10 Wiring:

.1 Inspect every device and test to demonstrate that disconnection of the device from the circuit or malfunction of the equipment or wiring activates the required supervisory signals. Inspection shall include verification that:

.1 Supervisory signals operate in response to open circuits, short circuits, ground faults and disconnection of plug-in components;

.2 Terminations of conductors entering and leaving equipment have been made;

.3 Circuit polarities are in accordance with the system design, where applicable.

.2 In addition, test to establish that the power supplied to any device is within its recommended operating range and that the required voltage levels are maintained and that the fusing is correct.

.11 Initiating Devices - Manual:

.1 Inspect manual alarm stations in consideration of the following:

.1 The device shall be mounted with sufficient clearance to facilitate ease of access and proper operation;

.2 Operate each manual alarm station, toggle switch and key switch to verify proper functions.

.12 Automatic heat detectors:

.1 Use a heat source reproducible in its intensity, as recommended by the manufacturer of the device, to initiate an alarm.

.2 Test equipment - Heat lamp or Air heater. DO NOT USE AN OPEN FLAME HEAT SOURCE.

.3 Apply heat source as to not damage or operate fusible disc parts.

.13 Automatic heat detectors - non-resettable:

.1 Test by simulating its electrical operation by jumpering the wiring points (creating a short) adjacent to its operating mechanism.

.14 Automatic smoke detectors - area type:

.1 Test by introducing smoke into its detecting chamber. This may consist of actual smoke from burning materials or artificially generated smoke aerosol spray as recommended by the manufacturer. The sensitivity should be noted and adjusted if necessary.

.15 Automatic smoke detectors:

.1 Examine the air sampling arrangements of the detectors under actual conditions of balanced air circulation by conducting a check of the field sensitivity and a check of the air velocity in accordance with the manufacturers' recommendations.

.2 Test gas to be used similar to Automatic Smoke Detector.

.16 Alarm signals - audible:

.1 Test on main power supply and standby power supply with the maximum expected load on the system.

.2 The audible signalling appliances shall function as intended and shall be audible throughout the building over the background noise present.

.3 Decibel recordings in each area covering 100 sq. metres shall be taken.

.4 The level of sound should usually be 15 dB above ambient noise level.

.17 Alarm signals - visual:

.1 The visual signal appliances shall function as intended and shall be clearly visible.

.18 Fire suppression supervision:

.1 Coordinate with the requirements of Section 21 13 00.

.2 Sprinkler and standpipe trade to active each sprinkler and standpipe supervisory and alarm device by operating valves and producing flows as required in conjunction with fire alarm technician to observe activation of flow switches, pressure switches, supervised valves, etc.

.19 Annunciators, printers and workstations:

.1 Inspect and operate to establish that their operation in conjunction with the control equipment and other system components, is as intended. The equipment shall be inspected to ensure:

.1 The zone of each alarm initiating device is properly indicated;

.2 The legend is clearly visible;

.3 Adequate voltage under local conditions is present;

.4 Wiring connections have been made in a workmanlike manner.

.5 Proper care must be taken to establish that each item is complete and satisfactory.

.20 Standby power supplies - batteries:

.1 Examine batteries for possible damage and consideration of the following:

.1 The charging system functions as intended;

.2 The installation has not resulted in the bypassing of a fuse or a similar protective device;

.3 The installation protects the batteries from accidental or mechanical damage.

.4 The batteries must be able to operate the fire alarm system with the charger input disconnected for one rated load cycle.

.21 Control equipment and transponders:

.1 Test to establish that they function as intended. The following examinations and tests shall be performed:

.1 A visual and physical inspection of all cables, plug interconnections, plug-in circuit components, lamps, sockets and controls to establish that their mechanical and electrical connections and mounting are as required for intended function and, where applicable, to confirm electrical supervision;

.2 Verification that all field wiring is terminated in a workman-like manner;

.3 All lamps and indicators shall be tested for operation and intended function;

.4 All keypad functions shall be tested for operation and intended function;

.5 All control unit functions shall be operated to verify appropriate response including all software routines and programme functions are simulated;

.6 Simulation of open circuits, short circuits and ground faults on all relevant internal circuits in order to confirm the appropriate supervisory response;

.2 Commissioning Report:

.1 Provide in accordance with requirements of Section 01 91 13, supplemented as specified herein.

.2 Report to include relevant information of the system including:

.3 Each system part described.

.4 How the system is operated.

.5 What functions the system performs.

.6 Requirements for tests and service.

.7 Itemization of all devices connected on the system, their general location.

.8 The date of the performed tests.

.9 All pertinent details of the report sheets requested.

.3 Verification:

.1 The Commissioning Report to be submitted to the Commissioning Manager upon completion of commissioning and will be subject to verification by the Commissioning Manager.

3.02 SIMULATIONS OF INTERCONNECTED SYSTEMS

.1 Provide simulations of all interconnected systems in accordance with CAN/ULC-S1001.

End of Section