Part 1 General

1.1 Words and Terms

.1 Conform to definitions and their defined meanings as in Section 01 19 00.

.2 Refer to Section 01 19 00 for Specification Grammar.

.3 Conform to the following definitions and their defined meanings in addition to those referenced in Section 01 19 00:

.1 Install: To remove from site storage, move or transport to intended location, install in position, connect to utilities, repair site caused damage, and make ready for use.

.2 Supply: To acquire or purchase, ship or transport to the site, unload, remove packaging to permit inspection for damage, re-package, replace damaged items, and safely store on-site.

.3 Provide: Wherever the term "provide" is used in relationship to equipment, piping and other materials specified for the work, it means "supply, install and connect". Wherever the terms “provide” is used in connection with services such as testing, balancing, start-up, preparation of drawings for any part of the work, it means procure, prepare, supervise, take responsibility for, and pay for these services.

.4 Typical: A representative characteristic that is standard for all installations whether individually noted or not throughout the documents. “Typical” applies to each individual or combined installation except where specifically noted or otherwise indicated that the application is non-typical.

.5 Exposed: Any work not concealed in wall, shaft, or ceiling cavities or spaces. Work behind doors, in closets or cupboards or under counters is considered exposed.

.6 New: Produced from new materials.

.7 Renewed: Produced or rejuvenated from an existing material to like-new condition to serve a new or existing service.

.8 Defective: A condition determined exclusively by the Contract Administrator.

1.2 Complementary Documents

.1 Drawings, specifications, and schedules are complementary to each other and what is called for by one will be binding as if called for by all.

.2 Should any discrepancy appear between the drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of the plans, and specifications, the Contractor shall obtain a ruling in writing from the Contract Administrator in writing before submitting the bid. If this is not done it will be assumed that the most expensive alternative has been included in the bid price.

.3 The drawings for mechanical work are performance drawings. They are generally diagrammatic and are not to scale unless detailed otherwise. They establish scope, material and installation quality and are not detailed installation instructions showing every offset, fitting, valve or every difficulty encountered during execution of work and will not be used as an excuse for deficiencies or

omissions. Where required installations are not shown on plans or are only shown diagrammatically, install in such a way as to conserve headroom and interfere as little as possible with free use or space through which they pass, while adequate space is allowed for service, maintenance, repair, or replacement for all equipment.

.4 Drawings indicate general location and route of new and existing mechanical systems. The review of exact location and routing of systems prior to bidding is the responsibility of the Contractor. Install piping and duct systems not exactly shown in plan or indicated by note, by graphic, or diagrammatically in schematic or riser diagrams to provide an operational assembly or system.

.5 Install components to physically conserve headroom, to minimize furring spaces, to accommodate installed Work, or other obstructions.

.6 Install ceiling mounted or exposed mechanical components such as diffusers, sprinkler heads and grilles in accordance with reflected ceiling drawings or floor plans.

.7 Locate devices with primary regard for convenience of operation and usage.

.8 Examine all discipline drawings, specifications, and schedules and related Work to ensure that Work can be satisfactorily executed. Conflicts or additional Work beyond Work described, to be brought to the attention of the Contract Administrator.

.9 All specification sections of the Project Manual and Drawings are affected by requirements of Division 01 sections.

1.3 Description of The Work

.1 Division of the Work among other contractors, subcontractors, suppliers or vendors is solely the Contractor's responsibility. Neither The City nor Contract Administrator assumes any responsibility to act as an arbiter to establish subcontract terms or disagreements between sectors or disciplines of the Work.

1.4 Contract Method

.1 Construct Work under the contract requirements in the applicable Division 00 sections.

.2 Contract Documents were prepared by the Contract Administrator for The City. Any use which a third party makes of the Contract Documents, or any reliance on or decisions to be made based on them, are the responsibility of such third parties. The Contract Administrator accepts no responsibility for any damages suffered by any third party as a result of decisions made or actions based on the Contract Documents.

1.5 Permits, Inspection and Testing

.1 File all necessary notices and approved layouts, obtain and pay for all Local Authority and Fire Underwriters Inspections, approvals and permits applicable to each Mechanical Section. Make changes required to secure Local Authorities approval, without extra cost. Where conflicting requirements occur, comply with most stringent regulation. Note that requirements shown or specified may exceed minimum standards set by Local Authorities.

.2 The Regulations of the A.S.M.E. Code and the Provincial Labour Department shall cover the design, manufacture, installation, welding and tests of piping and other equipment as specified hereafter.

.3 Obtain Registration Certificates for all pressure vessels, with suitable metal-framed glass covers installed where directed. Furnish all certificates required by Local Authorities before acceptance of building by The City.

.4 The City may request the Mechanical Section to operate device or material installed for such time as Contract Administrator may require, as a thorough test, before final acceptance. Such tests shall not be construed as evidence of acceptance, and no claim for cost of such operation for test, or damage due to inadequacy or defect will be recognized.

.5 Note that site reviews by the Contract Administrator are for the purpose of determining in general if the work is proceeding in accordance with the Contract Documents, and to endeavour to guard The City against defects and deficiencies and not to superintend the execution of the work, which is the Mechanical Contractor's and their Subcontractors' responsibility.

1.6 Examination

.1 Examine all contract documents to ensure work can be performed without changes to the Work as shown on plans. No allowance will be made later for necessary changes, unless notification of interferences have been brought to Contract Administrator's attention in writing, prior to bid closing.

.2 Verify that materials and equipment can be delivered to the place of the work and that sufficient space and access is available to permit installation as shown on the drawings.

.3 Verify the locations and inverts of service lines leaving and entering building to ensure their proper function prior to commencing work.

1.7 Closeout Submittals

.1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.2 Four weeks prior to Substantial Performance of the Work, submit to the Contract Administrator digital copies of operating and maintenance manuals and record drawings in Canadian English.

.3 Copy will be returned with Contract Administrator's comments.

.4 Revise content of documents as required prior to final submittal.

.5 Two weeks prior to Substantial Performance of the Work, submit to the Contract Administrator final digital copies of operating and maintenance manuals and record drawings, revised as per Contract Administrator's comments.

.6 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.7 Summary audit documents associated with requirements for Green Globes classification documentation.

.8 If requested, furnish evidence as to type, source and quality of products provided.

.9 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.10 On Contract Administrator's acceptance of the operating and maintenance manuals and record drawings, produce two hard copies of the closeout documents and ship to The City. Pay costs of transportation. Provide digital copy to City by electronic file transfer or physical media.

1.8 Operation and Maintenance Manual

.1 Format – Hard Copy

.1 Refer also to Section 01 78 10 for formats for manuals. Where there is a discrepancy with this section, follow the requirements of 01 78 10.

.2 Organize data in the form of an instructional manual.

.3 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 8.5 x 11 inch (219 x 279 mm) with spine and face pockets.

.4 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

.5 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.6 Arrange content by systems under Section numbers and sequence of Table of Contents.

.7 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.8 Text: Manufacturer's printed data, or typewritten data.

.9 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.2 Contents - Each Volume

.1 Refer also to Section 01 78 10 for formats for contents. Where there is a discrepancy with this section, follow the requirements of 01 78 10.

.2 Table of Contents: Provide:

.1 Title of project.

.2 Date of submission.

.3 Names, addresses, and telephone numbers of Contract Administrator and Contractor with name of responsible parties.

.4 Schedule of products and systems, indexed to content of volume.

.3 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.4 Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.

.5 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.6 Certificate of Acceptance: Relevant certificates issued by authorities having jurisdiction, including code compliance certificate, life safety systems performance certificate. pressure vessel acceptance.

.7 Review Reports

.8 CO's and RFI's

.9 Training: Refer to Demonstration and Training in this Section.

1.9 Recording Actual Site Conditions

.1 Record information on a full-sized set of drawings, and within the Project Manual.

.2 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information.

.3 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately recorded.

.4 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:

.1 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.2 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.3 Field changes of dimension and detail.

.4 Changes made by change orders.

.5 Details not on original Contract Drawings.

.6 References to related shop drawings and modifications.

.5 Specifications: legibly mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.6 Other Documents: Maintain manufacturer's certifications, inspection certifications, field test records required by individual specifications sections.

1.10 Record Documents

.1 Prior to Substantial Performance of the Work, electronically transfer the marked-up information from the as-built documents, as follows:

.1 Drawings: Scan the full-sized field-verified as-built drawing set and save to PDF format. Scans shall be in colour and with good resolution to ensure drawings and markups are legible.

.2 Specifications: Adobe Acrobat (PDF).

.2 Mark revised documents as "RECORD DOCUMENTS". Include all revisions.

.3 Submit completed record documents to Contract Administrator on physical electronic media or by electronic transfer.

1.11 Warranties and Bonds

.1 Refer to Section 01 78 10 for Warranties and Bonds.

1.12 Fabrication and Workmanship

.1 Employ skilled mechanics in their respective trades, under competent supervision, and where required by Provincial or Local regulations holder of acceptable qualification certificates.

1.13 Quality Assurance

.1 Provide testing organization services as specified in subsequent Sections.

.2 Testing organization: Current member in good standing of their respective professional or industry organization and certified to perform specified services.

.3 Comply with applicable procedures and standards of the certification sponsoring association.

.4 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

.5 Qualifications:

.1 Provide adequate workforce training through meetings and demonstrations.

.2 Provide a designated experienced person on site with de-construction experience throughout the project for consultation and supervision purposes.

1.14 Demonstration and Training

.1 Refer also to Section 01 79 00 for Demonstration and Training. Where there is a discrepancy with this section, follow the requirements of 01 79 00.

.2 Instruct The City's designated employees in proper care, operation, use and maintenance of all systems and equipment, and provide general explanatory literature required and start up supervision and instructions.

.3 Provide two weeks prior notice to The City to schedule the training.

.4 The City will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

.5 Upon completion of instructions, forward to Contract Administrator with a copy to The City a letter indicating person instructed and dates that the instruction took place. If in Contract Administrator’s opinion, this is not done satisfactorily, Contract Administrator may direct such instruction, and charge all costs involved to relevant section.

1.15 Conditions for Demonstrations

.1 Equipment has been inspected and put into operation in accordance with related sections.

.2 Testing, adjusting, and balancing have been performed and equipment and systems are fully operational.

.3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.16 Shop Drawings - Administrative Requirements

.1 Shop drawings shall be submitted electronically in PDF format documents to shopdrawings@eppsiepman.com.

.2 Shop drawing documents shall be grouped by specification section. Clearly list the specification section on the front page or cover sheet of the submittal. Shop drawings related to multiple sections may not be grouped together into a single document. Documents that are groups incorrectly will be returned without being examined and shall be considered rejected.

.3 Each drawing shall include the name of project as found on the drawings or specifications, the equipment supplier and the specification section that the equipment is specified under.

.4 Submit to Contract Administrator submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.5 Work affected by submittal shall not proceed until review is complete.

.6 Present Shop Drawings, product data, samples and mock-ups in SI Metric and/or Imperial inch-pound units, to match the units used in the schedules.

.7 Review submittals prior to submission to Contract Administrator. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents.

.8 Submittals not stamped, signed, dated, identified as to specific project, and attesting to their being reviewed will be returned without being examined and shall be considered rejected.

.9 Notify Contract Administrator, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.10 Verify field measurements and affected adjacent Work are coordinated.

.11 Contractor's responsibility for errors and omissions in submission is not relieved by Contract Administrator's review of submittals.

.12 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Contract Administrator review.

.13 Keep one reviewed copy of each submission on site.

1.17 Shop Drawings and Product Data Submissions

.1 The term "Shop Drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated,

regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications. Indicate layouts, quantity, details of equipment, control wiring diagrams, sizes, capacities and roughing in and exact requirements for concrete pits, bases and other supporting members.

.3 Each shop drawing must be certified by manufacturer and as such shall indicate that all product engineering has been performed to ensure the product will meet the requirements of the intended installation.

.4 Shop drawings for grilles, registers and diffusers shall be accompanied by an itemized list indicating the unit locations by room number and the unit size.

.5 Allow fifteen working days for Contract Administrator's review of each submission.

.6 Adjustments made on Shop Drawings by Contract Administrator are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Contract Administrator prior to proceeding with Work.

.7 Make changes in Shop Drawings as Contract Administrator may require, consistent with Contract Documents. When resubmitting, notify Contract Administrator in writing of any revisions other than those requested.

.8 Accompany submissions with transmittal letter, containing:

- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Other pertinent data.

.9 Submissions shall include:

- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.

.7 Operating weight.

.8 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to other parts of the Work.

.10 After Contract Administrator's review, distribute copies.

.11 Submit one copy of Shop Drawings as a pdf document by email attachment for each requirement requested in specification Sections and as Contract Administrator may reasonably request. Any electronic copy of shop drawings shall bear all the required marks of certification and approval by the manufacturer and contractor(s) as indicated above. The Contract Administrator will review and mark up one copy of the shop drawing, and return to the contractor by email attachment. The contractor shall then make copies as required for ordering and documentation purposes. Multiple copies of shop drawings will not be returned.

.12 Submit one electronic copy of product data sheets or brochures for requirements requested in specification sections and as requested by Contract Administrator where Shop Drawings will not be prepared due to standardized manufacture of product. Submittals shall be submitted as a pdf document by email attachment, or delivered as a hard copy. Any electronic copy of shop drawings shall bear all the required marks of certification and approval by the manufacturer and contractor(s) as indicated above.

.13 Delete information not applicable to project.

.14 Supplement standard information to provide details applicable to project.

.15 If upon review by Contract Administrator, no errors or omissions are discovered or if only minor corrections are made, one electronic copy will be returned and fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and re-submission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed. The contractor shall then make copies as required for ordering and documentation purposes. Multiple copies of shop drawings will not be returned.

.16 Checking of shop drawings by the Contract Administrator does not constitute acceptance of responsibility. Such checking constitutes assistance only to the Mechanical Division in the proper execution of their work.

1.18 Product Changes & Substitutions

.1 Change in Product/Products: Submit request for substitution or alternative in accordance with this Section, the Instructions to Bidders, and Division 01 Product Exchange Procedures Division 01 Substitutions Sections. In case of a discrepancy between this section and Division 00 and Divisions 01, the more stringent requirements shall apply.

.2 The Instructions to Bidders specify time restrictions for submitting requests for Substitutions during the bidding period to requirements specified in this section.

.3 Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

.4 Any substituted item submitted for consideration must not exceed the available space and weight limitations, and all additional costs for mechanical, electrical, structural and architectural revisions required to incorporate the substituted material shall be the responsibility of the Mechanical Division. Review maximum dimensions and weights when provided in the specification and schedules, and where not specified review the drawings for space limitations.

.5 A request constitutes a representation that the Bidder:

.1 Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.

.2 Will provide the same warranty for the Substitution as for the specified Product.

.3 Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to The City.

.4 Waives claims for additional costs or time extension which may subsequently become apparent.

.5 Will reimburse The City and Contract Administrator for review or redesign services associated with re-approval by authorities.

.6 Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

1.19 Progress Payment Submissions

.1 Submit progress payment breakdowns for review by the Contract Administrator to the requirements of Division 01.

.2 For mechanical submissions, provide line item breakdowns to indicate the following:

.1 Equipment progress payments for Fire Protection, Plumbing, Hydronic and HVAC.

.2 Labour progress payments for Fire Protection, Plumbing, Hydronic and HVAC.

.3 Controls

.4 Insulation

.5 Air Balancing

.6 Commissioning, Start Up and Training

.7 Close out documents – Record drawings, Operation and Maintenance documents.

.3 Equipment and materials must be located on site or in bonded storage with proof of storage for payment request to be accepted.

1.20 Certificates and Transcripts

.1 Submit Green Globes credit criteria associated with specified products in accordance with Green Globes requirements.

1.21 Product Supplied

.1 QUALITY

.1 Products, materials, equipment, parts or assemblies (referred to as Products) incorporated in Work: New, not damaged or defective, of best quality (compatible with specification requirements) for purpose intended. If requested, provide evidence as to type, source and quality of Products provided.

.2 Defective Products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.

.3 Should any dispute arise as to quality or fitness of Products, decision rests strictly with Contract Administrator.

.4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

.5 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

.2 AVAILABILITY

.1 Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items.

.2 If delays in supply of Products are foreseeable, notify Contract Administrator of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.3 In event of failure to notify Contract Administrator at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Contract Administrator reserves right to substitute more readily available Products of similar character, at no increase in Contract Price or Contract Time.

.3 STORAGE AND PROTECTION

.1 Store and protect Products in accordance with manufacturers' written instructions.

.2 Store with seals and labels intact and legible.

.3 Store sensitive Products in weather tight, climate controlled, enclosures in an environment favourable to Product.

.4 For exterior storage of fabricated Products, place on sloped supports above ground.

.5 Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of Products.

.6 Cover open ends of pipes, fixtures, ductwork, etc. to prevent entry of building rubbish.

.7 Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

.8 Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.

.9 Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

.4 TRANSPORTATION AND HANDLING

.1 Transport and handle Products in accordance with manufacturer's written instructions.

.2 Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.

.3 Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

.4 Protect all finished and unfinished work from soiling or damage, cover floors with tarpaulins or plywood as necessary, and repair any damage resulting from work of Mechanical Section.

.5 Protect finished surfaces to remain exposed, by paper, polyethylene or other satisfactory removable protective covering using paste acceptable to fixture manufacturer to prevent possible damage to finishes, until all reason for construction damage has passed and until acceptance by The City, and make good any such damage.

1.22 Special Cleaning

.1 Maintain tidiness within work of Mechanical Sections and at completion remove protective paper, labels, etc. and tools and waste materials. Leave clean and in perfect operating condition.

.2 Remove dirt, rubbish, grease, and dust for which this section is responsible from all exposed surfaces and fixtures.

.3 Operate, drain and flush out bearings and refill with new charge of lubricant, before final acceptance.

.4 Thoroughly clean piping, ducts and equipment of dirt, cuttings and other foreign substances within the scope of work area. Disconnect, clean and reconnect whenever necessary for purpose of locating and removing obstructions. Repair work damaged in course of removing obstructions. Refer to 23 31 00 for any additional duct cleaning requirements.

.5 Clean exposed surfaces of mechanical equipment, ductwork, piping, etc., and polish plated work.

.6 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion. Supply and install extended nipples to outside of bearing enclosures for lubrication purposes.

.7 Remove tools, surplus, and waste material from the building site upon completion of work. Clean grease, dirt, and excess material from walls, floors, ceilings, surfaces, and fixtures for which this Contractor was responsible, and leave the premises suitable for immediate use.

.8 Schedule cleaning operations so that resulting dust and other contaminants will not fall on wet, newly painted surfaces, infiltrate into occupied areas, or trigger fire alarm smoke or dust detectors.

.9 Replace heating, ventilating and air conditioning filters if units were operated during construction.

.10 Do not start air-handling systems unless the systems and associated ductwork are clean. Failure to properly clean the equipment and ductwork shall make the Contractor responsible to clean, repair or replace equipment and ductwork rendered deficient.

.11 Coordinate Green Globes related IAQ building flushing requirements with mechanical system cleaning.

.12 At the end of construction all systems shall be left ready for operation.

.13 This Section shall be responsible for repair work as may be necessary to remove dents and touch-up of factory finishes.

1.23 Sustainable and Low Impact Requirements

.1 Refer to Division 01 requirements for compliance requirements affecting all mechanical divisions, particularly:

.1 Section 01 74 19 – Waste Management and Disposal

.2 Adhesives and sealants used in interior locations shall contain a low proportion of volatile organic compounds (VOCs) and shall meet the South Coast Air Quality Management District (SCAQMD) Rule 1168. Shop drawings shall be provided indicating compliance with the VOC limits.

.3 Comply with the contract's waste management, waste diversion and recycling requirements and goal tracking.

1.24 Manufacturer's Written Instructions

.1 Unless otherwise indicated in the specifications, install or erect Products to manufacturer's written instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.

.2 Notify Contract Administrator in writing, of conflicts between specifications and manufacturer's instructions, so that Contract Administrator may establish course of action.

.3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Contract Administrator to require removal and re-installation at no increase in Contract Price or Contract Time.

1.25 Quality of Work

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Contract Administrator if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. Contract Administrator reserves right to require dismissal from site any workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Contract Administrator, whose decision is final.

.4 Assume full responsibility for layout of own work and for any damage caused to property of others through improper location or poor workmanship.

.5 ACCESSIBILITY OF EQUIPMENT

.1 The City places a high priority on being able to safely and efficiently gain access to systems and equipment for replacement and repair. All equipment must be accessible, as defined as follows:

.1 Ceiling mounted equipment shall only be considered accessible if a tradesman can place both hands on the equipment components which requires services (ie: fan motor, belt, pulley, bearing, fire damper linkages, valve/control valve, strainer or any other equipment component which requires periodic maintenance). The component must be in clear view, and access must be gained from an 8 or 10 foot step ladder. Access panels provided in drywall shall be sized and placed in such a manner that trades personnel can place two hands on the equipment components as stated above. Equipment located above acoustic tile ceiling shall be positioned in such a manner that equipment and its components can be accessed through a full tile which does not contain any devices such as light fixtures, speakers, smoke detectors or sprinkler heads. If this is not possible, it should be reviewed by the Contract Administrator/The City before deemed acceptable.

.2 Conduit, pipe, ducting and support racking or any other obstruction to accessibility shall be relocated at the contractor's expense by the contractor's forces.

.6 COORDINATION

.1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

.3 Check levels shown before commencement to ensure adequate falls for sewers and pipes and report discrepancies immediately. Failure to so check and report does not relieve this section from responsibility for consequent extra expenditures.

.4 Where space is indicated as reserve for future equipment, leave clear and install piping and other work so that connections can be made to future equipment.

.5 Secure approval where necessary to cut holes in either finished or unfinished work, employ section whose work is involved, cut openings no larger than necessary and without damage to adjoining work and carefully repair all damage to match adjacent work. Note the Mechanical Division is responsible for all required cutting and patching relating to this Contract, except as specifically noted otherwise.

.6 Provide and set bolts, templates, sleeves and fixing materials for fixing work under this section securely to work provided under other sections, in advance of other work, where required.

.7 Locate all openings in walls, partitions, beams, etc. required for installation of ducts, pipes and equipment, etc. specified in this section of the specifications and frame all openings as required.

.8 Installation of all equipment shall allow sufficient space to facilitate ease of maintenance. Clearance space shall allow for the removal of all components of equipment without hindrance. Where clearance requirements are not shown on the mechanical plans, manufacturer clearances must be maintained at a minimum.

.7 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

.8 FASTENINGS - EQUIPMENT

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use Type 304 or 316 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.26 Work For Other Trades

.1 The Mechanical Contractor shall install rough-ins and/or connections for all equipment requiring mechanical services, as shown on drawings or mentioned elsewhere in the specifications.

.2 Supply other trades with all necessary details, rough-in drawings, wiring diagrams, etc. as required.

1.27 Electrical Requirements

.1 Motors and electrical equipment supplied under Mechanical Division shall comply with Electrical Section and electrical characteristics scheduled or shown.

.2 See "Installation and Wiring Controls" in Electrical Section for equipment supplied under Electrical Section.

.3 The Electrical section shall provide starters for all motors and wire from starters to motors, unless otherwise indicated.

.4 The Electrical section shall wire between starters and switching components such as relays, float switches, and pressure switches.

.5 Supply to Electrical Section within four weeks after contract award, fully detailed diagrams of power and control wiring required for equipment supplied by Sections 21 – 25.

.6 Motors shall be squirrel cage induction type 1800 RPM unless otherwise noted. Where dampness occurs, all motors and electrical apparatus such as float switches, etc. supplied integrally with any piece of apparatus, shall be totally enclosed.

.7 All motors 1 hp and larger shall be high efficiency as defined in CSA C390.

1.28 Concealment

.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation, inform Contract Administrator if there is interference. Install as directed by Contract Administrator.

1.29 Access Panels

.1 Provide in ample time for installation under relevant sections all necessary access panels in walls and ceilings to allow access to dampers, valves, etc., size 300 mm x 300 mm (12" x 12") min. or as required for proper maintenance with steel panel and frame, similar to Acudor, type to suit application. Instruct relevant section for proper location of access panels. Final locations subject to Contract Administrator's approval. ULC approved access panels must be provided where access is through or into a fire partition or assembly. If access doors have been specified by architectural sections the architectural specification shall supersede this section.

1.30 Remedial Work

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.31 Alteration Work

.1 Where work is to be done in existing buildings, accurately survey, provide for avoidance of damage and interference to existing work and rectify any such damage due to work under Mechanical Sections. Accept existing work as it exists at time of tendering.

.2 Carefully dismantle existing mechanical equipment to be removed or relocated. Temporarily disconnect, remove, and reinstall existing equipment, piping,

ductwork, conduit, light fixtures, and similar items, which interfere with the new installation after completion of new work or of existing installations to be demolished. Store equipment and materials on the premises as directed by The City.

.3 All usable salvaged equipment and materials shall remain the property of the The City unless specifically noted otherwise. Such material shall be removed from the building and be safely and neatly stored on the site for removal by The City. The Contractor shall remove all rejected salvage from the site and legally dispose of it off site.

.4 Reuse existing equipment in new work after first repairing and reconditioning any defective items where noted. Safely cap and seal disconnected mechanical services within finished surfaces.

.5 The abandonment of existing equipment and material in place is not acceptable. All redundant services are to be removed back to active mains, which shall then be capped at existing point of connection.

.6 All mechanical equipment conflicting with new equipment being installed shall be moved or disconnected, without damage, by Contractor and shall remain property of The City. Remove ducts and piping not required in revised systems and interfering with new installation. This material shall become property of Contractor.

.7 Disconnect existing equipment indicated, intended to be reused, rough-in in new position, and after replacement connect fully, ready for use.

.8 Removal and relocation of mechanical equipment by relevant Mechanical Sections.

.9 Operation of HVAC equipment serving occupied areas during renovation

.1 Protect HVAC air handling equipment from collecting odours and pollutants during demolition & construction by implementing the following measures:

.1 Shut-down HVAC equipment in coordination with The City's representative during heavy construction or demolition.

.2 Isolate the functional HVAC system from the renovation to prevent intake of pollutants.

.3 Seal all return system openings in and immediately adjacent to the construction area where isolation of the renovation area is possible.

.4 Install and maintain temporary filters on return air openings from the renovation space when system is in operation and connection to the renovation space is necessary. Replace these filters at the end of the project.

.5 Avoid storage of waste and construction materials in the mechanical room.

.6 Use high-efficiency filters (MERV 13) for central filtration when operating the system during construction. Inspect filters daily and replace as required over the duration of the project.

.7 Protect diffusers, VAV boxes, ducts and other HVAC system components.

.8 Final cleaning of existing ducts, diffusers, and window units is required upon completion of work if evidence of contamination is found.

1.32 Location of Fixtures

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform Contract Administrator of conflicting installation. Install as directed.

1.33 Temporary Use of Equipment

.1 No portion of any mechanical system or equipment provided under Mechanical Sections may be used for temporary heating without Contract Administrator's written permission and observance of the following procedure:

.1 Oil and grease motor, fan and pump bearings, etc. check on a regular basis and maintain as recommended by manufacturer.

.2 Maintain and clean when necessary cleanable type filters and clean and oil just prior to take-over of building by The City. Replace throwaway type filters.

.3 Ensure that mechanical air handling equipment is not operated during painting.

.4 Employ equipment manufacturers and subtrades to ensure and certify that all systems and equipment are in proper condition, and guarantee all work used prior to take-over as for new work, from date of acceptance of building by The City.

.5 If permission for temporary use of mechanical equipment is granted, use Canadian Plumbing and Mechanical Contractors Association standard form of agreement as basis of responsibilities. Guarantee on complete installation shall not start until acceptance of building by The City.

.2 Where air handling systems are permitted to be operated before turnover to The City, all return air grilles/openings shall be equipped with MERV 8 filters to keep return air system clean of dust and dirt. Monitor all filters for dust loading and replace heating, ventilating and air conditioning filters. Replace non-LED lamps if used for more than one month.

1.34 Protection of Work In Progress

.1 Prevent overloading of any part of the Project.

.2 Do not cut, drill or sleeve any load bearing structural member unless specifically indicated without written approval of Contract Administrator.

1.35 Equipment Start Up and Verification Reports

.1 The contractor shall supply the equipment start-up reports for the mechanical equipment being installed.

.1 Forms shall be filled out in full, with all required and suggested fields.

.2 Forms shall include tester’s signature and the signature by the project manager for the mechanical contractor.

.2 The controls contractor shall supply a completed sequence verification checklist confirming all points of the system are functioning, reporting, and properly executing the sequence operation.

.1 Forms shall be developed and filled out by the contractor

.2 Forms shall include tester's signature and the signature by the project manager for the mechanical contractor.

END OF SECTION

Part 1 Pre-Training

1.1 General

.1 Mechanical contractor training record to comply with Section 01 79 00- Demonstration and Training and 21 05 00 – Common Work For Mechanical.

1.2 Pre-Training Requirements

.1 Submit pre-training setup and any other required information as defined in Sections 01 79 00 and 21 05 00 to The City's representative a minimum of two weeks ahead of proposed training date. Training date to be minimum two weeks ahead of substantial performance.

.2 Mechanical commissioning sign off date determined by The Contract Administrator.

.3 Acceptable training date and list of personnel will be based on The City's personnel availability. The City to provide date and personnel list within 3 days of receipt of pre-training setup.

1.3 Pre-Training Setup

Mechanical Commissioning Sign Off Date	
Training and Demonstration Date(s) and Time(s) Proposed	
Training and Demonstration Agenda and Schedule	
List of Excluded Systems	

Part 2 Training Record

2.1 Training Record Closeout

.1 Submit training close out record within 5 days of completion of training. Attendees listed to sign record verifying attendance and receipt of training and demonstration as scheduled on completion of training.

Training Date(s), Time(s)	
Contractors Attendees	
The City's Attendees	
Training and Demonstration Provided	

Part 1 General

1.1 References

.1 ASME B16.5 - Pipe Flanges and Flanged Fittings.

.2 ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings.

.3 ASME B16.11 - Forged Fittings Socket Welding and Threaded.

.4 ASME B16.25 - Buttwelding Ends.

.5 ASME B36.10 - Welded and Seamless Wrought Steel Pipe.

.6 ASTM A135 - Electric-Resistance-Welded Steel Pipe.

.7 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.

.8 ASTM A135 - Electric-Resistance-Welded Steel Pipe

.9 ASTM A795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

.10 ASTM B32 - Solder Metal.

.11 AWS A5.8 - Filler Metal for Brazing and Braze Welding.

.12 AWS D10.10 - Recommended Practices for Local Heating of Welds in Piping and Tubing.

.13 NFPA 13 - Installation of Sprinkler Systems.

.14 NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances

.15 NFPA 25 – Standard for the Inspection, Testing and Maintenance of Water Based Fire Protection Systems

.16 UL - Fire Resistance Directory.

.17 UL 262 - Gate Valves for Fire-Protection Service.

.18 UL 312 - Check Valves for Fire-Protection Service.

.19 UL 405 - Fire Department Connections.

.20 Underwriters Laboratories of Canada (ULC)

1.2 Submittals at Project Closeout

.1 Section: Procedures for submittals.

.2 Project Record Documents: Record actual locations of components and tag numbering.

.3 Operation and Maintenance Data: Include installation instructions and spare parts lists.

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1.3 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 Carbon steel pipe and fittings manufactured in China or India will not be permitted.

.3 Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience, licensed in the Province of Manitoba, member in good standing with the Canadian Automatic Sprinkler Association, and approved by manufacturer.

1.4 Regulatory Requirements

.1 Conform to cUL., UL., FM.

.2 Sprinkler Systems: Conform to NFPA 13.

.3 Welding Materials and Procedures: Conform to Manitoba Department of Labour and ASME Code requirements.

.4 Valves: Bear UL/cUL label or marking. Provide manufacturer's name and pressure rating marked on valve body.

.5 Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.5 Delivery, Storage, And Protection

.1 Section: Transport, handle, store, and protect products.

.2 Deliver and store valves in shipping containers, with labelling in place.

.3 Provide temporary protective coating on cast iron and steel valves.

.4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.6 Extra Materials

.1 Section: Operation and Maintenance Data.

.2 Provide two of valve stem packings for each size and type of valve installed.

1.7 Design Calculations

.1 The contractor shall carry out all necessary calculations and shall submit all calculations, data, and drawings in conformance with the requirements of NFPA 13 and the local authority having jurisdiction for Contract Administrator’s review prior to proceeding with work. All design calculations are to be sealed by a Professional Engineer and shall be stamped reviewed by the authority having jurisdiction. Calculations shall be completed based on direction and restrictions given on drawings.

.2 The design shall be based on hazard occupancy as scheduled on drawings.

.3 The contractor shall be responsible to obtain water supply flow and pressure from the local municipal authority. If this information is not available, the contractor shall include all costs necessary for the testing.

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1.8 Inspection and Tests

.1 All inspections and tests required by the above-mentioned authorities and agencies shall be arranged for and performed by this contractor.

.2 Inspections and testing to comply with NFPA 25.

.3 Carry out any necessary flow tests without extra compensation.

.4 All piping and fittings in the standpipe and sprinkler systems shall be hydrostatically tested at a pressure of 1380 kPa (200psi) for 2 hours without evidence of loss or leakage or as per NFPA 13.

Part 2 Products

2.1 Above Ground Piping and Fittings

.1 Steel Pipe: ASTM A53; ASTM A135; ASTM A135 UL listed, threadable, light wall; ASTM A795; or ASME B36.10; Schedule 10 black; or ASME B36.10; Schedule 40 black; or ASME B36.10; Schedule 10 galvanized; or ASME B36.10; Schedule 40 galvanized as scheduled below.

.1 Steel Fittings: ASME B16.9, wrought steel, buttwelded; ASME B16.25, buttweld ends; ASTM A234, wrought carbon steel and alloy steel; ASME B16.5, steel flanges and fittings; ASME B16.11, forged steel socket welded and threaded.

.2 Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

2.2 Flexible Sprinkler Hose

.1 Stainless steel braided flexible sprinkler hose

.1 Construction: 300 series stainless steel, EPDM gasket seal, nylon isolation ring, zinc plated carbon steel nuts and nipples.

.2 Inlet Connections:

.1 Grooved

.2 NPT threaded to NFPA standards

.3 Reducers provided by flexible hose manufacturer.

.2 cUL listed or FM approval

.3 Working conditions

.1 Maximum temperature: 107°C (225°F)

.2 Maximum Working Pressure: 1206 kPa (175 psi) cUL listed

.3 Minimum bend radius: 51 mm (2 inch) cULus Listed

.4 Bracket assemblies by hose manufacturer approved for hose application.

2.3 Backflow Preventers

.1 Listed Double Check Valve Assemblies:

.1 Manufacturers:

.1 Beeco.

.2 Zurn.

.3 Watts.

.4 Substitutions: Refer to Section 21 05 00.

.2 ANSI/ASSE 1024 / CSA B64.4

2.4 Gate Valves

.1 Up to and including 50 mm (2 Inches):

.1 Bronze body, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.

.2 Over 50 mm (2 Inches):

.1 Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid rubber covered bronze or cast iron wedge, flanged grooved ends.

2.5 Globe or Angle Valves

.1 Up to and including 50 mm (2 Inches):

.1 Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable rubber disc, threaded ends, with backseating capacity repackable under pressure.

.2 Over 50 mm (2 Inches):

.1 Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.6 Ball Valves

.1 Up to and including 50 mm (2 Inches):

.1 Bronze two-piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.

.2 Over 50 mm (2 Inches):

.1 Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive handwheel for sizes 250 mm (10 inches) and over, flanged.

2.7 Butterfly Valves

.1 Bronze Body:

.1 Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and built-in tamper proof switch.

2.8 Check Valves

.1 Up to and including 50 mm (2 Inches):

.1 Bronze body and swing disc, rubber seat, threaded ends.

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.2 Over 50 mm (2 Inches):

.1 Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends with automatic ball check.

2.9 Drain Valves

.1 Compression Stop:

.1 Bronze with hose thread nipple and cap.

.2 Ball Valve:

.1 Brass with cap and chain, 20 mm (3/4 inch) hose thread unless otherwise noted.

2.10 Floor Plates

.1 In new construction, where pipes pass through concrete or masonry walls provide steel pipe sleeves full thickness of wall.

.2 In new construction, risers shall have watertight floor sleeves as recommended in NFPA 13. In renovation or existing construction, cored openings are acceptable provided the penetration is sealed and watertight, and meets all requirements of NFPA 13.

.3 Provide split or solid round floor plates on all exposed pipes passing through walls, floors, or ceilings.

2.11 Specialties

.1 Sight glass shall be a combination moisture and liquid indicator with protection cap. Sight glass shall be Alco, Mueller, Sporlan or Henry. Size shall be full line size.

.2 Pressure gauges shall comply with NFPA 13. Port connection shall not be smaller than 6.4 mm. The pressure limit must not be less than twice the working pressure of the sprinkler/standpipe system.

.3 Signs

.1 Signs indicating valves shall be secured with metal wire or chains

.2 Shall identify the portion of building served

.3 Sign shall be made of metal of rigid plastic

.4 According to NFPA 13

Part 3 Execution

3.1 Preparation

.1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

.2 Remove scale and foreign material, from inside and outside, before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

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3.2 Installation

.1 Use grooved mechanical couplings and fasteners only in accessible locations.

.2 Install piping to NFPA 13 for sprinkler systems.

.3 Plastic piping systems are not permitted.

.4 Pipe 38mm (1-1/2") and smaller shall be joined by threaded connections.

.5 Pipe 50mm (2") and larger may be joined by roll groove mechanical joints.

.6 Flexible sprinkler hoses acceptable where site conditions permit usage.

.7 Provide galvanized pipe and fittings for dry and pre-action sprinkler systems.

.8 Welded pipe sections shall be shop fabricated as far as possible to minimize field welding required.

.9 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by the same manufacturer.

.10 Side outlet mechanical tees that are comprised of gasketed cast iron housings that fully encircle the pipe and are secured with through-bolts are acceptable. Mechanical tees that use U-bolts or wire to secure the tee to the pipe will not be accepted.

.11 Route piping in orderly manner, plumb and parallel to building structure and as instructed on drawings. Maintain gradient.

.12 Install piping to conserve building space, to not interfere with use of space and other work.

.13 Group piping whenever practical at common elevations.

.14 In new construction, sleeve pipes passing through concrete or masonry partitions, walls, and floors.

.15 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

.16 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

.17 Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

.18 Do not penetrate building structural members unless indicated.

.19 In new construction, provide sleeves when penetrating footings floors and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required. Sleeve locations shall be noted on shop drawings.

.20 When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

.21 Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.

.22 Provide gate, ball or butterfly valves for shut-off or isolating service.

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.23 Provide drain valves at main shut-off valves, low points of piping and apparatus. Obtain written approval from Contract Administrator for final locations of all drain valves not shown on drawings.

.24 All drains shall be routed to sanitary drainage points. Draining to the storm sewer system or sump pits is not allowed.

.25 Division 26 to wire monitoring alarm switches for each supervised valve. Alarms shall be connected to the annunciator panel. Coordinate wiring requirements with electrical trade.

.26 Final inspection and testing to conform to NFPA 25.

END OF SECTION

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Part 1 General

1.1 References

.1 NFPA 13 - Installation of Sprinkler Systems.

.2 NFPA 1963 – Standard for Fire Hose Connections

.3 FM - Factory Mutual Approval Guide.

.4 CSA C22.1 – Canadian Electrical Code.

.5 UL - Fire Resistance Directory.

.6 UL 199 - Automatic Sprinklers for Fire-Protection Service.

.7 Underwriters Laboratories of Canada (ULC)

.8 City of Winnipeg - Fire Department Connections Requirements

1.2 System Description

.1 System to provide coverage for entire building.

.2 Provide system to NFPA 13 and local Authority Having Jurisdiction requirements.

.3 Determine volume and pressure of incoming water supply from water flow test data.

.4 Interface system with building fire and smoke alarm system if applicable.

.5 Provide fire department connections where indicated.

1.3 Submittals at Project Closeout

.1 Section: Procedures for submittals.

.2 Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

.3 Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.

.4 Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

.5 Warranty: Submit manufacturer warranty and ensure forms have been completed in The City’s name and registered with manufacturer.

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1.4 Quality Assurance

.1 Perform Work to NFPA 13.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.3 Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.5 Regulatory Requirements

.1 Conform to ULC and FM.

.2 Perform Work to NFPA 13.

.3 Equipment and Components: Bear ULC, UL, FM label or marking.

.4 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 Delivery, Storage, and Protection

.1 Section: Transport, handle, store, and protect products.

.2 Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.7 Extra Materials

.1 Section: Operation and maintenance data.

.2 Provide extra sprinklers to NFPA 13.

.3 Provide suitable wrenches for each sprinkler type.

.4 Provide metal storage cabinet located adjacent to alarm valve.

Part 2 Products

2.1 Sprinklers

.1 Suspended Ceiling:

.1 Type: Recessed pendant type with matching push-on escutcheon plate.

.2 Finish: Chrome plated.

.3 Escutcheon Plate Finish: To match sprinkler body.

.4 Fusible Link: Glass bulb type temperature rated for specific area hazard unless otherwise noted.

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.5 Provide concealed sprinkler complete with white cover in locations noted on drawings.

.2 Exposed Area Type:

.1 Type: Standard upright type.

.2 Finish: Brass.

.3 Fusible Link: Glass bulb type temperature rated for specific area hazard unless otherwise noted.

.4 Guards: Provide cage guards in exposed and accessible locations and in mechanical/electrical/utility spaces, finish to match sprinkler finish.

.3 Dry Sprinklers:

.1 Type: Standard pendant type with matching push on escutcheon plate.

.2 Finish: Chrome plated.

.3 Escutcheon Plate Finish: To match sprinkler body.

.4 Fusible Link: Glass bulb type temperature rated for specific area hazard unless otherwise noted.

.4 Guards: Finish to match sprinkler finish.

.5 Windows sprinklers:

.1 Application specific sprinklers designed specifically for protection of glazed surfaces.

.2 ULC listed system under testing to ULC/ORD C263.1.

.3 Horizontal or vertical sidewall type with frangible bulb, as required by the application.

.6 All sprinkler shall be permanently marked so as to identify each sprinkler based on type, orifice size, shape, deflector characteristic, pressure rating and thermal sensitivity.

2.2 Piping Specialties

.1 Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.

.2 Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with accelerator; with test and drain valve.

.3 Pressure Gauge: Provide ULC FM approved listed for fire protection, having aluminum cases, bronze geared movements, bronze bourdon type, friction glass cover and precision type pointer. Accuracy to be 1% of full span. Gauges shall be 100mm diam. throughout. Pressure range shall be selected so that needle is approximately vertical at normal system pressure. Gauges shall have dual scale (psi/kPa) with psi more prominent.

.4 Pressure Reducing Valves: Provide, where required, ULC and FM labelled pressure reducing valves (PRV) with adjustable spring range, sized to suit

required flow and pressure differential, capable of maintaining differential pressure at 138 kPa (20 psi) during both flow and static conditions. Provide all necessary trim: Downstream and upstream pressure gauges, isolation valves, by-pass valves, pressure relief valve on low pressure side to compensate for leakage across the PRV.

.5 Fire Department Connections:

.1 ULC listed, to NFPA 1963, capable of

.1 Pump pressure test at 13.8 bar (200 psi) for 5 minutes

.2 Strainer screen force of 100 N from both sides

.3 Ability to displace a screen/strainer by hand

.2 Connection: Single 100mm (4") 2 lug hard coated aluminum Storz type hose connection angled at 30° downward to suit fire department hardware; threaded pipe connection to sprinkler service with National Standard Thread, latchable hose lock, inlet cap with chain of matching material and finish. Hose sealing surface machined and protected against environmental exposure. Corrosion and tamper resistant screen capable of high water flow rates installed in the connection.

.3 Drain: 19 mm (3/4 inch) automatic drip, outside.

.4 Label: identification plate, constructed of aluminum or brass, specifying "Auto Sprinkler", "Standpipe", or "Auto Sprinkler & Standpipe" department connection. Contractor shall shall provide submittal of identification plate and wording to local fire department or AHJ designate for approval.

2.3 Window Sprinkler System

.1 Window sprinkler systems shall be supplied where indicated on the drawings. A complete manufactured system shall be provided by the sprinkler contractor and installed as per manufacturer's recommendations complete with sealed shop drawings.

.2 Mechanical drawings will indicate general location of windows to be protected. The exact window system construction and required fire resistance rating shall be determined by the sprinkler contractor by reviewing the architectural drawings and specifications.

.3 Provide pendent vertical sidewall sprinkler heads.

2.4 Deflectors

.1 Provide metal deflectors sized to NFPA 13 requirements.

.2 Brackets, Deflector And Screws Painted To Match Ceiling.

Part 3 Execution

3.1 Installation

.1 Install to NFPA 13.

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.2 Install equipment to manufacturers written instructions.

.3 Provide approved double backflow preventer assembly at sprinkler system water source connection as required by authority having jurisdiction.

.4 Fire department connection

.1 Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent fire department connectors to allow full swing of fire department wrench handle.

.2 The fire department connection shall be installed between 760 (30”) above grade. Where connection height limitations exist and installation is less than 760 mm (30”) above grade, a straight 4” Storz connection and signage on the wall above, may be acceptable on coordination with the Authority Having Jurisdiction.

.3 Fire department connection identification plate shall be mounted on the wall at the fire department connection.

.5 Coordinate location of outside alarm gong on building wall with fire alarm contractor.

.6 Place pipe runs to minimize obstruction to other work.

.7 Place piping in concealed spaces above finished ceilings.

.8 Centre sprinklers in one direction only in ceiling tile with location in other direction at ¼, ½, or ¾ of the ceiling tile length, dependent upon spacing and coordination with ceiling elements. Layout instructions provided on the architectural and mechanical drawings override spacing instruction given above.

.9 Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. The contractor shall bear all responsibility to clean sprinklers of paint or if necessary to replace with new.

.10 Flush entire piping system of foreign matter.

.11 Provide protective guards for all sprinkler heads installed:

.1 In confined but accessible spaces.

.2 In exposed and accessible utility locations such as mechanical, electrical or service spaces

.3 Below stairwells located at heights below 2400 mm (8 ft).

.4 Where indicated on drawings.

.5 As required by NFPA 13.

.12 Hydrostatically test entire system. Test shall be witnessed by authority having jurisdiction.

.13 System drains and test connections: run to the nearest open drain in the building or to outdoors through wall away from paved areas. Seal and caulk around

piping through wall and provide escutcheon and prime paint all metal surfaces exposed to outdoors.

.14 Before commencement of any work, examine work of other trades and make immediate report to Contract Administrators of any defect or interference affecting work or guarantee of this work.

.15 If drilling of structural beams or other load bearing members is required by design or by site conditions for passage of piping, obtain Contract Administrator's approval for location and proposed drilling procedure before drilling. Drill only in locations previously approved by Contract Administrator. Where drilling is required by design or existing site conditions, be responsible for carrying out same to approved procedure.

.16 Allow for expansion and contraction when installing pipe hangers.

.17 Install horizontal valves with stems upright where space allows.

.18 Carefully coordinate work with other trades so that unnecessary offsets and revisions to the approved drawings are avoided. Failure to coordinate does not relieve Contractor from meeting performance standards.

.19 Application specific sprinklers such as window sprinklers shall be installed in accordance with the listing requirements.

.20 Provide deflectors between sprinkler heads where minimum separation distances between heads does not conform to NFPA 13 or manufacturer's requirements.

3.2 Interface With Other Products

.1 Ensure required devices are installed and connected as required to fire alarm system.

3.3 Schedules

.1 Refer to the drawings for sprinkler schedules.

END OF SECTION

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Part 1 General

1.1 References

.1 ASME B31.1 - Power Piping.

.2 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

.3 ASTM A106 - Seamless Carbon Steel Pipe for High-Temperature Service.

.4 NFPA 17A - Standard on Wet Chemical

.5 NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

.6 FM - Factory Mutual Approval Guide.

.7 ULC - Fire Protection Equipment Directory – Canada

.8 ANSI/CAN/UL/ULC 300 - Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment.

1.2 System Description

.1 Design, fabrication, and installation: In compliance with requirements and recommendations of NFPA 17A and 96.

.2 The system shall be an automatic fire suppression system using a wet chemical agent for cooking grease related fires.

.1 Capable of suppressing fires in the areas associated with ventilating equipment including hoods, ducts, plenums, and filters as well as auxiliary grease extraction equipment.

.2 Capable of suppressing fires in areas associated with cooking equipment, such as fryers; griddles and range tops; upright, natural charcoal, or chain-type broilers; electric, lava rock, mesquite or gas-radiant char-broilers; and woks.

.3 Pre-engineered type having minimum and maximum guidelines established by the manufacturer and listed by Underwriters Laboratories (UL/ULC).

.4 Installed and serviced by personnel trained by the manufacturer.

.5 Capable of protecting cooking appliances by utilizing either dedicated appliance protection and/or overlapping appliance protection

1.3 Design Requirements

.1 Upon activation of fire-extinguishing system, power source to electric cooking range to be shut off. Shutoff devices require manual reset.

.2 Provide a manual means of system activation.

.3 Upon activation of fire-extinguishing system, an audible alarm or visual indicator shall show that the system has activated.

.4 Provide signal to fire alarm system.

1.4 Submittals

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings:

.1 To bear stamp of approval of The City's fire insurance underwriter.

.2 Indicate layout of system, including piping and location of each component. Include control diagrams, wiring diagrams, and written sequence of operation.

.3 Provide data sheets covering each piece of equipment comprising the system including cylinders, manifolds, control panel, nozzles, detectors, alarm bells or horns, switches, and annunciators.

.3 Manufacturer's Installation Instructions: Indicate installation of equipment and system components.

1.5 Project Record Documents

.1 Section 21 05 00: Submittals for project closeout.

.2 Accurately record exact location of equipment, equipment identification markings, conduit and piping routing details, and agent storage positions.

1.6 Operation and Maintenance Data

.1 Section 21 05 00: Submittals for project closeout.

.2 Include schematic description of fire suppression system installed, drawings illustrating control logic and equipment locations, and technical brochures describing equipment.

.3 Include list of recommended spare parts.

.4 Include checklists and procedures for emergency situations, trouble shooting techniques, abort functions, system control panel operation, trouble procedures, and safety requirements.

1.7 Quality Assurance

.1 ULC listed, CE marked, all approvals by Authority Having Jurisdiction approved agency.

.2 Manufactured by a company with demonstrated experience in the design and manufacture of pre-engineered fire suppression systems.

.3 The manufacturer shall be ISO 9001 registered.

1.8 Qualifications

.1 Manufacturer: Company specializing in manufacturing of products specified in this Section with minimum ten years documented experience.

.2 Installer: Company specializing in performing the work of this Section with minimum 3 years documented experience, approved by manufacturer, who is capable of providing replacement charge within 24 hours.

1.9 Regulatory Requirements

.1 Confirm to NFPA 96 and UL300.

.2 Conform to electrical code for electrical wiring and wiring devices.

1.10 Delivery, Storage, and Handling

.1 Deliver, store, protect and handle products to site to Section 21 05 00.

.2 Accept materials and components on site in shipping containers. Inspect for damage.

.3 Deliver and store equipment in shipping containers with labelling in place. Deliver fire suppressant in approved containers.

.4 Store materials and equipment in clean, dry, non-freezing space.

1.11 Warranty

.1 Section 21 05 00: Submittals for project closeout.

.2 The pre-engineered fire suppression system components shall be warranted for five years from date of substantial completion against defects in workmanship and material.

1.12 Extra Materials

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide one complete set of special tools required for servicing and maintaining equipment installed, to Section 21 05 00.

Part 2 Products

2.1 Restaurant Fire Suppression Systems

.1 Manufacturers

.1 Ansul, Product R-102.

.2 Substitutions: Refer to Section 21 05 00.

.2 Components

.1 The basic system shall consist of a regulated release assembly which includes a regulated release mechanism and a wet chemical storage tank housed within a single enclosure. Nozzles, blow-off caps, detectors, cartridges, agent, fusible links, and pulley elbows shall be supplied in separate packages in the quantities needed for fire suppression system arrangements. Additional equipment shall include remote manual pull station, mechanical and electrical gas valves, and electrical switches for automatic equipment and gas line shut-off, and building fire alarm control panel interface.

.2 Wet Chemical Agent: The extinguishing agent shall be a specially formulated, aqueous solution of organic salts with a pH range between 7.7 – 8.7, designed for flame knockdown and foam securement of grease related fires.

.3 Agent Tank: The agent tank shall be installed in a stainless steel enclosure or wall bracket. The tank shall be constructed of stainless steel. Tanks shall be available in two sizes; 1.5 gallon (5.7 L) and 3.0 gal (11.4 L).The tank shall have a working pressure of 110 psi (7.6 bar), a test pressure of 330 psi (22.8 bar), and a minimum burst pressure of 660 psi (45.5 bar). The tank shall include an adaptor/tube assembly containing a burst disc union.

.4 Regulated Release Mechanism: The regulated release mechanism shall be a spring-loaded, mechanical/pneumatic type capable of providing the expellant gas supply to one or two agent tanks depending on the capacity of the gas cartridge used or three 3.0 gallon (11.4 L) agent storage tanks in certain applications. It shall contain a factory installed regulator deadset at 110 psi (7.6 bar) with an external relief of approximately 180 psi (12.4 bar). It shall have the following actuation capabilities: automatic actuation by a fusible link detection system and remote manual actuation by a mechanical pull station. The regulated release mechanism shall contain a release assembly, regulator, expellant gas hose, and agent storage tank housed in a stainless steel enclosure with cover. The enclosure shall contain knock-outs for 1/2 in. conduit. The cover shall contain an opening for a visual status indicator. It shall be compatible with mechanical gas shutoff devices; or, when equipped with a field or factory-installed switch(es), it shall be compatible with electric gas line or appliance shut-off devices, or connections to a building fire alarm control panel.

.5 Regulated Actuator Assembly: When more than two agent tanks or three agent tanks in certain applications are required, the regulated actuator shall be available to provide expellant gas for additional tanks. It shall be connected to the cartridge receiver outlet of the regulated release

mechanism providing simultaneous agent discharge. The regulator shall be deadset at 110 psi (7.6 bar) with an external relief of approximately 180 psi (12.4 bar).The regulated actuator assembly shall contain an actuator, regulator, expellant gas hose, and agent tank housed in a stainless steel enclosure with cover. The enclosure shall contain knockouts to permit installation of the expellant gas line.

.6 Discharge Nozzles: Each discharge nozzle shall be tested and listed with the R-102 system for a specific application. Nozzles tips shall be stamped with the flow number designation (1/2, 1, 2, or 3). Each nozzle shall have a metal or rubber blow-off cap to keep the nozzle tip orifice free of cooking grease build-up.

.7 Distribution Piping: Distribution piping shall be Schedule 40 black iron, chrome-plated, or stainless steel conforming to ASTM A120, A53, or A106.

.8 Detectors: The detectors shall be the fusible link style designed to separate at a specific temperature, or shall be electric thermal detectors designed to operate at a factory preset temperature.

.9 Cartridges: The cartridge shall be a sealed steel pressure vessel containing either carbon dioxide or nitrogen gas. The cartridge seal shall be designed to be punctured by the releasing device supplying the required pressure to expel wet chemical agent from the storage tank.

.10 Flexible Conduit: The manufacturer supplying the Restaurant Fire Suppression System shall offer flexible conduit as an option to rigid EMT conduit for the installation of pull stations and/or mechanical gas valves. The flexible conduit shall be UL Listed and include all approved components for proper installation.

.11 Pull Station Assembly: The Fire Suppression System shall include a remote pull station for manual system actuation. The pull station shall be designed to include a built-in guard to protect the pull handle. The pull station shall also be designed with a pull handle to allow for three finger operation and shall be red in color for quick visibility

.12 Pipe Hangers: ASME B31.1, UL or FM approved for sprinkler systems, split clamp up to 60 mm (2-1/2 inch) size, riser clamps over 60 mm (2-1/2 inch) size, adequate to offset discharge thrust.

.13 Escutcheons: Chrome plated pressed or stamped brass, one piece or split pattern, minimum 50 mm (2 inches) larger than opening.

Part 3 Execution

3.1 Examination

.1 Section 21 05 00: Procedures for execution of work. Verify that spaces are ready to receive work.

3.2 Installation

.1 Install to manufacturer's written instructions and NFPA 17A.

.2 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe. Remove scale and dirt on inside and outside before assembly. Blow out pipe before nozzles or discharge devices are installed.

.3 Route piping in orderly manner, concealed, plumb and parallel to building structure, and maintain gradient. Install piping to conserve building space, and not interfere with use of space and other work.

.4 Prepare pipe, fittings, supports, and accessories for finish painting, to Section 09 91 00 - Painting.

.5 Install engraved plastic instruction plate, detailing emergency procedures, at control panel and at each manual discharge and abort switch location. At control panel identify control logic units, contacts, and major circuits with permanent nameplates.

3.3 Testing

.1 Provide testing and test reports to Section 01 45 00 – Quality Control.

.2 Test distribution piping and valving, prior to nozzle installation. Inspect joints as directed by the manufacturer. Repair leaks and retest. Maintain test pressure for four hours.

.3 Confirm electric power is isolated from cooking equipment when fire suppression system is activated.

.4 Upon completion of installation provide final checkout inspection by factory trained representative of manufacturer to ascertain proper system operation. Leave system in a fully commissioned and automatic readiness state with circuitry energized and supervised. Testing and demonstration may be done concurrently where feasible to The City.

.5 Test circuits including automatic discharge, manual discharge, equipment shut-down, alarm devices, and storage container pressure. Test supervision of each circuit.

.6 Submit original copies of tests, indicating that factory trained technical representatives of the manufacturer have inspected and tested systems and are satisfied with methods of installation, connections and operation.

3.4 Manufacturer's Field Services

.1 Prepare and start systems to Section 21 05 00 – Common Work for Mechanical.

.2 Provide experienced manufacturer's trained personnel to supervise installation and performance testing of the system.

3.5 Demonstration

.1 Section 21 05 00: Submittals for project closeout.

.2 Training shall be conducted by representatives of the manufacturer.

.3 Demonstrate that components except cylinder discharge assembly, are functioning properly and in conjunction with controls system.

.4 Submit integrated step-by-step test procedure for approval 30 days prior to start of demonstration based on manufacturer's instructions.

.1 Arrange meeting prior to demonstration with representatives of The City, the The City's Underwriter (where required by The City), and the installer.

.2 Perform visual inspection and overall review of system installed.

.5 Where discharge testing is required, leave system will full wet chemical agents and ready for The City's use.

END OF SECTION

Part 1 General

1.1 Responsibilities

.1 The Contractor shall:

.1 Attend mandatory site commissioning meetings to review completed forms.

.2 Provide all coordination required to schedule, coordinate, and complete all commissioning activities. Due to interdependency of the various systems and items of equipment, significant coordination will be required to facilitate commissioning.

.3 Complete all Equipment commissioning Forms specific to the actual equipment involved on this project. Forms are included in the specifications package.

.4 The Contractor is responsible for the sub-trades and their respective specialists and suppliers in participating in commissioning work and in providing the services required for the commissioning.

.5 Complete forms and sign off when each form is satisfactorily completed.

.6 Provide instruction and training on all components to The City.

.2 The Contract Administration Team shall:

.1 Review and verify completed Equipment and Installation Forms

.2 Attend mandatory site commissioning meetings to review completed forms.

.3 Sign off Forms when satisfactorily completed by the Contractor.

.4 Maintain Master Deficiency List

1.2 Description

.1 Commissioning activities to be performed by the contractor include but are not limited to the following:

.1 Verification that all equipment has been supplied to the project in accordance with the specification. Every piece of equipment requires the satisfactory completion of a Static Verification Forms. Static verification shall be done shortly after equipment delivery to site and well in advance of the functional testing to allow time to resolve deficiencies that may be identified at this stage.

.2 Verification of equipment startup, and completion of Start-Up Forms.

.3 Verification that each system has been functionally tested and that the system components act and react interdependently and as per design. The Contractor(s) perform the testing as required to allow the Contract Administrator and The City to verify systems operation. The Contractor is responsible to record the information and results of this work in the Functional Performance Test Forms.

□

.4 All deficiencies are to be satisfactorily completed prior to substantial completion.

END OF SECTION

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Part 1 General

1.1 References

.1 AWWA B300-04 - Hypochlorites.
.2 AWWA B301-04 - Liquid Chlorine.
.3 AWWA B302-05 - Ammonium Sulfate.
.4 AWWA B303-05 - Sodium Chlorite.
.5 ANSI/AWWA C651-14 - Disinfecting Water Mains.

1.2 Submittals for Information

.1 Section 21 05 00: Submission procedures.

.2 Test Reports: Indicate results comparative to specified requirements.

1.3 Closeout Submittals

.1 Section 21 05 00: Submission procedures.

.2 Record Documentation:

.1 Disinfection report:

.1 Type and form of disinfectant used.
.2 Date and time of disinfectant injection start and time of completion.
.3 Test locations.
.4 Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
.5 Date and time of flushing start and completion.
.6 Disinfectant residual after flushing in ppm for each outlet tested.

.2 Bacteriological report:

.1 Date issued, project name, and testing laboratory name, address, and telephone number.
.2 Time and date of water sample collection.
.3 Name of person collecting samples.
.4 Test locations.
.5 Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
.6 Coliform bacteria test results for each outlet tested.
.7 Certification that water conforms, or fails to conform, to bacterial standards.

1.4 Quality Assurance

.1 Perform Work in accordance with AWWA C651.

.2 Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three years documented experience.

.3 Testing Firm: Company specializing in testing potable water systems, approved by the Province of Manitoba.

.4 Submit bacteriologist's signature and authority associated with testing.

1.5 Regulatory Requirements

.1 Conform to applicable code or regulation for performing the work of this Section.

.2 Provide certificate of compliance from authority having jurisdiction indicating approval of water system.

Part 2 Products

2.1 Disinfection Chemicals

.1 Chemicals: AWWA B300, Hypochlorite, AWWA B301, Liquid Chlorine, AWWA B302, Ammonium Sulfate, and AWWA B303, Sodium Chlorite.

Part 3 Execution

3.1 Examination

.1 Section 21 05 00: Verify existing conditions before starting work.

.2 Verify that piping system has been cleaned, inspected, and pressure tested.

.3 Perform scheduling and disinfecting activity with start-up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.2 Execution

.1 Provide and attach required equipment to perform the work of this Section.

.2 Introduce treatment into piping system.

.3 Maintain disinfectant in system for 24 hours.

.4 Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.

.5 Replace permanent system devices removed for disinfection.

.6 Pressure test system to 690 kPa (100 psi) plus the system height in water column pressure for a period of twelve hours. Repair leaks and re-test.

.7 Test samples for coliform bacteria at each outlet tested.

3.3 Field Quality Control

.1 Section 01 45 00: Field inspection and testing.

.2 Test samples in accordance with AWWA C651.

END OF SECTION

Part 1 General

1.1 References

.1 CAN/ULC-S102.2 - Standard method of test for surface burning characteristics of flooring, floor covering and miscellaneous materials and assemblies

.2 CAN/CSA-B1800 - Thermoplastic non-pressure piping

.3 CSA B137 Thermoplastic Pressure Piping Standards

.4 NSF/ANSI 61 – Drinking Water System Components – Health Effects

.5 ANSI/NSF 372 - Drinking Water System Components - Lead Content

.6 ASME B31.9 - Building Services Piping.

.7 ASME SEC IV - Construction of Heating Boilers.

.8 ASME SEC IX - Welding and Brazing Qualifications.

.9 MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.

.10 MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

.11 ASME B16.22-2001 (R2005) - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.12 ASME B16.26 - Copper Alloy Bronze Fittings for Flared Copper Tubes.

.13 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

.14 ASTM B42 - Seamless Copper Pipe, Standard Sizes.

.15 ASTM B43 - Seamless Red Brass Pipe, Standard Sizes.

.16 ASTM B68 - Seamless Copper Tube, Bright Annealed.

.17 ASTM B75 - Seamless Copper Tube.

.18 ASTM B22.18-03 - Seamless Copper Water Tube.

.19 ASTM B251 - General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.

.20 ASTM B302 - Threadless Copper Pipe, Standard Sizes.

.21 ASTM D2665 - Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

.22 ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

.23 ASTM D2855-96 (2002) - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

.24 ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

.25 ASTM D2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

.26 ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

.27 ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

.28 AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 inch - 48 inch (350 mm - 1200mm).

.29 CAN/CSA B137.9-17 - Polyethylene/aluminum/polyethylene (PE- AL-PE) composite pressure-pipe systems

.30 CSA 6.32/ANSI LC-4 - Press-connect metallic fittings for use in fuel gas distribution systems

.31 CAN/CSA B149.1 – Natural Gas and Propane Installation Code.

.32 AGA Z21.22 - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.

.33 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

.34 Government of Manitoba – Inspection and Technical Services technical bulletins.

1.2 Closeout Submittals

.1 Section 21 05 00: Submission procedures.

.2 Record Documentation: Record actual locations of valves on record drawings.

1.3 Quality Assurance

.1 Perform Work to the standards of the Province and Municipality of Jurisdiction.

.2 Valves: Manufacturer's name and pressure rating marked on valve body.

.3 Welding Materials and Procedures: Conform to ASME SEC IX and applicable Provincial labour regulations.

.4 Welder's Certification: To Manitoba Department of Labour standards.

.5 Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

.6 Carbon steel pipe and fittings manufactured in China or India will not be permitted.

1.4 Regulatory Requirements

.1 Licensed in the jurisdiction of work where licencing is legislated.

.2 Perform Work to the latest version of the Manitoba Plumbing Code and local Municipal requirements

.3 Perform natural gas and propane work to the latest version of the CSA B149.1 gas code, Manitoba Gas Notices and local Municipal requirements.

.4 Conform to applicable code for installation of backflow prevention devices.

.5 Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.5 Delivery, Storage, and Protection

.1 Refer to specification section Product Requirements: Transport, handle, store, and protect products.

.2 Accept valves on site in shipping containers with labelling in place. Inspect for damage.

.3 Provide temporary protective coating on cast iron and steel valves.

.4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

.5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.6 Environmental Requirements

.1 Refer to specification section Environmental Protection: Environmental conditions affecting products on site.

.2 Do not install underground piping when bedding is wet or frozen.

Part 2 Products

2.1 Sanitary Sewer Piping, Buried Within 1500 mm (5 Feet) of Building

.1 PVC Pipe: CAN/CSA B1800

.1 Fittings: PVC.

.2 Joints: ASTM D2855, solvent weld to ASTM D2564.

2.2 Sanitary Sewer Piping, Above Grade

.1 PVC Pipe with FSR25/SDC50: CAN/CSA B1800

.1 Piping shall be tested and listed in accordance with CAN/ULC-S102.2 and clearly marked with the certification logo indicating a flame spread rating (FSR) not exceeding 25 and a smoke developed classification (SDC) not exceeding 50.

.2 Fittings: PVC.

.3 Joints: ASTM D2855, solvent weld to ASTM D2564.

.4 Manufacturer: IPEX System XFR or equal.

2.3 Sump Pump Discharge Piping, Above Grade

.1 PVC Pipe: CSA B137.3, pipe and fittings

.1 Schedule 40 piping, solvent welding to CSA B137.3

2.4 Sewage and Sump Pump Discharge Piping, Below Grade

.1 PVC Pipe: CAN/CSA B1800

.1 Fittings: PVC.

.2 Joints: ASTM D2855, solvent weld to ASTM D2564.

2.5 Water Piping, Buried Beyond 1500 mm (5 Feet) of Building

.1 Up to 50mm (2”): Soft temper copper, Type K: ASTM B88

.1 Fittings: ANSI B22.18 or ANSI B16.18 soldered pressure fittings.

.2 Joints: ASTM B32, lead-free solder, Grade 50B.

2.6 Water Piping, Above Grade

.1 Copper Tubing 50mm (2”) and under: ASTM B88, Type L hard drawn.

.1 Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

.2 Joints ASTM B32, solder, Grade 95TA.

.2 Copper Tubing over 50mm (2”): ASTM B88, Type L hard drawn.

.1 Fittings: Silver brazed fittings.

2.7 Storm Water Piping, Buried Beyond 1500 mm (5 Feet) Of Building

.1 PVC Pipe: SDR 35; CAN/CSA B1800.

.1 Fittings: PVC.

.2 Joints: ASTM F477, elastomeric gaskets.

2.8 Storm Water Piping, Above Grade

.1 PVC Pipe: CAN/CSA B182.1

.1 Manufacturer: IPEX Building Sewer and Drain

.2 Fittings: PVC.

.3 Joints: ASTM D2855, solvent weld to ASTM D2564.

.2 PVC Pipe with FR25: CAN/CSA B182.1

.1 Manufacturer: IPEX System 15 or equivalent

.2 Fittings: PVC.

.3 Joints: ASTM D2855, solvent weld to ASTM D2564.

.3 PVC Pipe – FR25, SR50: CAN/CSA B182.1

.1 Manufacturer: IPEX System XFR or equal

.2 Piping shall be tested and listed in accordance with CAN/ULC-S102.2 and clearly marked with the certification logo indicating a flame spread rating of 25 and a smoke developed classification not exceeding 50.

.3 Fittings: PVC.

.4 Joints: ASTM D2855, solvent weld to ASTM D2564.

2.9 Natural Gas Piping, Buried Within 1500 mm (5 Feet) Of Building

.1 Steel Pipe: ASTM A53/ASTM A106 Schedule 40 black.

.1 Fittings: CSA Z662 or ASME B16 series malleable iron or steel, or certified to ANSI LC-4/CSA 6.32

.2 Joints: welded to CSA Z662 or otherwise by authority having jurisdiction

.3 Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 0.25 mm (10 mil) polyethylene tape. Alternative: factory coated steel pipe suitable for underground burial.

.2 Polyethylene pipe: CSA B137.4, polyethylene pipe for gas service.

.1 Fittings: B137.4 or B137.4.1, fusion welded.

.2 Tracing wire – integrated or separate to the piping.

2.10 Natural Gas Piping, Above Grade

.1 Steel Pipe: ASTM A53/A106 Schedule 40 Black.

.1 Fittings: CSA Z662 or ASME B16 series malleable iron or steel, or certified to ANSI LC-4/CSA 6.32

.2 Joints: to CSA B149, press fit to CSA 6.32, flanged, threaded to ASME B1.20.1 or welded to CSA Z662 or otherwise by authority having jurisdiction.

.1 All joints NPS 2-1/2 or greater to be welded only.

2.11 Flanges, Unions, and Couplings

.1 Pipe Size 80 mm (3 inches) and under:

.1 Ferrous pipe: Class 150 malleable iron threaded unions.

.2 Copper tube and pipe: Class 150 bronze unions with soldered joints.

.2 Pipe Size Over 25 mm (1 inch):

.1 Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

.2 Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

.3 Grooved and Shouldered Pipe End Couplings:

.1 Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.

.2 Sealing gasket: "C" shape composition sealing gasket.

.4 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.12 Globe Valves

.1 Construction Up To and Including 50 mm (2 inches), bronze disc:

.1 Manufacturers:

.1 Red-White/Toyo

.2 Kitz

.3 Crane

.4 Substitutions: Refer to Section 21 05 00.

.2 MSS SP-80, Class 125, bronze body, bronze trim, handwheel, bronze disc, solder ends.

.2 Construction Up To and Including 50 mm (2 inches), bronze disc:

.1 Manufacturers:

.1 Red-White/Toyo

.2 Kitz

.3 Crane

.4 Substitutions: Refer to Section 21 05 00.

.2 MSS SP-80, Class 125, LF bronze body, brass and bronze trim, handwheel, bronze or brass disc, solder ends.

.3 LF to NSF 372.

.3 Construction Up To and Including 50 mm (2 inches), PTFE disc:

.1 Manufacturers:

.1 Kitz

.2 Crane

.3 Substitutions: Refer to Section 21 05 00.

.2 MSS SP-80, Class 150, bronze body, bronze trim, handwheel, PTFE disc, solder ends.

.4 Construction: 63 mm (2-1/2 inches) and Larger:

.1 Manufacturers:

.1 Red-White/Toyo

.2 Kitz
.3 Crane
.4 Substitutions: Refer to Section 21 05 00.

.2 MSS SP-85, Class 125, cast iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends.

2.13 Ball Valves

.1 Manufacturers:

.1 MAS
.2 Kitz
.3 Crane.
.4 Substitutions: Refer to Section 21 05 00.

.2 Construction 63 mm (2.5 inches) and smaller:

.1 Class 150, NSF/ANSI 61, MSS SP-110, 4100 kPa (600 psi) CWP
.2 Body, Two piece, NSF/ANSI 372 Lead Free:
.1 Silicon Bronze Alloy, or
.2 Dezincification Resistant (DZR) Brass
.3 Full port 316 stainless ball, PTFE seats and packing, blow-out proof stem, lever handle, solder ends.

.3 Construction 75mm (3 inches) and larger:

.1 Ball valves shall be of the floating-ball design capable of providing bi-directional, tight shutoff in accordance with MSS SP-72.
.2 The valves shall be rated at 150# WSP/300# WOG.
.3 Bodies shall be ductile iron per ASTM A536, With ANSI Class 150 raised-face flanges.
.4 The interior and exterior of the body shall be epoxy-coated.
.5 The ball shall be PFA infused stainless steel, with a stainless steel blowout-proof stem.
.6 The seats and body seals shall be PTFE.
.7 The stem seal shall be PTFE, externally adjustable chevron type.
.8 Valves shall be equipped with locking handles as standard. If service conditions require, valves may be equipped with 2" square operating nuts, manual gear operators, or pneumatic, electric, or hydraulic actuators.

2.14 Plug Valves

.1 Manufacturers:

.1 Nordstrom Valves, Inc. MSS SP-78, Type II.
.2 Substitutions: Refer to Section 21 05 00.

.2 Construction 50 mm (2 inches) and smaller: Figure 114, MSS SP-78, 2700 kPa (400 psi), cast iron body and plug, pressure lubricated, PTFE or Buna N packing, flanged or threaded ends. Provide lever operator with set screw.

.3 Construction 65 mm (2-1/2 inches) and larger: MSS SP-78, 1200 kPa (175 psi), cast iron body and plug, pressure lubricated, PTFE or Buna N packing, flanged ends. Provide lever operator with set screw.

2.15 Flow Controls

.1 Manufacturers:

.1 Watts.

.2 Conbraco.

.3 Substitutions: Refer to Section 21 05 00.

.2 Construction: Class 150, brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

.3 Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum pressure 24 kPa (3.5 psi).

2.16 Swing Check Valves

.1 Construction: Up to and including 80 mm (3 inches):

.1 Manufacturers:

.1 Kitz.

.2 Substitutions: Refer to Section 21 05 00.

.2 MSS SP-80, Class 150, bronze body and cap, bronze swing disc with rubber seat, solder ends. CSA B62 compliant.

.2 Construction: 50 mm (2 inches) and Larger:

.1 Manufacturers:

.1 American Valve, Inc.

.2 Kitz Corporation.

.3 Watts Regulator ;

.4 Zy-Tech Global Industries, Inc.

.5 Substitutions: Refer to Section 21 05 00.

.2 MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged ends. CSA B62 compliant.

.3 Construction: PVC:

.1 CSA B62, ASTM D1784

.1 NSF 61 compliant for potable water applications.

.2 Manufacturers:

.1 IPEX

.2 Substitutions: Refer to Section 21 05 00.

.3 Material: Valve body, bonnet, swing arm, and disc of PVC to ASTM D1784.

.4 Seals: O-ring seals and shutter of EPDM.

.5 Connections: socket weld with union connection or threaded with union connection

.6 Swing check valves shall be full flow, gravity operated, full face disc seal, full open disc stop to prevent over-travel, no wetted metal parts.

.7 Service of the valve shall be possible without removal from the system line.

.8 Installable in either horizontal or vertical orientations.

.9 Valve ratings:

.1 Up to 75 mm (3") shall be rated at 100 psi at 73°F.

.2 +100 mm (+4") shall be rated at 70 psi at 73°F.

2.17 Spring Loaded Check Valves

.1 Manufacturers:

.1 Class 150: Mueller 72-IHB-3-H (Ductile Iron Body) Moygro &-I515WM5B (SS Disc, Viton Seat)

.2 Substitutions: Refer to Section 21 05 00.

.2 Class 150, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

.3 Construction: PVC:

.1 CSA B62, ASTM D1784

.1 NSF 61 compliant for potable water applications.

.4 Manufacturers:

.1 IPEX

.2 Substitutions: Refer to Section 21 05 00.

.5 Material: Valve body, ball, end connectors and unions of PVC to ASTM D1784.

.6 Seals: O-ring seals and shutter of EPDM.

.7 Spring Material: Stainless steel

.8 Connections: socket weld or threaded, union end connection.

.9 Installable in either horizontal or vertical orientations.

.10 Valve ratings: 1600 kPa (232 psi) at 23°C (73°F).

2.18 Relief Valves

.1 Pressure Relief:

.1 Manufacturers:

.1 Watts

.2 Substitutions: Refer to Section 21 05 00.

.2 AGA Z21.22 certified, bronze body, PTFE seat, steel stem and springs, automatic, direct pressure actuated.

.2 Temperature and Pressure Relief:

.1 Manufacturers:

.1 Watts

.2 Conbraco

.3 Substitutions: Refer to Section 21 05 00

.2 AGA Z21.22 certified, bronze body, PTFE seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 98.9 degrees C (210 degrees F), capacity ASME SEC IV certified and labelled.

2.19 Strainers

.1 Construction: Size 50 mm (2 inch) and under:

.1 Manufacturers:

.1 Spirax-Sarco

.2 Substitutions: Refer to Section 21 05 00.

.2 Threaded bronze body Y pattern 2070 kPa (300 psi) CWP, Y pattern with 0.8 mm 1/32 inch stainless steel perforated screen.

.2 Construction: Size 40 mm (1-1/2 inch) to100 mm (4 inch):

.1 Manufacturers:

.1 Spirax-Sarco

.2 Substitutions: Refer to Section 21 05 00.

.2 Class 125, bronze body, Y pattern, flanged ends, with 1.6 mm (1/16 inch) stainless steel perforated screen.

Part 3 Execution

3.1 Examination

.1 Section 21 05 00: Verify existing conditions before starting work.

.2 Verify that excavations are to required grade, dry, and not over-excavated.

3.2 Preparation

.1 Ream pipe and tube ends. Remove burrs.

.2 Remove scale and dirt, on inside and outside, before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

3.3 Installation

.1 Install to manufacturer's written instructions.

.2 Install water piping to National Plumbing Code and ASME B31.9.

.3 Provide non-conducting dielectric connections wherever jointing dissimilar metals.

.4 Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

.5 Install piping to maintain headroom, conserve space, and not interfere with use of space.

.6 Group piping whenever practical at common elevations.

.7 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

.8 Hangers and support, refer to Section 23 07 19.

.1 Provide clearance in hangers, from structure and other equipment for installation of insulation and access to valves and fittings.

.2 Support all hangers from top chord of joists, spanning supports or in concrete decking for all piping. Decking clips are acceptable to 25 kg (50 lbs) loads.

.3 Roof decking clips to support up to 25 kg (50 lbs) with minimum 1 meter spacing between clips unless otherwise directed by the structural engineer. Roof decking support clip fasteners shall not penetrate the roof membrane. Storm water and waste water to be hung directly from structural members or from spanned supports between structural members only, no attachments to roof decking.

.4 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

.5 Provide support for utility meters to requirements of utility companies.

.6 Support for buried pipe under concrete structural slabs shall be hung from the slab using epoxy coated or stainless steel hangers, hardware and hanger rod secured to the rebar.

.9 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.

.10 Establish elevations of buried piping outside the building to ensure not less than 2.4 m (8 ft) of cover.

.11 Vents

.1 Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

.2 Pipe vents from gas pressure reducing valves to outdoors and terminate in weather-proof hood.

.12 Penetrations and sleeves

.1 Support Division 07 with materials and coordination to support the firestop requirements as required by Division 07.

.2 Sleeve pipes passing through partitions, walls and floors. Set sleeves in concrete forms for all pipes passing through concrete walls, beams and slabs.

.3 Install 100 mm (4 inch) concrete curbs around all pipe penetrations in mechanical rooms.

.4 Pipe sleeves to extend above floor line as follows:

.1 Unfinished areas – 25 mm (1 inches).

.2 Finished areas (copper sleeves) – 7 mm (1/4 inches).

.3 Mechanical rooms, kitchens and washrooms – 100 mm (4 inches).

.5 Caulk sleeves to provide watertight installation.

.6 Where pipes pass through floors and walls in finished areas and where exposed to view, provide Crane #10 B.C. chrome-plated, pressed steel floor plates.

.7 Install galvanized, oversize pipe sleeves on passing through walls or partitions, for building into wall construction, by other trades.

.8 Sleeves and holes for piping on cold water systems shall be large enough to accommodate pipe insulation. Insulation on piping for hot water systems may stop at walls or floors.

.9 Prior to installing sleeves in concrete beams, receive final jobsite approval by Contract Administrator

.13 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

.14 Provide support for utility meters to requirements of utility companies.

.15 Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 91 10.

.16 Install bell and spigot pipe with bell end upstream.

.17 Valves

.1 Isolation valves shall be provided as follows:

.1 At water main take-off, or connection to the building domestic water system for renovations

.2 At each fixture group.

.3 At every piece of equipment.

.4 At each floor level off a riser.

.2 Install valves with stems upright or horizontal, not inverted.

.18 Storm water piping: Install clamps across all no-hub MJ couplings on piping 125 mm (5”) and larger for all horizontal piping, including elbows at the base of vertical pipes. Refer to 23 05 29 for supports and anchors on storm water piping.

.19 Natural gas piping

.1 Installation to CSA B149.1 and local authority having jurisdiction requirements. Refer to active technical bulletins by ITSM (Inspection and Technical Services Manitoba). Installations to be done by a gas fitter licensed in the jurisdiction of work.

.2 Pressure test to CSA B139.1.

.3 Buried piping:

.1 Install buried piping with polyethylene or steel piping. Transition to steel piping before entering building or rising above ground. Plastic piping acceptable in buried applications only.

.2 Install polyethylene piping with tracer wire with both ends terminating minimum 450 mm (18") above grade. Test wiring before burial.

.4 Inspections:

.1 Buried plastic piping for cuts, scratches and gouges. Replace damaged sections.

.2 Inspect buried joints to CSA B149.

3.4 Pipe Pressure Testing

.1 Do not insulate pipe prior to pressure testing. Pressure test in sections if necessary before concealing or insulating pipe.

.2 Do not introduce water for testing where freezing conditions exist or where piping systems being tested are located above sensitive areas or equipment that may be damaged or contaminated by water leakage.

.3 Hydraulically test all pipe. Pneumatic testing not permitted without prior approval from the Contract Administrator and the Authority Having Jurisdiction.

.4 Should leaks develop in any part of the piping system, remove and replace defective sections, fittings and equipment. Pipe dope, caulking, tape, lead wool, dresser couplings, etc. shall not be used to correct deficiencies. The contractor shall be responsible for all cleanup related to leakage during flushing, testing, and chemical treatment of piping, including original building piping if included in the testing.

.5 Subject piping to a hydrostatic pressure of at least that 1-½ times the operating pressure of the system for a period of at least 12 hours. If leaks are detected, such leaks shall be repaired and the test started over. Record results and submit witnessed (by Contract Administrator or The City's representative) reports to the Contract Administrator.

.6 Register pressures at the highest system point.

.7 Provide at least 48 hours (during working days) notice to Contract Administrator prior to testing to allow the tests to be witnessed.

3.5 Application

.1 Use grooved mechanical couplings and fasteners only in accessible locations.

.2 Install unions downstream of valves and at equipment or apparatus connections.

.3 Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

.4 Valves

.1 Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

.2 Install globe or ball valves for throttling, bypass, or manual flow control services.

.3 Provide spring loaded check valves on discharge of water pumps and domestic water (clean water) systems.

.4 Provide plug valves in natural and propane gas systems for shut-off service.

.5 Provide flow controls in water recirculating systems where indicated.

.5 Plastic piping installed in combustible buildings shall have a 25/50 flame and smoke rating when installed in plenums.

.6 PVC DWV piping installed in non-combustible buildings shall comply with the restrictions in the following table.

COMBUSTIBLE PIPE APPLICATIONS SUITABILITY FOR USE				
Product	NON-COMBUSTIBLE BUILDING			
	General Usage	Air Plenum1	Vertical Services Spaces2	Underground
Combustible Pipe FSR25: (eg. IPEX System 15)	P	N3	N	P
Combustible Pipe FSR25/SDC50: (eg. IPEX XFR, CPVC)	P	P	N	P
MJ Grey Coupling	P	P	N	N

1. Restrictions for air plenums also apply to combustible buildings as well.
2. Certified firestopping devices are required whenever the system penetrates a vertical or horizontal separation, and shall be certified to CAN4-S115 and tested with a pressure differential of 50 Pa.
3. Sizes 20” and 24” are N

3.6 Erection Tolerances

.1 Section 01 73 00: Tolerances.

.2 Establish invert elevations, slopes for drainage to one percent (1/8 inch per foot) minimum, except pipe sized 75 mm (3 inches) or less shall have a slope no less than two percent (1/4 inch per foot). Maintain gradients.

.3 Slope water piping minimum 0.25 percent and arrange to drain at low points.

3.7 Service Connections

.1 Provide new sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

.2 Provide new water service complete with approved reduced pressure double check backflow preventer and water meter with by-pass valves and pressure reducing valve. Meter and valve arrangement to confirm to the requirements of the Authority Having Jurisdiction.

.1 Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

.3 Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 2 psi. Provide regulators on each line serving gravity type appliances, sized to equipment.

3.8 System Cleaning

.1 Clean interior and exterior of all systems including strainers.

.2 Maintain tidiness within work of Mechanical Sections and at completion remove protective paper, labels, etc. and tools and waste materials. Leave clean and in perfect operating condition.

.3 Remove dirt, rubbish, grease, and dust for which this section is responsible from all exposed surfaces and fixtures.

.4 Thoroughly clean piping and equipment of dirt, cuttings and other foreign substances within the scope of work area. Disconnect, clean and reconnect whenever necessary for purpose of locating and removing obstructions. Repair work damaged in course of removing obstructions.

.5 Clean exposed surfaces of mechanical equipment, piping, etc., and polish plated work.

.6 Remove tools, surplus, and waste material from the building site upon completion of work. Clean grease, dirt, and excess material from walls, floors, ceilings, surfaces, and fixtures for which this Contractor was responsible, and leave the premises suitable for immediate use.

.7 Schedule cleaning operations so that resulting dust and other contaminants will not fall on wet, newly painted surfaces, infiltrate into occupied areas, or trigger fire alarm smoke or dust detectors.

3.9 Disinfection of Domestic Water Piping System

.1 Disinfect water distribution system to Section 22 05 81.

END OF SECTION

Part 1 General

1.1 References

.1 American Society of Mechanical Engineers (ASME)

- .1 ASME A112.6.3 - Floor and Trench Drains
- .2 ASME A112.6.4 – Roof, Deck and Balcony Drains
- .3 ASME A112.26.1 - Water Hammer Arrestors.

.2 American Society of Sanitary Engineers (ASSE)

- .1 ASSE 1010 - Performance Requirements for Water Hammer Arresters
- .2 ASSE 1011 - Hose Connection Vacuum Breakers.
- .3 ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent.
- .4 ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.

.3 American Water Works Association (AWWA)

- .1 AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

.4 Canadian Standards Association

- .1 CSA B125.1/ASME A112.18.1 - Plumbing Supply Fittings
- .2 CSA B125.3 – Plumbing Fittings
- .3 CSA B125.6/ASME A112.18.6 - Flexible water connectors
- .4 CAN/CSA-B181.2 - Polyvinylchloride (PVC) and Chlorinated Polyvinylchloride (CPVC) Drain, Waste, and Vent Pipe and Pipe Fittings
- .5 CAN/CSA-B182.1 – Plastic Drain and Sewer Pipe and Pipe Fittings
- .6 CSA B79 - Commercial and Residential Drains and Cleanouts.

.5 National Safety Foundation (NSF)

- .1 NSF/ANSI 61 – Drinking Water System Components – Health Effects

.6 PDI G-101 - Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.

.7 ASME A112.14.3 – Grease Interceptors

.8 CSA B481.0, Material, design, and construction requirements for grease interceptors;

- .1 CSA B481.1, Testing and rating of grease interceptors using lard;
- .2 CSA B481.2, Testing and rating of grease interceptors using oil;
- .3 CSA B481.3, Sizing, selection, location, and installation of grease interceptors

.9 PDI WH-201 - Water Hammer Arrestors.

.10 CSA-B64-2011 Series - Backflow Preventers and Vacuum Breakers.

.1 CSA B64.1.1/ANSI/ASSE 1001– Performance requirements for Atmospheric Type Vacuum Breakers (AVB)

.2 CSA B64.10 - Selection and installation of backflow preventers/Maintenance and field testing of backflow preventers

1.2 Submittals for Review

.1 Section 21 05 00: Submission procedures.

.2 Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

.3 Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

1.3 Closeout Submittals

.1 Section 21 05 00: Submission procedures.

.2 Operation Data: Indicate frequency of treatment required for interceptors.

.3 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

.4 Record Documentation: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors, trap seal primers.

1.4 Maintenance Material Submittals

.1 Section 01 78 10: Maintenance and extra material requirements.

1.5 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

1.6 Regulatory Requirements

.1 Perform Work to the latest version of the Manitoba Plumbing Code and local Municipal requirements.

.2 All components installed in domestic water system to be lead free to NSF 61 requirements.

1.7 Delivery, Storage, and Protection

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Accept specialties on site in original factory packaging. Inspect for damage.

Part 2 Products

2.1 Flexible Pipe Connectors

.1 Manufacturers:

.1 Flextrol
.2 Flex Tech Industries
.3 Hydro-flex
.4 Substitutions: Refer to Section 21 05 00

.2 Supply and install where shown on the drawings as in details, flexible pipe connectors as manufactured by Flex Tech Industries, selected to meet operating and test pressures of systems served.

.3 Minimum 450 mm (18”) in length unless otherwise noted.

.4 Domestic Water Services

.1 Braided stainless steel outer sheathing with nylon reinforced vinyl tubing, threaded fixture connections, 861 kPa (125 psi) pressure rating, 82°C (180°F) temperature rating, NSF 61 and UPC certified

.2 Up to 50 mm (2") - bronze connectors constructed of Phosphor corrugated bronze hose and bronze single braid with brass male ends.

.3 63 mm (2½") and larger - Connectors constructed of Phosphor corrugated bronze hose and stainless steel single braid with van stone floating flanges and s.s. sleeve at all wetted areas.

2.2 Roof Drains

.1 Manufacturers:

.1 Mifab
.2 Zurn
.3 Watts.
.4 Substitutions: Refer to Section 21 05 00.

.2 Standard Roof Drains (RD-1):

.1 Assembly: AMSE A112.6.4.
.2 Body: Lacquered cast iron with sump.
.3 Strainer: Removable cast metal dome with vandal proof screws.
.4 Accessories: Coordinate with roofing type, refer to Roofing Section:
.1 Membrane flange and membrane clamp with integral gravel stop.
.2 Adjustable under deck clamp.
.3 Roof sump receiver.
.4 Waterproofing flange.
.5 Parabolic controlled flow weir, 5 gpm per inch of water head, up to 22.5 gpm.
.6 Levelling frame.
.7 Adjustable extension sleeve for roof insulation.

.8 Strainer free area of 43 square inches.

.3 Roof Overflow Drains (RD-2)

.1 Manufacturer: MIFAB.

.2 Other acceptable manufacturers offering equivalent products.

.1 Zurn

.2 Watts.

.3 Substitutions: Refer to Section 21 05 00.

.3 Lacquered cast iron body and clamp collar and bottom clamp ring; pipe extended to 150 mm (6 inches) above flood elevation.

2.3 Downspout Nozzles (DS-1)

.1 Manufacturer: Zurn Model Z199

.2 Other acceptable manufacturers offering equivalent products.

.1 Mifab

.2 Watts.

.3 Substitutions: Refer to Section 21 05 00.

.3 Construction

.1 Nickel bronze body,

.2 Wall flange

.3 Outlet nozzle,

.4 Optional threaded or no-hub inlet

2.4 Floor Drains

.1 Manufacturers:

.1 Mifab

.2 Zurn.

.3 Watts.

.4 Jay R. Smith

.5 Substitutions: Refer to Section 21 05 00.

.2 Floor Drain

.1 ASME A112.6.3,

.2 Epoxy coated cast iron two piece body with double drainage flange,

.3 Weep holes,

.4 ½" trap primer connection port,

.5 Refer to floor drain schedule below,

.6 Funnels shall be supplied in lieu of strainer as noted in schedule below,

.7 Floor without Surface Membrane

.1 Reversible clamping collar,

.2 Primary and secondary weep holes,

.3 Adjustable 5” (127mm) strainer less membrane clamp, refer to schedule for type.

.8 Floor with Surface Membrane

.1 Reversible clamping collar,

.2 Primary and secondary weep holes,

.3 Adjustable 5” (127mm) strainer with surface membrane clamp, refer to schedule for type.

Floor Drain Schedule:

Tag	Body Material	Inlet Strainer	Vandal Proof	Sediment Bucket	Trap Seal Primer
FD-1	Epoxy coated Cast Iron	Heavy Duty, Nickel Bronze	No	No	No
FD-2	Epoxy coated Cast Iron	Nickel Bronze, 4”x9” Funnel	No	No	No

Contractor shall provide the floor drain suitable for the finished floor unless otherwise noted on the drawing. Refer to architectural details and plans for membrane requirements. Floors with sheet membranes (vinyl floor, etc) shall have surface membrane clamp.

2.5 Trench Drains (TD-1)

.1 Manufacturers:

.1 Zurn Z882 (basis of design)

.2 Mifab

.3 Watts.

.4 Substitutions: Refer to Section 21 05 00.

.2 Modular channel sections shall be made of 0% water absorbent High Density Polyethylene (HDPE).

.3 Channels shall be 2438mm (96") long, 305mm (12”) wide. Assembled trench drains shall be 12192mm (40’) total length. Refer to architectural floor plans.

.4 Positive mechanical connection between channel sections that will not separate during installation and shall mechanically lock into the concrete surround every 305mm (12").

.5 Channels shall have a smooth, 76mm (3") radiused self cleaning bottom with a Manning’s coefficient of 0.009 and 1.04% or neutral 0% built in slope. Channels shall have rebar clips standard to secure trench in its final location.

.6 Provide with standard DGC grates (heavy duty ductile iron slotted grate) that lock down to frame. Grates conforming to ASTM specification A536-84. Supplied in 608mm (24") nominal lengths with 21mm (13/16") wide slots, and (38mm) 1-1/2" bearing depth. Grate has an open area of 171,027 sq. mm per meter (80.8 sq. in

per ft.) The 6mm (1/4") thick heavy-duty carbon steel frame assembly conforms to ASTM specification

.7 A36 with 102mm (10 - 4") long concrete anchors per 2438mm (96"). Grate lockdown bars are to be integral to the frame. The frame is supplied with a powder coated finish. All welds must be performed by a certified welder per ASTM standard AWS D1.1. Frames Shall be produced in the U.S.A.

2.6 Cleanout Covers

.1 Exterior Surfaced Areas:

.1 Manufacturers:

.1 Mifab

.2 Zurn.

.3 Watts.

.4 Substitutions: Refer to Section 21 05 00.

.2 Round cast nickel bronze access frame and non-skid cover.

.2 Interior Finished Floor Areas:

.1 Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

.3 Interior Finished Wall Areas:

.1 Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

.4 Interior Unfinished Accessible Areas:

.1 Caulked or threaded type.

.2 Bolted stack cleanouts on vertical rainwater leaders.

2.7 Hose Bibs (HB-#)

.1 Interior:

.1 Manufacturers:

.1 Mifab

.2 Zurn.

.3 Watts.

.4 Substitutions: Refer to Section 21 05 00.

.2 Exposed-type anti-contamination wall faucet with ¾” (19mm) male hose connection and anti-siphon vacuum breaker.

.3 Exterior finish to be brass, operating handle to be cast-iron, coloured blue or red (for cold or hot), and inlet connection shall be ½” (13mm) F.P.T.

.4 Vacuum breaker to be certified to A.S.S.E. Standard 1011 and listed by I.A.P.M.O.

2.8 Hydrants (WH-#)

.1 Wall Hydrant:

.1 Manufacturers:

.1 Watts HY-725

.2 Mifab

.3 Zurn.

.4 Substitutions: Refer to Section 21 05 00.

.2 Certified exposed type, self draining, non freeze wall hydrant

.3 With ANSI/ASSE 1019 approved anti-siphon and vandal resistant integral vacuum breaker, 3/4" (19) male hose connection.

.4 Hydrant assembly complete with neoprene plunger to control both the flow and drain functions, hardened bronze operating stem, drain port under the hexagon nut, heavy duty brass casing, 360 degree swivel inlet connection, heavy duty chrome plated bronze head casting, polished chrome plated face plate and satin finished nickel bronze box with hinged locking cover.

2.9 Washing Machine Recessed Valve Box (WM-1)

.1 Washing Machine Box - Plastic:

.1 Basis of Design: Oatey

.1 Other manufacturers:

.1 Mifab

.2 Zurn.

.3 Watts

.4 Substitutions: Refer to Section 21 05 00.

.2 Approvals: IAPMO listed: PS-54, ASSE 1010

.3 PVC enclosure for recessed wall installation and wall stud mounting suitable for left or right side mounting.

.4 Hot and cold water connections with shut off valves. Water connections to be for copper, CPVC, PEX or PE-RT as required.

.5 Brass quarter turn or single lever valve handle for hot and cold water connections, comes with temperature indicators.

.6 Single knockout for 50 mm (2 inch) waste with aligned knockout above drain for indirect connections.

.7 Options:

.1 Water hammer arrestor.

2.10 Hose Wash Ring (WR-1)

.1 National Fire Equipment Hydro-Wick Hose Washer 70FLHW30PS

.1 No Substitutions Permitted

.2 38mm (1.5 inch) NPSH Connection, cleans up to 76mm (3 inch) coupled hose

2.11 Backwater Valves

.1 PVC

.1 Manufacturers:

.1 IPEX

.2 Canplus

.3 Substitutions: Refer to Section 21 05 00.

.2 CAN/CSA-B181.2, Polyvinylchloride (PVC) and Chlorinated Polyvinylchloride (CPVC) Drain, Waste Vent Pipe and Pipe Fittings

.3 Size to match drain pipe, extension sleeve, and access cover.

2.12 Backflow Preventers (BFP)

.1 Double Check Valve Assemblies:

.1 Manufacturers:

.1 Beeco.

.2 Zurn.

.3 Watts.

.4 Substitutions: Refer to Section 21 05 00.

.2 ANSI/ASSE 1024 / CSA B64.5

.3 Bronze body with corrosion resistant internal parts and stainless steel springs,

.4 Two independently operating check valves with intermediate atmospheric vent.

.2 Atmospheric Vacuum Breaker

.1 Manufacturers:

.1 Beeco.

.2 Zurn.

.3 Watts.

.4 Substitutions: Refer to Section 21 05 00.

.2 ANSI/ASSE 1001 / CSA B64.1.1

.3 Bronze/brass body with heat and water hammer resistant tight sealing disc float.

.4 Lead free for all potable water applications.

2.13 Water Hammer Arrestors

.1 Manufacturers:

.1 Mifab

.2 Zurn.

.3 Watts.

.4 Substitutions: Refer to Section 21 05 00.

.2 ASME A112.26.1,

.1 Stainless steel construction,

.2 Bellows type sized to PDI WH-201,

.3 Pre-charged suitable for operation in temperature range -73 to 149 degrees C (-100 to 300 degrees F) and maximum 1700 kPa (250 psi) working pressure.

2.14 Potable Water Automatic Balancing Valves

.1 Manufacturers:

.1 Victaulic/IMI TA (Tour & Andersson) Series 76X

.2 Caleffi

.3 Substitutions: Refer to Section 21 05 00.

.2 Construction up to and including 19mm (3/4” inch):

.1 Lead-free construction, Certified in accordance with NSF/ANSI 61 for commercial cold and hot water service, rated to 83°C (180°F), and NSF/ANSI 372

.2 Series 300 stainless steel body, nickel plated brass union nut.

.3 One-piece body to include a handle ball valve, a flow control cartridge assembly.

.4 Dual pressure or pressure/temperature test valves for verifying accuracy of flow performance for all sizes combined with a manual air vent, and a union end.

.5 Valve shall be suitable for a flow range of 0.33 GPM/1.50 LPM to 12 GPM/45.4 LPM and flow rate pre-set accuracy variation of +/-5% over 95% of the control range

.6 Valves shall be offered with two pressure differential control ranges of 13-220 kPa (2-32 psi) or 35-414 kPa (5-60 psi) differential.

.7 Set valves serving plumbing fixtures to 0.5 gpm.

.3 Valve shall come fully assembled and be permanently marked to show direction of flow; shall have a body tag to indicate flow rate and model number.

.4 Valve internal control mechanism shall consist of a stainless steel one-piece cartridge with segmented port design and full travel linear coil spring.

.5 Manufacturer shall be able to provide certified independent laboratory tests verifying accuracy of performance.

.6 All flow control valve cartridges shall be warranted by the manufacturer for five years from date of sale

2.15 Grease Interceptor (GI-1)

.1 Manufacturer: Schier GB-50

.1 Other acceptable manufacturers offering equivalent products.

.1 Mifab

.2 Green Turtle

.3 Substitutions: Refer to Section 21 05 00.

.1 Construction:

.1 Tested and rated by CSA or IAPMO

.2 Constructed of seamless polyethylene or fiberglass. Other materials by prior approval only.

.3 Furnished for above or below grade installation as noted on drawings and schedules.

.4 Interceptor shall be certified to ASME A112.14.3 (type D) and CSA B481.2

.5 Provide with field adjustable riser system, built-in flow control, built-in test caps and three outlet options.

.6 Minimum grease removal efficiency: 90% according to CSA B481.2.

.7 3" inlet/outlets Sch. 40.Plain End (No-Hub)

.8 Flow rate: 50 gpm (3.2 l/s)

.9 Liquid capacity: 65 gal (246 l)

.10 Solids Capacity: 13 gal (49 l)

.11 Weight: 148 lbs (67 kg)

.12 Cover shall provide water/gas-tight seal and have minimum 16,000 lbs (7257 kg) load capacity.

.13

2.16 Oil And Grit Interceptor (OI-1)

.1 Manufacturer: Striem Series OS-100

.2 Other acceptable manufacturers offering equivalent products.

.1 Substitutions: Refer to Section 21 05 00.

.3 Construction:

.1 4" inlet/outlets Sch. 40.Plain End (No-Hub)

.2 Integral flow control and vent connections

.3 Max flow rate: 100 gpm (6.2 l/s)

.4 Liquid capacity: 250 gal (946 l)

.5 Max oil capacity: 144 gal (545 l)

.6 Sand capacity : 95 gal (360 l)

.7 Unit weight w/std. covers: 346 lbs (157 kg)

.8 16,000 lb (7257 kg) load rated, bolted, gas/water tight covers.

.9 Maximum operating temperature 190F (88C) continuous.

.10 Seamless molded polyethylene tank.

2.17 Hose Reel

.1 Industrial grade hose reel, spring retractable, all steel construction with baked-on powder coat finish. Based on ReelCraft Series 8000, Model D83075 OLP reel with hose, 601034-3 inlet hose, 600980 swing bracket.

.1 Hose anti latch-out feature ensures hose retracts every time.

.1 Guide arm is field adjustable for wall or ceiling mounting positions.

.2 Dual pedestal base and guide arm design are structurally reinforced.

.2 Five-in-one, heat-treated aluminium casting incorporates main shaft, ratchet, spring arbor and inlet/outlet plumbing in one-piece casting.

.3 Containerized spring assembly to provide safe and easy handling during maintenance.

.3 Two sealed ball bearings for smooth rotation of main shaft.

.4 Unit to be complete with 23m long 19mm I.D. low pressure PVC hose rated to 65 Deg.C at 1724 kPa.

.4 Wall-Mounted Swing Bracket: Provide bracket matched to hose reel that shall pivot approximately 180°. All steel construction with a durable baked on powder coat finish.

.5 Unit to be complete with 19mm flexible inlet hose assembly to connect from hose bibb to reel inlet.

.5 Unit to be complete with all required mounting accessories.

Part 3 Execution

3.1 Installation

.1 Install to manufacturer instructions.

.2 Cleanouts

.1 Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

.2 Install wall cleanouts serving urinals above the flood plane of the fixture but below the top of the fixture it serves not including the flush valve.

.3 Encase exterior cleanouts in concrete flush with grade.

.4 Install floor cleanouts at elevation to accommodate finished floor.

.3 Backflow Devices

.1 Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.

.2 All water cross connection and backflow prevention shall comply with City of Winnipeg By-Law 107 and CSA B64.10. Note that where severe hazards exist, an approved control device must be installed both on service pipe as well as on pipe at source of potential contamination.

.3 Expenses for material, installation, testing and approval of cross connection and backflow prevention shall be paid by Section 22 40 10.

.4 Provide minimum 1-1/4" (32mm) clearance between backflow preventer body and adjacent structure (wall, ceiling, etc.) and equipment. Clearance space to be sufficient to facilitate easy removal for servicing. The BFP

shall be located no higher on wall than 48" (1200mm) above the finished floor.

.5 Backflow preventers shall be sized for the maximum rated flow of the equipment it is serving.

.6 All testable backflow prevention devices shall be installed in accessible locations as defined by CSA-B64.10. If this cannot be accomplished, provide access platforms, etc. at no extra cost to The City.

.7 Install testable backflow preventers on domestic water outlets to washing machines and dishwashing equipment.

.8 Pipe relief from backflow preventer to nearest drain sized to manufacturer's requirements.

.4 Water Hammer Arrestors

.1 Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to washing machine outlets, banks of flush valve fixtures (eg. Water closets, urinals).

.2 Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 20 mm (3/4 inch) minimum, and minimum 450 mm (18 inches) long.

END OF SECTION

Part 1 General

1.1 References

.1 CSA B45.1 / ASME A112.19.2 - Ceramic plumbing fixtures

.2 CSA B45.2 / ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures

.3 CSA B45.4 / ASME A112.19.3 - Stainless Steel Plumbing Fixtures

.4 CSA B125.1 / ASME A112.18.1 - Plumbing Supply Fittings

.5 CSA B125.2 / ASME A112.18.2 – Plumbing Waste Fittings

.6 CSA B125.3 - Plumbing Fittings

.7 CSA B125.6 / ASME A112.18.6 – Flexible Water Connectors

.8 CSA B125.14 / ASME A112.4.14 - Manually operated valves for use in plumbing systems

.9 CSA B125.16/ASSE 1016/ASME A112.1016 - Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations

.10 CSA B125.70 / ASSE 1070/ASME A112.1070 - Performance requirements for water temperature limiting devices

.11 CSA B651 – Barrier-free Design.

.12 ASSE 1071 - Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment

.13 ANSI/ISEA Z358.1 - Emergency Eye Wash and Shower Equipment.

.14 NPCC 2010 – National Plumbing Code of Canada

.15 NSF

.1 NSF 61 - Drinking Water System Components – Health Effects

1.2 Submittals for Review

.1 Section 21 05 00: Submission procedures.

.2 Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

1.3 Closeout Submittals

.1 Section 21 05 00: Submission procedures.

.2 Maintenance Data: Include fixture trim exploded view and replacement parts lists.

.3 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in The City's name and registered with manufacturer.

1.4 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.5 Regulatory Requirements

.1 Products Requiring Electrical Connection: Listed and classified by CSA as suitable for the purpose specified and indicated.

1.6 Delivery, Storage, and Protection

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Accept fixtures on site in factory packaging. Inspect for damage.

.3 Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

Part 2 Products

2.1 Water Closets – Flush Valve – Floor-Mounted

.1 WC-1:

.1 Manufacturer: American Standard Madera FlowWise Model 6461.001
- .1 No substitutions.

.2 ASME A112.19.2 / CSA B45.1:
- .1 Floor mounted, vitreous china bowl, with elongated rim, 419 mm (16.5") height
- .2 4.84 lpf (1.28 gpf)
- .3 (1-1/2 inch) 38 mm top spud,
- .4 Bolt caps,
- .5 Colour: white
- .6 One year limited warranty

.2 Exposed Sensor Operated Flush Valve (Battery) – Non-Barrier Free:

.1 Manufacturer: American Standard Selectronic Sensor Operated Flush Valve Model 6066.121.002
- .1 No substitutions

.2 Watersense Listed

.3 ASME A112.19.2 / CSA B45.1:

.1 Exposed chrome plated, electronic infrared sensor flush valve
.2 Chloramine resistant diaphragm with forged brass diaphragm retainer and renewable seat.
.3 Distance measurement based on bowl length for activation setting. Field adjustable.
.4 Four AA batteries, factory-installed, low battery indicator, 10-year battery (4000 flushes per month) warranty
.5 Integral screwdriver stop and vacuum breaker,
.6 Metal non hold open over-ride button,
.7 Pressure loss check angle stop with cap,
.8 Valve outlet tube 292 mm (11-1/2 inches) height
.9 Factory set to 4.8lpf (1.28 gal) flush volume.

.3 Seat:

.1 Manufacturer: Bemis Commercial Heavy Duty Plastic Self Sustaining Toilet Seat, Elongated, Model 1055SSC.
.1 No substitutions

.4 Back Rest:

.1 Manufacturer: Franke CM-16104.
.1 Other acceptable manufacturers offering equivalent products.
.2 Substitutions: Refer to Section 21 05 00.
.2 Stainless steel bar uses #4 gloss with flanges and covers.
.3 Antique white solid core plastic laminate 10”x4” panel back.
.4 Concealed snap flanges and mounting hardware included.
.5 Provide adequate backing in wall for support and comply to local codes for barrier free requirements.

2.2 Lavatories:

.1 LAV-1: Stainless Steel Drop-In Countertop Basin:

.1 Manufacturer: Franke Model V1619/6/1
.1 No substitutions
.2 Construction: CSA B45.1 (ASME A112.19.3):
.1 Construction: 18-10 Stainless steel, type 304, 18 gauge,
.2 Self-rimming and positive hold-down clamping,
.3 Mirror-finished rim, satin-finished bowl, undercoated.
.4 32 mm (1-1/4”) waste fitting.
.5 Overall: 416 x 470 mm (16.5 x 18.5 inches)
.6 Basin: 279 x 386 x 152 mm (11 x 15.25 x 6 inches)
.7 One faucet hole, 38 mm (1.5” inch) diameter
.8 Seal of putty, caulking, or concealed vinyl gasket.

.2 LAV-2: Vitreous China Wall Hung Basin:

.1 Manufacturer: American Standard Decorum Wall Hung Lavatory Model 9024.001EC
.1 No substitutions.
.2 ASME A112.19.2 / CSA B45.1:
.1 Vitreous china wall hung lavatory,
.2 Rectangular basin and splash lip,
.3 Overall: 508 x 464 mm (20 x 18-1/4 inch)
.4 Basin Depth: 127 mm (5 inch)
.5 One faucet hole, center
.6 Integral rear overflow
.7 Colour: white
.3 ADA / CSA B651:
.1 Barrier-free compliant.

.1 Lavatory Faucet - Electronic:

.1 Manufacturer: Delta Hands Free 591T1220
.1 No substitutions
.2 Watersense Listed
.3 CSA B125.1/ASME A112.18.1;
.1 Cast brass, chrome plated one piece body with integral waterproof sensor and connector and metal hold down.
.1 Outlet 100 mm (4”) above floor rim level
.2 Outlet: 1.9L/min (0.5 gpm) vandal resistant, aerated
.3 CSA B651 accessibility compliant
.2 Serviceable filter upstream of the solenoid valve
.3 Adjustable sensing range of 75 to 380 mm (3” to 15”) and timeout of 15 to 75 seconds.
.4 Hard Wire electronic sensor with transformers and converters as required for conversion from 120V power.
.5 Solenoid and controller in plastic surface mount housing
.6 NSF 61 Lead Free compliant
.7 5-year limited warranty
.4 Trim:
.1 Mixing valve, Delta R3070-MIXLF
.2 Open grid strainer, chrome finish

.2 Lavatory Pipe Insulation:

.1 Manufacturer: TrueBro Lav Guard 2 E-Z
.2 Other acceptable manufacturers offering equivalent products.
.1 Substitutions: Refer to Section 21 05 00.
.3 Material:
.1 Molded vinyl Nominal Wall 3 mm (1/8") constant
.2 UV Protection

.3 Trimming (E-Z Series) "Internal, E-Z Tear-To-Fit trim feature"

.4 Fasteners (E-Z Series) Internal E-Z Grip fasteners (reusable)

.5 Color - China white, Paintable

.6 Burning Characteristics ASTM D-635

.7 "ASTM G21 and G22 - Bacteria/Fungus Resistance

2.3 Sinks:

.1 SK-1: Single Compartment, Undermount, Stainless Steel

.1 Manufacturer: Franke CUX11021-ADA-CA

.1 Substitutions: Refer to Section 21 05 00.

.2 ASME A112.19.3:

.1 18-8 stainless steel sink, 18 gauge, satin finished bowl,

.2 Type 304 stainless steel,

.3 Basin: 540 x 410 x 127 mm (21.25 x 16.125 x 5 inches) L x W x D

.4 89mm (3-1/2”) basket strainer waste filling and installation kit

.2 Trim:

.1 Manufacturer: Delta Model 1959LF.

.1 Substitutions: Refer to Section 21 05 00.

.2 ASME A112.18.1:

.1 Single-control brass deckmount faucet,

.2 One hole installation

.3 Cast brass body, tubular swing spout with 120 degree rotation, 150 mm width, 293 mm total height, spout 185 mm above counter

.4 5.7 l/m (1.5 gpm) aerator

.5 Finish, chrome

.3 NSF 61 Lead Free compliant

.3 Accessories:

.1 Chrome plated 1.3 mm (17 gauge) brass P-trap with clean-out plug and arm with escutcheon,

.2 Angle valve screwdriver stop,

.3 Chrome-plated copper supplies.

.4 SK-2: Sink Integrated in Stainless Steel Counter, Two Compartment

.1 Sink provided by Division 05

.2 Trim provided by Division 22:

.1 Manufacturer: Krowne 12-812L, or equivalent.

.2 ASME A112.18.1:

.1 2-hole 203 mm (8") deckmount mixing faucet with polished chrome plated brass body

.2 Add-on faucet with compression cartridge and lever handle (1/4 turn with spring checks), 305 mm (12” tubular swing nozzle with 3.8 l/min (1.8 gpm) VR aerator, 180° rotation

.3 NSF 61 Lead Free compliant

.5 Accessories:

.1 Chrome plated 1.3 mm (17 gauge) brass P-trap with clean-out plug and arm with escutcheon,

.2 Angle valve screwdriver stop,

.3 Chrome-plated copper supplies.

.6 SK-3: Sink Integrated in Stainless Steel Counter, Two Compartment

.1 Sink provided by Division 05

.2 Trim provided by Division 22:

.1 Manufacturer: T&S Model B-0123-12V15-B.

.1 No substitutions

.2 ASME A112.18.1:

.1 2-hole 203 mm (8") deckmount mixing faucet with polished chrome plated brass body

.2 Add-on faucet with compression cartridge and lever handle (1/4 turn with spring checks), 305 mm (12”_tubular swing nozzle with 5/7 l/min (1.5 gpm) VR aerator, 180° rotation

.3 610 mm (24”) riser, 1118 mm (44”) flexible stainless steel hose with heat resistant handle, 1.15 gpm spray valve, compression cartridges with spring checks, lever handles (1/4 turn with spring check), 13 mm (½”) NPT female inlets, 152 mm (6”) adjustable wall bracket, spray valve holder and overhead spring

.3 NSF 61 Lead Free compliant

.7 Accessories:

.1 Chrome plated 1.3 mm (17 gauge) brass P-trap with clean-out plug and arm with escutcheon,

.2 Angle valve screwdriver stop,

.3 Chrome-plated copper supplies.

.8 SK-4: Sink Integrated in Stainless Steel Counter, Single Compartment

.1 Sink provided by Division 05

.2 Trim provided by Division 22:

.1 Manufacturer: Delta Trinsic 9159-DST

.1 Substitutions: Refer to Section 21 05 00.

.2 ASME A112.18.1:

Single hole deckmount faucet with pull down sprayer, single handle flow/temperature control, polished chrome plated brass body

.1 Tubular swing spout with 360 degree rotation, 241 mm width, 399 mm total height, spout 214 mm above counter

.3 6.8 l/m (1.8 gpm) aerator

.4 NSF 61 Lead Free compliant

.9 Accessories:

.1 Chrome plated 1.3 mm (17 gauge) brass P-trap with clean-out plug and arm with escutcheon,

.2 Angle valve screwdriver stop,

.3 Chrome-plated copper supplies.

.10 SK-5: Single Compartment, Top-mount Utility Sink, Stainless Steel

.1 Manufacturer: Kohler Ballard Model K-5798-3

.1 Substitutions: Refer to Section 21 05 00.

.2 ASME A112.19.3:

.1 18-8 stainless steel sink, 18 gauge, satin finished bowl,

.2 Three faucet holes

.3 Type 304 stainless steel,

.4 Basin: 540 x 400 x 287 mm (21.25 x 15.75 x 11.25 inches)

.5 89mm (3-1/2”) basket strainer waste filling and installation kit

.11 Trim:

.1 Manufacturer: Delta Model 27C1234-S7

.1 Substitutions: Refer to Section 21 05 00.

.2 ASME A112.18.1:

.1 Two-handle, deck mount faucet, with hose and sprayer

.2 Four hole installation (install sprayer in counter next to sink)

.3 Cast brass body with 279 mm (11”) tubular swing spout, aerator outlet 5.7 l/min (1.5 gpm).

.4 102 mm (4”) blade handles

.5 Comes with deck mount sprayer and hose

.6 Colour: polished chrome

.3 NSF 61 Lead Free compliant

.12 Accessories:

.1 Chrome plated 1.3 mm (17 gauge) brass P-trap with clean-out plug and arm with escutcheon,

.2 Angle valve screwdriver stop,

.3 Chrome-plated copper supplies.

2.4 Bathtubs and Showers:

.1 SH-1: Standard Shower

.1 Manufacturer: MAAX Camelia SH-4834, Model 105919-S-000-001

.1 No Substitutions

.2 2-piece acrylic shower unit with centre drain, no seat
.3 Colour: white
.4 Size: 1219 x 876 x 2007 mm (48 x 34.5 x 79 inches)
.5 Shower Trim:
.1 ASME A112.18.1 / CSA-B125.1 / ASSE 1016
.1 Shower Head:
.1 Manufacturer: Kohler Model K-10282-AK-CP
.1 No substitutions
.2 Watersense Listed
.3 Single-function showerhead with 66-nozzel 140 mm (5.5”) diameter sprayface, wall mount
.4 Polished chrome finish
.5 ½” NPT connection
.6 9.5 l/min (2.5 gpm) maximum
.2 Faucet and Valve Controls:
.1 Manufacturer: Kohler Model K-TS10276-4-CP and K-8304-K
.1 No substitutions
.2 Single lever handle with faceplate
.3 Pressure-balanced shower valve,
.4 Pressure Balancing Cartridge with integral spool and sleeve assembly;
.5 Adjustable hot water limit stop.
.6 Cartridge shall contain all the movable parts and shall be accessible from the front of the unit.
.7 The escutcheon will have a hot and cold coded index.
.8 Polished chrome finish
.3 Drain:
.1 Manufacturer: Kohler K-9132-CP
.1 No substitutions
.2 Round, perforated strainer drain
.3 111 mm (4-3/8”) diameter, for use with 50 mm (2”) drain pipe
.4 Solid brass construction
.5 Polished chrome finish
.4 Provide with curtain rod, curtain hangers, and shower curtain

2.5 Service Sinks:

.1 MS-1 Mop Sink:

.1 Manufacturer: Fiat Product MSB-2424
.1 No substitutions.

.2 Dimensions: 610 x 610 x 254 mm (24 x 24 x 10 inch)

.3 Molded stone mop service basin

.2 MS-2:

.1 Custom fabricated mop sink provided by Division 03 and Division 05. Refer to architectural detail 6/A510.

.3 Trim:

.1 Faucet:

.1 Manufacturer: Fiat 830-AA service faucet

.1 No substitutions

.2 Chrome plated with vacuum breaker, integral stops, adjustable wall brace, pail hood, and 19 mm (3/4") hose thread on spout

.2 Hose and Bracket:

.1 Manufacturer: Fiat 832-AA service faucet

.1 No substitutions

.3 Drain:

.1 Stainless steel with dome strainer and lint basket

.2 For connection to 3" drain pipe

2.6 Emergency Eye-Wash / Shower Combined Station:

.1 Manufacturer: Guardian Equipment G1902P and G1902P-SSH.

.2 Other acceptable manufacturers offering equivalent products.

.1 Haws.

.2 Bradley.

.3 Substitutions: Not permitted.

.3 ANSI Z358.1:

.1 Combination eye wash/shower safety station with ABS plastic shower head, ABS plastic bowl, powder coated cast aluminum flag handle and floor flange,

.2 32 mm (1 ¼") IPS Schedule 40 galvanized pipe and fittings, 25 mm (1") IPS and 13 mm (½") IPS U.S. made chrome plated brass stay open ball valves, and polished stainless steel pull rod.

.3 Unit shall have two polypropylene 'GS Plus' spray heads with integral "flip-top" dust covers, filters, and 6.8 l/min (1.8 pgm) flow control orifices mounted on a chrome plated brass eyewash assembly.

.4 Unit shall include ANSI compliant sign.

.4 Eye-Wash / Shower Combined Station Thermostatic Mixing Valve:

.1 Manufacturer: Guardian Model G3807.

.1 Substitutions: Refer to Section 21 05 00.

.2 ANSI Z358.1, ASSE 1071:

.1 Valve has flow rate of 11 to 200 l/min (3 to 53 gallons per minute (GPM).

.2 Valve has bimetallic thermostat that is preset at 29°C (85°F). High temperature limit stop is set to 32°C (90°F).

.3 Valve has thermometer on outlet to monitor delivered water temperature.

.4 Fail Safe: In event of loss of hot water supply, internal bypass allows valve to deliver cold water to safety units. In event of loss of cold water, valve will close and not deliver water.

.5 Mounting: Unit is mounted in 18 gauge Type 304 stainless steel recessed housing. Cabinet has hinged door with lock.

.6 Inlets: 25 mm (1") NPT female inlets with integral checkstops and strainers. Union connections permit valve to be installed with supplies from top or rear. Minimum supply pressure required is 40 PSI. Outlet: 32 mm (1 1/4") NPT female outlet.

Part 3 Execution

3.1 Examination

.1 Verify that walls and floor finishes are prepared and ready for installation of fixtures.

.2 Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 Preparation

.1 Rough-in fixture piping connections to minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 Installation

.1 Install to manufacturer's instructions.

.2 Install each fixture with trap, easily removable for servicing and cleaning.

.3 Provide chrome plated rigid supplies to fixtures with screwdriver stops, reducers, and escutcheons. Install all exposed piping and valves neatly and close to the wall. Supplies should be run as plumb as possible.

.4 Install components level and plumb.

.5 All mixing valves serving multiple fixtures shall be installed in recessed cabinets.

.6 Sanitary pipe serving lavatories shall run fully concealed within plumbing chase and only penetrate wall directly inline with each basin. No lateral offset will be permitted. There shall be one penetration per basin. All exposed sanitary pipe shall be chrome plated complete with echeloned plates at wall. Echeloned plate shall be secured to wall with silicone.

.7 Install lavatory mixing valves neatly and out of site under millwork unless specified as installed in recessed cabinet. Secure with proper fasteners – galvanized strapping is not acceptable. Where provided on the drawings, refer to mixing valve installation details.

.8 The temperature of water discharging into a shower shall be set and tested by the contractor to not exceed 49°C (120°F).

.9 Install and secure fixtures in place with wall supports or wall carriers (as specified in Part 2 Products) and bolt, washer, nut fasteners.

.10 Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 92 00, colour to match fixture.

.11 Seal sinks and lavatories to the millwork. Install gasket where supplied or recommended by sink or lavatory manufacturer.

.12 Solidly attach water closets to floor with lag screws.

.13 Emergency shower / eye-wash stations should be installed so that shower head is at least 82" above floor and 32" from wall or nearest obstruction.

.14 Thermally insulate and jacket all exposed drain pipe extensions, traps, and trap arms below barrier-free wall-hung lavatories.

3.4 Interface With Other Products

.1 Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 Adjusting

.1 Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

.2 Adjust stops or valves to comply with specified flow rates.

.3 Adjust sensor ranges to allow consistent operation of fixtures.

3.6 Cleaning

.1 Section 01 74 00: Cleaning installed work.

.2 Clean plumbing fixtures and equipment.

END OF SECTION

Part 1 General

1.1 References

.1 ASHRAE 90A - Energy Conservation in New Building Design.

.2 ASME Section 8D - Boilers and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.

.3 CSA

- .1 CSA B51 - Boiler, Pressure Vessel, and Pressure Piping Code.
- .2 CSA B64 Series Definitions, General Requirements, and Test Methods for Vacuum Breakers and Backflow Preventers
- .3 CAN/CSA B125.1/ASME A112.18.1 - Plumbing Supply Fittings
- .4 CAN/CSA-B125.2/ASME A112.18.2 - Plumbing Waste Fittings
- .5 CSA B149.1 – Natural Gas and Propane Installation Code
- .6 CSA C22.2 – General requirements - Canadian Electrical Code, Part II (Electrical Safety Standards)
- .7 CAN/CSA-C191 - Performance of Electric Storage Tank Water Heaters for Domestic Hot Water Service.
- .8 CSA/ANSI Z21.10.1:19/CSA 4.1 - Gas water heaters, volume I, storage water heaters with input ratings of 75,000 Btu per hour or less
- .9 CSA 4.3/ANSI Z21.10.3 - Gas water heaters - Volume III, Storage water heaters with input ratings above 75,000 Btu per hour, circulating and instantaneous

.4 UL

- .1 UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters.

.5 NSF

- .1 NSF/ANSI 42 - Drinking Water Treatment Units – Aesthetic Effects
- .2 NSF/ANSI 61 - Drinking Water System Components – Health Effects
- .3 NSF/ANSI 372 - Drinking Water System Components - Lead Content

.6 Canadian Energy Efficiency Regulations

1.2 Submittals for Review

.1 Section 21 05 00: Submission procedures.

.2 Product Data:

- .1 Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
- .2 Indicate pump type, capacity, power requirements.
- .3 Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

.4 Provide electrical characteristics and connection requirements.

.3 Shop Drawings:

.1 Indicate heat exchanger dimensions, size of tappings, and performance data.

.2 Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

1.3 Closeout Submittals

.1 Section 21 05 00: Submission procedures.

.2 Record Documentation: Record actual locations of components and electrical power supply.

.3 Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

.4 Test Results: Provide water hardness results for pre- and post-softened water.

.5 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in The City's name and registered with manufacturer.

1.4 Maintenance Material Submittals

.1 Section 01 78 10: Maintenance and extra material requirements.

.2 Extra Stock Materials: Provide two spare pump seals for each pump.

1.5 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years experience.

.2 Provide pumps with manufacturer's name, model number, and rating/capacity identified.

.3 Ensure products and installation of specified products are to recommendations and requirements of the following organizations:

.1 Canadian Gas Association (CGA).

.2 National Sanitation Foundation (NSF).

.3 American Society of Mechanical Engineers (ASME).

.4 International Association of Plumbing and Mechanical Officials (IAPMO)

.5 National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).

.6 National Electrical Manufacturers' Association (NEMA).

.7 Underwriters Laboratories (UL).

.4 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

.5 AHRI certification:

.1 Residential gas fired water heaters to National Uniform Energy Factor regulations and first hour rating output.

1.6 Regulatory Requirements

.1 Conform to the Canadian Energy Efficiency Regulations for regulated products.

.2 Conform to CGA / AGS requirements for water heaters.

.3 Conform to ASME Section 8D for manufacture of pressure vessels for heat exchangers.

.4 Conform to ASME Section 8D for tanks.

.5 Certification markings to indicate compliance with Canadian codes and standards.

.6 Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

.7 All wetted surfaces to comply with NSF requirements for low lead content.

1.7 Delivery, Storage, And Protection

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.8 Warranty

.1 Section 21 05 00: Warranties.

.2 Provide a five (5) year warranty to include coverage for failure to meet specified requirements, for domestic water heaters, water storage tanks, and packaged water heating systems.

Part 2 Products

2.1 Commercial Electric Water Heaters (DWH-#)

.1 Manufacturers:

.1 A.O. Smith.
.2 Rheem/Ruud.
.3 Bradford White.
.4 Aerco.
.5 Substitutions: Refer to Section 21 05 00.

.2 Type: Factory-assembled and wired, electric, vertical storage.

.3 Performance - refer to schedules.

.4 Tank:

.1 Glass lined welded steel,
.2 100 mm (4 inch) diameter inspection port,
.3 Thermally insulated with minimum insulating value of RSI-2.2 (R-12.5), encased in corrosion-resistant steel jacket.
.4 Baked-on high-temperature porcelain enamel finish.
.5 Working pressure rating of 150 psi.

.5 Controls:

.1 Automatic immersion water thermostat,
.2 Externally adjustable temperature range from 16 to 82°C (60 to 180°F),
.3 Flanged or screw-in nichrome elements,
.4 Integral, manual reset, high temperature limit thermostat.

.6 Accessories:

.1 Brass water connections and dip tube,
.2 Drain valve,
.3 Magnesium anode, rigidly supported,
.4 CSA certified and ASME rated temperature and pressure relief valve.

2.2 Indirect Hot Water Heaters / Storage Tanks (ST-1)

.1 Manufacturers:

.1 Thermo 2000
.2 Bradford White
.3 Substitutions: Refer to Section 21 05 00.

.2 Performance: Refer to Schedules.

.3 Heat Exchanger:

.1 Double-wall copper piping in the form of parallel helicoidal lines having a maximum operating pressure of 1034 kPa (150 psi).
.2 All copper components and assembly will meet the low lead requirements for potable plumbing products and NSF 61.

.4 Tank:

.1 High-density carbon steel.
.2 Joints arc-welded using the MIG/Argon method
.3 Maximum allowable working pressure of 1034 kPa (150 psi). , hydrostatically tested at 2068 (300 psi).
.4 Insulation shall be 50 mm (2'') HFC-free polyurethane insulation limiting heat loss to (1/4 °C) (½ °F) per hour.
.5 Outer steel jacket surface coated with baked powder-based paint

.5 Accessories:

.1 ASME rated pressure relief valve set at 207 kPa (30 psi) protecting the tank

.2 13mm (½") automatic air vent with a shut-off valve for easy replacement.

.3 2 ½'' diameter temperature and pressure indicator on the front

.4 ¾'' drain (ball) valve made of brass, which have a maximum working pressure of 150 psi

.5 Adjustable legs for leveling

2.3 Potable Water Expansion Tanks – Diaphragm Type (ET-3)

.1 Manufacturers:

.1 ITT/B & G.

.2 Taco.

.3 Armstrong.

.4 Armtrol

.5 Calefactio

.6 Substitutions: Refer to Section 21 05 00.

.2 Construction: Welded steel, tested and stamped to Section 8D of ASME Code; supplied with National Board Form U-1, rated for working pressure of 860 kPa (125 psig), with flexible butyl diaphragm sealed into tank, and steel legs or saddles.

.1 Construction: Welded steel, with flexible butyl diaphragm sealed into tank

.2 Factory pre-charged to 55 psi.

.3 Accessories: Pressure gauge and air-charging fitting, tank drain;

.4 Performance:

.1 Refer to schedules.

Potable Water Expansion Tanks – Bladder Type

2.4 Inline Circulator Pumps

.1 Manufacturers:

.1 ITT / B & G.

.2 Taco.

.3 Armstrong.

.4 Substitutions: Refer to Section 21 05 00.

.2 Casing: Bronze, rated for 860 kPa (125 psig) working pressure, with stainless steel rotor assembly.

.3 Impeller: PPE Resin

.4 Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings or Ceramic.

.5 Seal: Carbon rotating against a stationary ceramic seat.

.6 Drive: Flexible coupling.

.7 Accessories:

.1 Automatic Timer Kit
.1 Modes: On/off/Intervals.
.2 Check Valve
.3 Three Speed

.8 Performance:

.1 Refer to schedule.

2.5 Submersible Sump Pumps

.1 Manufacturers:

.1 Little Giant EC Series.
.2 Liberty
.3 ITT / Goulds.
.4 Barnes.
.5 Substitutions: Refer to Section 21 05 00.

.2 Type: Completely submersible, vertical, centrifugal.

.3 Motor: thermal overload protected, stainless-steel heat-treated shaft, continuous duty il-free motor, permanently lubricated lip seal.

.4 Casing: Cast iron pump body.

.5 Impeller: Glass-reinforced thermoplastic, stainless-steel heat-treated shaft.

.6 Solids handling capability: 1/2”.

.7 Bearings: Ball bearings.

.8 Performance:

.1 Refer to schedules.

.9 Sump Pit:

.1 Fibreglass basin with perforated steel cover plate
.2 762 mm (30 inches) diameter, 1219 mm (48 inches) deep.

.10 Duplex Sump Controller:

.1 Basis of Design: Zoeller 10 series
.2 cUL listed
.3 Hand-Off-Auto Toggle Switch for each pump

.4 Green pump run pilot light for each pump

.5 Alarms:

.1 Alarm test and silence switches

.2 Audible alarm with 83 to 85 decibel rating for high water condition

.3 High Water Alarm

.4 Integral auxiliary terminal board connections (dry contact) for remote alarm monitoring

.6 Single phase - Circuit breaker for each pump. Refer to schedule.

.7 Magnetic starter for each pump

.8 Alternating mechanism

.9 Numbered terminal strip for connecting pumps and variable level float switches

.11 NEMA 1 - general purpose, indoor

.1 Red pilot light

.12 4 level float switch control operation:

.1 Float 1: low level – shut off both pumps

.2 Float 2: high level – duty pump on

.3 Float 3: high-high level – standby pump on

.4 Float 4: critical level alarm

.5 Floats: corrosion resistant, non-mercury float switch or vertical rod with non-submersible switch.

.13 Sequence:

.1 Duty pump operates on high water level, stops on low water level.

.2 Standby pump operates on high-high water level with both pumps operating.

.3 Alternator changes designation of duty and standby pumps.

.4 Alarm sounds on actuation of float 4.

Part 3 Execution

3.1 Installation

.1 Install water heaters to manufacturer's instructions and to local regulations and requirements.

.2 Coordinate with plumbing piping and related fuel piping, gas venting, and electrical work to achieve operating system.

.3 Domestic Hot Water Storage Tanks:

.1 Provide painted steel frame support, independent of building structural framing members.

.2 Clean and flush after installation. Seal until pipe connections are made.

.4 Pumps:

.1 Ensure shaft length allows sump pumps to be located minimum 600 mm (24 inches) below lowest invert into sump pit and minimum 150 mm (6 inches) clearance from bottom of sump pit.

.2 Provide air cock and drain connection on horizontal pump casings.

.3 Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.

.4 Decrease from line size with long radius reducing elbows or reducers.

.5 Support piping adjacent to pump such that no weight is carried on pump casings.

.6 Provide supports under elbows on pump suction and discharge line sizes 100 mm (4 inches) and over.

.7 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

.8 Align and verify alignment of base mounted pumps prior to start-up.

.9 Oil sensing probes to be tested for proof of activation during installation.

END OF SECTION

Part 1 General

1.1 References

.1 MIL-E-17814E - Expansion Joints, Pipe, Slip-Type, Packed.

1.2 Performance Requirements

.1 Provide structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

.2 Expansion Calculations:

.1 Installation Temperature (hot water heating, domestic hot water, steam, condensate): 10 degrees C (50 degrees F).

.2 Operational Temperatures

.1 Hot Water Heating: 99 degrees C (210 degrees F).

.2 Domestic Hot Water: 60 degrees C (140 degrees F).

.3 Safety Factor: 30 percent.

1.3 Project Record Documents

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.4 Operation and Maintenance Data

.1 Section 21 05 00: Submittals for project closeout.

.2 Maintenance Data: Include adjustment instructions.

1.5 Qualifications

.1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.6 Delivery, Storage, and Handling

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

.3 Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.

□

1.7 Warranty

.1 Warranty: Include coverage for leak free performance of packed expansion joints.

Part 2 Products

2.1 Flexible Pipe Connectors

.1 Steel Piping:

.1 Manufacturers:

.1 HYSPAN.

.2 Substitutions: Refer to Section 21 05 00

.2 Inner Hose: Stainless Steel.

.3 Exterior Sleeve: Double braided stainless steel.

.4 Pressure Rating: 1380 kPa (200 psi) WOG and 121 degrees C (250 degrees F).

.5 Joint: As specified for pipe joints.

.6 Size: Use pipe sized units.

.7 Maximum offset: 20 mm (3/4 inch) on each side of installed centre line.

.2 Copper Piping – domestic water services up to and including 50 mm (2”):

.1 Manufacturers:

.1 Hydro Flex Inc.

.2 HYSPAN.

.3 Substitutions: Refer to Section 21 05 00.

.2 Inner Hose: Bronze

.3 Exterior Sleeve: Single braided bronze.

.4 Pressure Rating: 1380 kPa (200 psi) WOG and 121 degrees C (250 degrees F).

.5 Joint: As specified for pipe joints.

.6 Size: Use pipe sized units

.7 Maximum offset: 20 mm (3/4 inch) on each side of installed centre line.

.3 Copper Piping – domestic water services over 50 mm (2”):

.1 Manufacturers:

.1 Hydro Flex Inc.

.2 Substitutions: Refer to Section 21 05 00.

.2 Inner Hose: Bronze

.3 Exterior Sleeve: Single braided stainless steel with Van Stone floating flanges and stainless steel sleeve at all wetted areas.

.4 Pressure Rating: 1380 kPa (200 psi) WOG and 121 degrees C (250 degrees F).

.5 Joint: flanged.

□

.6 Size: Use pipe sized units

.7 Maximum offset: 20 mm (3/4 inch) on each side of installed centre line.

2.2 Expansion Joints

.1 Stainless Steel Bellows Type:

.1 Manufacturers:

.1 HYSPAN Model 8503

.2 Flextronics.

.3 Substitutions: Refer to Section 21 05 00.

.2 Pressure Rating: 1380 kPa (200 psi) WOG and 121 degrees C (250 degrees F).

.3 Maximum Compression: 45 mm (1-3/4 inch).

.4 Maximum Extension: 6 mm (1/4 inch).

.5 Joint: As specified for pipe joints.

.6 Size: Use pipe sized units.

.7 Application: Steel piping 75 mm (3 inch) and under.

.2 External Ring Controlled Stainless Steel Bellows Type:

.1 Manufacturers:

.1 HYSPAN Model 3500 series.

.2 Flextronics.

.3 Substitutions: Refer to Section 21 05 00.

.2 Pressure Rating: 1380 kPa (200 psi) WOG and 121 degrees C (250 degrees F).

.3 Maximum Compression: 24 mm (15/16 inch).

.4 Maximum Extension: 8 mm (5/16 inch).

.5 Maximum Offset: 3 mm (1/8 inch).

.6 Joint: Flanged.

.7 Size: Use pipe sized units.

.8 Accessories: Internal flow liner. Externally guided.

.9 Application: Steel piping over 75 mm (3 inch).

2.3 Accessories

.1 Pipe Alignment Guides:

.1 Manufacturers:

.1 Anvil.

.2 HYSPAN.

.3 Substitutions: Refer to Section 21 05 00.

.2 Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 25 mm (1 inch) thick insulation, minimum 75 mm (3 inch) travel.

□

Part 3 Execution

3.1 Installation

.1 Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required and where indicated on the drawings.

.2 If not otherwise indicated on the drawings 1200 mm x 1200 mm (4' x 4') expansion loops shall be installed on all copper hot water heating piping having a straight run in excess of 12 m (40'). The expansion loop shall be centred in the straight run, with alignment guides on each side of the loop and anchors at the extreme ends of the pipe run. Similar loops shall be installed on straight runs of steel steam, condensate and hot water piping which exceeds 18 m (60') in length.

.3 Follow Manufacturer's written instructions in regard to proper length, anchoring and guiding, pre-compression, removal of spacers, and testing.

.4 When expansion joints are installed at ambient temperatures higher than minimum system operating temperature, they shall be pre-compressed prior to installation, to allow for eventual contraction of piping.

.5 Construct spool pieces to exact size of flexible connection for future insertion.

.6 Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.

.7 Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

.8 Rigidly anchor pipe to building structure where necessary. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

.9 Provide Victaulic piping with minimum one joint per 25 mm (1 inch) pipe diameter instead of flexible connector supported by vibration isolation. Victaulic piping need not be anchored.

END OF SECTION

□

Part 1 General

1.1 References

.1 ASME B40.100 - Pressure Gauges and Gauge Attachments.

.2 ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.

.3 ASME B40.100 - Pressure Gauges and Gauge Attachments

.4 ASME B40.200 - Thermometers, Direct Reading and Remote Reading

.5 ASTM E1 - Specification for ASTM Thermometers.

.6 ASTM E77 - Inspection and Verification of Thermometers.

.7 ASTM E2251- Standard Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids

.8 AWWA C700 - Cold Water Meters - Displacement Type, Bronze Main Case.

.9 AWWA C701 - Cold Water Meters - Turbine Type, for Customer Service.

.10 AWWA C702 - Cold Water Meters - Compound Type.

.11 AWWA C706 - Direct-Reading, Remote Registration System for Cold-Water Meters.

.12 AWWA C707 - Encoder-Type Remote-Registration Systems for Cold-Water Meters

.13 AWWA M6 - Water Meters - Selection, Installation, Testing, and Maintenance.

.14 ISA RP 3.2 - Flange Mounted Sharp Edged Orifice Plates for Flow Measurement.

.15 UL 393 - Indicating Pressure Gauges for Fire-Protection Services.

.16 UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service.

1.2 Submittals For Review

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide list which indicates use, operating range, total range and location for manufactured components.

1.3 Submittals At Project Closeout

.1 Section 21 05 00: Submittals for project closeout.

□

.2 Project Record Documents: Record actual locations of components and instrumentation.

1.4 Environmental Requirements

.1 Section 21 05 00: Environmental conditions affecting products on site.

.2 Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.5 Extra Materials

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide two bottles of red gauge oil for static pressure gauges.

Part 2 Products

2.1 Pressure Gauges

.1 Manufacturers:

.1 Winters.
.2 Trerice.
.3 Ashcroft.
.4 Substitutions: Refer to Section 21 05 00.

.2 Compliance: ASME B40.100

.3 Gauge: stainless steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

.1 Case: Steel with bronze or brass bourdon tube.
.2 Gauges shall be dry – no glycerine or silicone fill.
.3 Size: nominal 100 mm (4 inch) diameter dial - gauges located up to 3000 mm (10'-0") above finished floor.
.4 Size: nominal 150 mm (6 inch) diameter dial - gauges located above 3000 mm (10'-0") above finished floor.
.5 Range: gauges shall be selected based on the application to show twice the normal operating pressure with indicating needle at 12 o'clock position for normal operating pressure.
.6 Mid-Scale Accuracy: One percent (1%) of full span.
.7 Scale: Both psi and kPa with psi prominent figure.
.8 Gauges for domestic water applications shall conform to NSF 61 and NSF 372.

2.2 Pressure Gauge Tappings

.1 Gauge Cock: Tee or lever handle, brass for maximum 1034 kPa (150 psig).

□

.2 Needle Valve: Brass 6 mm (1/4 inch) NPT for minimum 1034 kPa (150 psig).

.3 Pulsation Damper: Pressure snubber, brass with 6 mm (1/4 inch) connections.

.4 Syphon for gauges on steam systems: Stainless-steel shut-off ball valve complete with ¼" NPT stainless-steel coil siphon rated minimum 1723 kPa (250 psig) working pressure.

2.3 Stem Type Thermometers

.1 Manufacturers:

.1 Winters.
.2 Trerice.
.3 Ashcroft.
.4 Substitutions: Refer to Section 21 05 00.

.2 Compliance: ASME B40.200, ASTM E2251, ASTM E1

.3 Thermometer: Liquid in glass; adjustable angle, coloured organic fluid, lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device.

.4 Choice of stem types shall not be made until piping/ductwork and equipment, etc., has been erected. Stem type must be approved by Contract Administrator.

.1 Size: 225 mm (9 inch) scale.
.2 Window: Clear heavy-duty strength glass or acrylic.
.3 Stem:
.1 Hydronic: Brass, stainless steel, aluminum. Aluminum only acceptable with thermowell. Stem insertion length to be roughly half the pipe diameter.
.2 Air: air duct type with mounting flange
.3 Stem length based on pipe/duct size and insulation thickness. For insulation thicknesses exceeding 50 mm (2") use extension neck unless otherwise accounted for in the thermostat construction.
.4 Range: select range such that average operating temperature will be nominally between 50-75% of full range.
.5 Accuracy: ASTM E77: 2 percent. Calibration: Both °F and°C.

2.4 Dial Thermometers

.1 Manufacturers:

.1 Winters.
.2 Trerice.
.3 Ashcroft.
.4 Substitutions: Refer to Section 21 05 00.

.2 Compliance: ASME B40.200

□

.3 Thermometer: stainless steel case, adjustable angle with front recalibration, bimetallic actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.

.4 Choice of stem types shall not be made until piping and equipment, etc., has been erected. Stem type must be approved by Contract Administrator.

.1 Size: nominal 75 mm (3 inch) diameter dial - thermometers located up to 1500 mm (5'-0") above finished floor.

.2 Size: nominal 125 mm (5 inch) diameter dial - thermometers located above 1500 mm (5'-0") above finished floor.

.3 Lens: Clear heavy-duty strength glass.

.4 Accuracy: 1 percent.

.5 Calibration: Both °F and°C.

.6 Range: select range such that average operating temperature will be nominally between 50-75% of full range.

2.5 Thermometer Supports

.1 Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

.2 Flange: 75 mm (3 inch) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 Test Plugs

.1 Test Plug: 6 mm (1/4 inch) or 13 mm (1/2 inch) brass or stainless steel (depending on system) fitting and cap for receiving 3 mm (1/8 inch) outside diameter pressure or temperature probe with neoprene core for temperatures up to 93°C (200°F), Nordel core for temperatures up to 176°C (350°F), Viton core for temperatures up to 204°C (400°F).

.2 Test Kit: Carrying case, internally padded and fitted containing two 60 mm (2-1/2 inch) diameter pressure gauges, two gauge adapters with 3 mm (1/8 inch) probes, two 38 mm (1-1/2 inch) dial thermometers.

2.7 Static Pressure Gauges

.1 Manufacturers:

.1 Dwyer

.2 Winters

.3 Substitutions: Refer to Section 21 05 00.

.2 Compliance: ASME B40.100

.3 Dial gauges: 90 mm (3-1/2 inch) diameter dial in metal case, magnahelic with diaphragm actuation, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.

□

.4 Inclined manometer, coloured liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.

.5 Range: select range such that average operating pressure will be nominally between 50-75% of full range.

.6 Accessories: Static pressure tips with compression fittings for bulkhead mounting, 6 mm (1/4 inch) diameter tubing.

Part 3 Execution

3.1 Installation

.1 Install to manufacturer's written instructions.

.2 Pressure Gauges

.1 Domestic water and hydronic pressure gauges shall be installed where indicated in the drawings and at the following locations:

.1 Building water service entrance into building.

.2 Inlet and outlet of each pressure reducing valve.

.3 Inlet and outlet of each pump and heat exchanger.

.1 Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to common gauge with isolation to pipe tap.

.2 Static pressure gauges shall be installed where indicated in the drawings and at the following locations:

.1 Air handling unit filter banks (differential)

.2 Ductwork connected to air handling units.

.3 Supply fan discharge.

.3 Install pressure gauges with pulsation dampers. Provide needle valve to isolate each gauge. Provide syphon on gauges in steam systems. Extend nipples and syphons to allow clearance from insulation.

.4 Gauges subject to vibration shall have copper tube extension and shall be located away from source of vibration; preferably on an adjacent wall or other stable mounting surface.

.5 Coil and conceal excess capillary on remote element instruments.

.6 Direct mounted pressure gauges shall be installed in piping tees with pressure gauge located on pipe at the most readable position.

.7 Valves and snubbers shall be installed in piping for each pressure gauge.

.3 Thermometers

.1 Provide thermometers across all hydronic heating and cooling equipment including but not limited to boilers, cooling towers, heat exchangers, and similar equipment. For air coils, provide thermostats on air handling units only. Provide thermometers at other locations as indicated on the drawings. Hydronic thermometers to be installed with separable wells.

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.2 Provide dial thermometers mounted to air handling unit ductwork on the return, mixed air, supply and outside air.

.3 Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 60 mm (2-1/2 inch) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

.4 Install thermometers with back or bottom inlet stems, depending on which is better for ease of reading.

.5 Brass separable wells to have insulation extensions, where mounted on insulated piping or equipment, to ensure dials are clear. Stems and wells to be immersed in liquid flow, minimum length of stems to be 152mm.

.6 Where a separable well is mounted in pipe 38mm diam. or less, enlarge pipe to 50mm diam. for well length plus 76mm.

.7 Install thermometers in air duct systems on flanges.

.8 Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 25 50 01 and/or 25 50 02.

.9 Locate duct mounted thermometers minimum 10 feet (3 m) downstream of mixing dampers, coils, or other devices causing air turbulence.

.4 Install thermometers on supply and return fluid lines serving air handling unit coils.

.5 Provide instruments with scale ranges selected according to service with largest appropriate scale.

.6 Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45°off vertical.

.7 Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

.8 Test plugs:

.1 Locate test plugs adjacent to control device sockets.

.2 Test plugs shall be installed on the inlet and outlet pipes of all heat exchangers or water heaters serving more than one plumbing fixture.

END OF SECTION

□

Part 1 General

1.1 References

.1 ASME - SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

.2 CSA B51 - Boiler, pressure vessel, and pressure piping code

.3 NBCC 2010 - National Building Code of Canada

.4 NPCC 2010 – National Plumbing Code of Canada

.5 NFCC 2010 – National Fire Code of Canada

1.2 Project Record Documents

.1 Section 21 05 00: Submittal Procedures.

.2 Record actual locations of hydronic specialties.

1.3 Operation and Maintenance Data

.1 Section 21 05 00: Submittal Procedures.

.2 Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.4 Quality Assurance

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.5 Delivery, Storage, and Handling

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Accept valves on site in shipping containers with labeling in place. Inspect for damage.

.3 Provide temporary protective coating on cast iron and steel valves.

.4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

.5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

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1.6 Maintenance Service

.1 Provide service and maintenance of glycol system for one year from date of substantial completion.

.2 Provide a monthly visit to make glycol fluid concentration analysis on site with refractive index measurement instrument. Detail findings with maintenance personnel in writing of corrective actions needed including analysis and amounts of glycol or water added.

Part 2 Products

2.1 Flexible Pipe Connectors

.1 Manufacturers:

.1 Flextrol
.2 Flex Tech Industries
.3 Hydro-flex
.4 Substitutions: Refer to Section 21 05 00

.2 Supply and install where shown on the drawings as in details, flexible pipe connectors as manufactured by Flex Tech Industries, selected to meet operating and test pressures of systems served.

.3 Minimum 450 mm (18”) in length unless otherwise noted.

.4 Heating Water Services

.1 Up to 50 mm (2") - Stainless steel connectors constructed of 304 series stainless corrugated hose and braid with steel ends to match equipment.
.2 Over 50 mm (2") - flexible rubber joint with neoprene and nylon body, cadmium steel flanges, spring wire beading.

2.2 Diaphragm-Type Expansion Tanks (ET-1 and ET-2)

.1 Manufacturers:

.1 Bell and Gossett
.2 Taco
.3 Armstrong
.4 Armtrol
.5 Calefactio
.6 Substitutions: Refer to Section 21 05 00

.1 Provide pre-charged, diaphragm expansion tanks meeting current ASME and CSA code requirements designed for a minimum working pressure of 860 kPa (125 psi).

.2 Tanks to be constructed of mild steel with finish painted surface and complete with all necessary tappings in combination with fill valve and automatic vent, angle cocks and guards.

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.3 Air charging valve connection to be standard Schrader tire valve.

.4 Diaphragm to be Heavy Duty Butyl Rubber.

.5 Sizes to be as shown on the drawings and as specified.

.6 Select expansion tank pressure relief valve as noted in schedule.

.7 Set pressure reducing valve as noted in schedule.

2.3 Air Vents

.1 Manual Type:

.1 Manufacturers:

.1 Dole
.2 Bell and Gossett
.3 Taco
.4 Maid O'Mist
.5 Watts
.6 Substitutions: Refer to Section 21 05 00

.2 Short vertical sections of 50 mm (2 inch) diameter pipe to form air chamber, with 3 mm (1/8 inch) brass needle valve at top of chamber.

.3 On aqueous glycol systems, provide with threaded or sweat connection for drainage connection.

.2 Float Type:

.1 Manufacturers:

.1 Maid O'Mist
.2 Watts
.3 Bell and Gossett
.4 Taco
.5 Armstrong
.6 Armtrol
.7 Substitutions: Refer to Section 21 05 00

.2 Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.4 Air and Air-Sediment Separators (DAS-1)

.1 Combination Air & Air-Sediment Separators:

.1 Manufacturers:

.1 Spyrotherm
.2 Bell and Gossett
.3 Taco
.4 Armstrong

□

.5 Substitutions: Refer to Section 21 05 00

.2 Coalescing style in-line dirt and air separator; steel body; tested and stamped to ASME SEC 8-D; for 862 kPa (125 psig) operating pressure.

.3 Removable Coalescing medium to be stainless steel.

.4 Unit to be complete with separate venting chamber and shall have top mounted full port float and brass venting mechanism. Venting mechanism shall be threaded to allow for the piping of overflow.

.5 Unit complete with removable end cover for access to coalescing medium.

.6 Provide with prefabricated removable insulated jacket, minimum 25 mm (1 inch) thick insulation.

2.5 Strainers

.1 Manufacturers:

.1 Spirax-Sarco

.2 Watts

.3 Crane

.4 Mueller

.5 Substitutions: Refer to Section 21 05 00.

.2 On Liquid heat transfer services,

.1 50 mm (2 inch) and under:

.1 Screwed brass or iron body for 1200 kPa (175 psig) working pressure, Y pattern with stainless steel or Monel perforated screen.

.2 Mesh:

.1 0.8 mm (1/32 inch) serving all temperature control valves, automatic flow control devices,

.3 Size 63 mm (2-1/2 inch) and larger:

.1 Flanged iron body for 1200 kPa (175 psig) working pressure, Y pattern with stainless steel or Monel perforated screen.

.2 Mesh:

.3 0.8 mm (1/32 inch) serving all temperature control valves, automatic flow control devices,

2.6 Pump Suction Diffusers

.1 Manufacturers: Suction diffuser shall match supplied pump manufacturer.

.1 Bell and Gossett

.2 Taco

.3 Armstrong

.4 Substitutions: Refer to Section 21 05 00

□

.2 Fitting: Angle pattern, cast-iron body, threaded for 50 mm (2 inch) and smaller, flanged for 65 mm (2-1/2 inch) and larger, rated for 1200 kPa (175 psig) working pressure.

.3 Suction diffuser to be complete with inlet vanes, cylinder strainer with 5 mm (3/16 inch) diameter openings, disposable fine mesh strainer to fit over cylinder strainer.

.4 Accessories: Adjustable foot support, blowdown tapping in bottom, gauge tapping in side.

2.7 Combination Pump Discharge (Triple-Duty) Valves

.1 Manufacturers:

.1 Bell and Gossett
.2 Taco
.3 Armstrong
.4 Substitutions: Refer to Section 21 05 00

.2 Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 1200 kPa (175 psig) operating pressure.

.3 Valve to be complete with :

.1 non-slam check valve with spring-loaded bronze disc and seat,
.2 stainless steel stem,
.3 calibrated adjustment permitting flow regulation, brass readout,

.4 Packing to be Teflon-Graphite. NO ASBESTOS PERMITTED.

2.8 Manual Flow Controls

.1 Manufacturers:

.1 Griswold Controls
.2 Bell and Gossett
.3 Watts.
.4 Victaulic/IMI TA (Tour & Andersson)
.5 Substitutions: Refer to Section 21 05 00.

.2 Up to and including 50mm (2 inch):

.1 Brass or bronze body, rated for 2070 kPa (300 psi) at 120 degrees C (250 degrees F),
.2 sweat or NPT end connections,
.3 full port nickel-plated brass ball valve with Teflon seats,
.4 temperature and pressure test valves and air vent,
.5 handle complete with memory stop and graduated markings.

.3 50mm to 300mm (2 inch to 12 inch):

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.1 Carbon steel body, rated for 1200 kPa (175 psi) at 120 degrees C (250 degrees F),

.2 flanged end connections,

.3 carbon steel low-loss venturi with Piezon-Ring,

.4 bronze disc butterfly valve,

.5 temperature and pressure test valves and air vent,

.4 Calibration: Control flow within 3 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control.

2.9 Relief Valves

.1 Manufacturers:

.1 Kunkle

.2 Spirax-Sarco

.3 Watts

.4 Bell and Gossett

.5 Substitutions: Refer to Section 21 05 00.

.2 ASME Section VIII rated valve:

.1 Carbon steel body, resilient EPDM or EPR soft seat, stainless steel stem and springs, packed leaver with gag. All wetted parts on leaver and gag screw to be stainless steel.

.2 Must be rated and stamped for ASME Section VIII.

.3 On 63mm (2 ½ inch) and larger connections, provide 150# flanges.

.3 Non-ASME rated valve:

.1 Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated.

.2 Designed for liquid service.

2.10 Glycol Feed System (GFS-1)

.1 Manufacturers:

.1 Axiom.

.2 Calefactio

.3 Substitutions: Refer to Section 21 05 00.

.2 Provide packaged glycol feed system consisting of:

.1 208 litre (55 US gal.) polyethylene tank with cover;

.2 Pump suction hose with inlet strainer;

.3 Pressure pump with thermal cut-out;

.4 Integral pressure switch;

.5 Integral check valve;

.6 Cord and plug;

.7 Pre-charged accumulator tank with EPDM diaphragm;

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.8 Manual diverter valve for purging air and agitating contents of storage tank;

.9 Adjustable 35-380 kPa (5-55 psi) pressure regulating valve with pressure gauge;

.10 Integral replaceable strainer;

.11 Built-in check valve;

.12 Union connection; 12 mm (1/2") x 900 mm (36") long flexible connection hose with check valve.

.13 Low level monitoring and alarm with dry contact for monitoring by BAS.

.3 Pump shall be capable of running dry without damage.

.4 Power supply: 3-prong plug and cord, 115v/60/1, 0.7 amps.

.5 Unit shall be completely assembled and certified to CSA standard C22.2 No 68.

2.11 Glycol Solution

.1 Glycol Solution:

.1 Manufacturers:

.1 Dow Model Dowfrost

.2 Brenntag Model Stanfrost

.3 Substitutions: Refer to Section 21 05 00.

.2 Provide aqueous solution by using propylene glycol and distilled or de-ionized water and shall contain red dye for easy leak detection.

.3 All percentage solutions shall be based on percent volume.

.4 Following systems to be filled with 35% aqueous glycol solution. Solution shall be blended up 35% glycol and 65% distilled or de-ionized water concentration, with a freezing point of –21.1 degrees C (-6.0 degrees F).

.5 Glycol solution supplier shall provide The City and Contract Administrator with written analysis results of tested product after installation.

Part 3 Execution

3.1 Installation

.1 Install specialties to manufacturer's written instructions.

.2 Expansion Tanks

.1 Adjust expansion tank pressure to suit design criteria and as directed by the Contract Administrator.

.2 Install pressure gauge at inlet to tank.

.3 Provide valved drain connection on tank side of expansion tank isolation valve.

.4 Provide union connection and isolation valve at each tank to allow removal of tank without disrupting service.

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.3 Where large air quantities can accumulate, provide enlarged air collection standpipes.

.4 Air Vents

.1 Provide manual air vents at system high points and as indicated.

.2 On aqueous glycol systems, automatic air vents are not permitted.

.3 Pipe all air vents on aqueous glycol systems back to glycol fill tank. Piping to be a minimum of 12mm (1/2 inches)

.5 Strainers

.1 Provide valved drain and hose connection on strainer blow down connection.

.2 Supply and install strainers ahead of all temperature control valves, pressure reducing valves, pump suctions and where indicated on the drawings.

.6 Pump Suction Fitting

.1 Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

.7 Triple Duty Valve

.1 Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps where indicated.

.8 Support pump fittings with floor mounted pipe and flange supports.

.9 Balancing Valves

.1 Manual balancing valves shall be sized to flow and selected for 5.98 kPa (2 feet) pressure drop across the valve in the fully open position in accordance with manufactures recommendation. Contractor shall consult with balancing valve manufacturer to ensure correct valve selection.

.10 Relief Valve

.1 Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

.2 Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

.3 Pipe relief valve outlet to nearest floor drain.

.4 Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

.11 Glycol

.1 Clean and flush glycol system before adding glycol solution. Refer to Section 23 25 00.

.2 Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

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.3 Perform tests determining strength of glycol and water solution and submit written test results.

END OF SECTION

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Part 1 General

1.1 References

.1 American Society of Mechanical Engineers

.1 ASME B31.1 - Power Piping.
.2 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
.3 ASME B31.9 - Building Services Piping.

.2 American Society for Testing and Materials

.1 ASTM F708 - Design and Installation of Rigid Pipe Hangers.

.3 Canadian Standards Association

.1 CSA B149.1 - Natural gas and propane installation code

.4 Manufacturers Standardization Society

.1 ANSI/MSS SP58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

.5 National Fire Protection Association

.1 NFPA 13 - Installation of Sprinkler Systems.

.6 Underwriters Laboratories

.1 UL 203 - Pipe Hanger Equipment for Fire protection Service.

1.2 Submittals

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate system layout with location and detail of trapeze hangers.

.3 Product Data: Provide manufacturers catalogue data including load capacity.

.4 Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

.5 Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.3 Regulatory Requirements

.1 Conform to applicable code for support of plumbing, and hydronic piping.

.2 Supports for Sprinkler Piping: To NFPA 13.

.3 Supports for natural gas pipe to CSA B149.1

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Part 2 Products

2.1 Pipe Hangers and Supports

.1 Manufacturers:

.1 Anvil.

.2 Grinnel.

.3 Substitutions: Refer to Section 21 05 00.

.2 Fire Protection Piping:

.1 Conform to NFPA 13.

.2 Hangers for Pipe Sizes 13 to 38 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.

.3 Hangers for Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.5 Wall Support for Pipe Sizes to 75 mm (3 inches): Cast iron hook.

.6 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.3 Plumbing Piping - DWV:

.1 Conform to ASME B31.9.

.2 PVC DWV Pipe Support: to manufacturer’s requirements.

.4 Plumbing Piping - Water:

.1 Conform to ASME B31.9.

.2 Perforated strap or wire hangers are not permitted.

.3 Hangers to be adjustable after pipe is in place.

.4 Clevis hangers shall be oversized to suit the outside diameter of insulation and jacket to maintain the integrity of insulation and vapour barrier.

.1 Insulation protection

.1 On piping 2" and smaller, carry insulation over pipe hangers. On all domestic cold water piping over 1-1/4”, use oversized clevis hangers and insulation protection shield (equivalent to Grinnell Fig 167) to maintain integrity of vapour barrier.

.2 On copper piping over 2" use at each hanger or support Grinnell Fig. 167 insulation protection shield or equivalent). Shields shall have a minimum length of 12" (305mm) to spread weight. Rectangular solid wood or polyethylene

blocks cut to suit the insulation thickness shall be installed at hanger locations. Wedges are not permitted.

.5 Hangers for Pipe Sizes 15 to 40 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.

.6 Hangers for Cold Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.

.7 Hangers for Hot Pipe Sizes 50 to 100 mm (2 to 4 inches): Carbon steel, adjustable, clevis.

.8 Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Adjustable steel yoke, cast iron pipe roll, double hanger.

.9 Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.

.10 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.

.11 Wall Support for Pipe Sizes to 80 mm (3 inches): Cast iron hook.

.12 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.

.13 Vertical Support: Steel riser clamp.

.14 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.15 Floor Support for Hot Pipe Sizes to 100 mm (4 inches): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.

.16 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.17 Isolation: Copper piping shall be isolated from steel supports by appropriate use of copper plated hangers, plastic coated hangers, tinning pipe at supports, or provision of suitable lead or copper isolators.

.5 Hydronic Piping:

.1 Conform to ASME B31.9.

.2 Perforated strap or wire hangers are not permitted.

.3 Hangers to be adjustable after pipe is in place.

.4 Clevis hangers shall be oversized to suit the outside diameter of insulation and jacket to maintain the integrity of insulation and vapour barrier.

.1 Insulation protection

.1 On piping 2" and smaller, carry insulation over pipe hangers. On all chilled water piping use oversized clevis hangers and insulation protection shield (equivalent to Grinnell Fig 167) to maintain integrity of vapour barrier.

.2 On insulated steel pipe over 2" use at each hanger or support, Grinnell Fig. 160, 161 or 162 to suit pipe size and insulation thickness. Pack space between saddle and pipe with insulation.

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.3 On copper piping over 2", use at each hanger or support Grinnell Fig. 167 protection shield or equal. Shields shall have a minimum length of 12" (305mm) to spread weight. Rectangular solid wood or polyethylene blocks, cut to suit the insulation thickness, shall be installed at hanger locations. Wedges are not permitted.

.5 Where pipe expansion in excess of 12mm (1/2") axially occurs or where indicated to be installed on the drawings, provide Grinnell Fig. 171 Adjustable Pipe Roll or Grinnell Fig. 271 Pipe Roll Stand.

.6 Hangers for Pipe Sizes 13 to 38 mm (1/2 to 1-1/2 inch): Carbon steel, adjustable swivel, split ring.

.7 Hangers for Cold Pipe Sizes 50 mm (2 inches) and over: Carbon steel, adjustable, clevis.

.8 Hangers for Hot Pipe Sizes 50 to 100 mm (2 to 4 inches): Carbon steel, adjustable, clevis.

.9 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.10 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm (6 inches) and over: Steel channels with welded spacers and hanger rods, cast iron roll.

.11 Wall Support for Pipe Sizes to 76 mm (3 inches): Cast iron hook.

.12 Wall Support for Pipe Sizes 100 mm (4 inches) and over: Welded steel bracket and wrought steel clamp.

.13 Vertical Support: Steel riser clamp.

.14 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.15 Floor Support for Hot Pipe Sizes to 100 mm (4 inches): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.16 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.17 Isolation: Copper piping shall be isolated from steel supports by appropriate use of copper plated hangers, plastic coated hangers, tinning pipe at supports, or provision of suitable lead or copper isolators.

.18 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

.19 Inserts: Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

.6 For roof mounted piping, provide supports equivalent to:

.1 Guided or Hung pipe supports

.1 PHP Systems portable pipe hanger model PP 10 roof supported strut style with pipe roller guides, channel or hanger.

.2 PHP Systems portable pipe hanger Model PSE-2-2 with clevis style hangers or supports with roof mount base for multiple pipes.

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.3 Supports to be galvanized steel with stainless steel clamps and cast iron rollers. Membrane pads to be closed-cell extruded polystyrene insulation equal to Dow Chemical Roofmate. Pipe shall be a minimum of 8" above finished roof level.

.2 Pipe on roof support:

.1 Basis of Design: MIFAB C-Port Series

.2 Recycled UV resistant rubber, 165 mm (6.5") high, for pipe or rooftop equipment support. Supports to be selected, sized, and configured to match installation requirements and roof construction. Pipe clamps on supports to be sized for one size larger than pipe for natural gas and propane piping. All metal work including strut or pipe clamps to be stainless steel.

2.2 Duct Hangers and Supports

.1 Perforated strap or wire hangers not permitted.

.2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct.

.1 Maximum size duct supported by strap hanger: 500mm. Larger ducts to use trapeze hangers.

.3 Hanger configuration: to SMACNA.

.4 Hangers: galvanized steel angle with galvanized steel rods to SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size (mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

.5 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.2 For steel joist: manufactured joist clamp or steel plate washer.

.3 For steel beams: manufactured beam clamps.

.6 Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.7 Duct Supports – Roof Installations

.1 "H" frame constructed of galvanized steel with height adjustment. Frames to sit on roof mount pads of UV resistant rubber or similar load spreading design. Metal on roof pads not acceptable.

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2.3 Accessories

.1 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.4 Inserts

.1 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.5 Sleeves

.1 Sleeves for Pipes Through Non-fire Rated Floors: 1.2 mm thick (18 gauge) galvanized steel.

.2 Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 1.2mm thick (18 gauge) galvanized steel.

.3 Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed refer to Section 07 84 00.

.4 Where pipes pass through floors, walls or ceilings, in finished areas and where exposed to view, supply and install chrome-plated pressed steel floor plates.

.5 Sleeves for Round Ductwork: Galvanized steel.

.6 Sleeves for Rectangular Ductwork: Galvanized steel or wood.

.7 Firestopping Insulation: Glass fibre type, non-combustible; refer to Section 07 84 00.

.8 Sealant: Acrylic; refer to Section 07 92 00.

Part 3 Execution

3.1 Installation

.1 Install to manufacturer's written instructions.

.2 Reference ANSI/MSS SP-58 for the selection, application and installation of hangers and supports.

3.2 Inserts

.1 Provide inserts for placement in concrete formwork.

.2 Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

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.3 Provide hooked rod to concrete reinforcement section for inserts carrying pipe over100 mm (4 inches).

.4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

.5 Install galvanized oversize pipe sleeves on all pipes passing through walls or partitions, for building into wall construction by other trades.

.6 All sleeves are to be large enough to accommodate pipe insulation as specified.

.7 The Mechanical Division shall include in tender price all cost of drilling for sleeves up to 175 mm (7") in precast sections relative to work under Divisions 22 and 23. Prior to drilling all openings/locations must be checked by the Contract Administrator. Drilling shall be done using diamond core drilling machinery.

.8 All sleeves in mechanical rooms, janitors closets and washrooms shall extend 100 mm (4") above the finished floor level to prevent water seeping down.

.9 Caulk the space between pipes and floor sleeves or openings, to prevent water seeping down, with an approved caulking compound. The caulking compound and method of application shall be to the Contract Administrator's approval.

.10 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

3.3 Pipe Hangers and Supports

.1 Install to manufacturer's written instructions.

.2 Install heating glycol piping to ASME B31.9.

.3 Perforated strap or wire hangers will not be permitted.

.4 Support horizontal piping as scheduled.

.5 Support for buried pipe under new slabs or existing shall be hung from the slab using epoxy coated or stainless steel hangers, hardware and hanger rod secured to the rebar.

.6 Hangers in new concrete structural floor systems shall be supported by inserts placed prior to pouring of concrete. Inserts shall be Grinnell cast iron or wrought steel adjustable type.

.7 Where the structural system is open web steel joists, piping shall be supported by means of angles spanning the top chords of adjacent joists. The number of joists to be spanned in this way shall be determined by the incident load of piping.

.8 In no case shall the hanging of piping directly from roof or ceiling decking be allowed, unless special permission is obtained from the Constract Administrator.

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.9 Copper hot water piping in long runs, where expansion may be significant and where hanger rods are less than 600 mm (2") in length may require roller hangers. Any such cases which cannot be avoided shall be referred to the Constract Administrator for a decision. If necessary, roller hangers shall be installed as directed with protection saddles as specified. Expansion and contractions of domestic H.W. piping should not be a problem, as wide fluctuations in temperature are not normal. Piping shall be hung from slabs, rather than from the bottom of beams, in order to keep hanger rods sufficiently long to take up any movement.

.10 Install hangers to provide minimum 13 mm (1/2 inch) space between finished covering and adjacent work.

.11 Place hangers within 300 mm (12 inches) of each horizontal elbow.

.12 Use hangers with 38 mm (1-1/2 inch) minimum vertical adjustment.

.13 Support all pipe with MJ couplings on both sides of the joint. At multiple fittings or short lengths, support every 300 mm (12”).

.14 Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub or with pipe clamps on hubless pipe.

.15 Storm water piping:

.1 All pipe supports, anchors, clamping, and thrust supports shall support the weight of the pipe and its contents.

.2 Provide all necessary support to restrain thrust forces resulting from internal pipe pressures. Refer to CISPI 301 & 310.

.3 MJ couplings are not permitted on PVC storm water piping. All joints to be solvent-welded.

.4 Restrain all joints on piping 125 mm (5”) and larger to prevent horizontal movement. Use sway bracing as needed to restrain sideways movement of the system. Install blocks, rods, bracing or other suitable methods at each branch opening or change in direction.

.5 Storm water piping below grade including in the crawlspace shall be adequately supported with thrust blocks or suitable anchors to restrain all sideways movement and thrust forces.

.16 Natural gas piping:

.1 Install piping to CSA B149, refer to additional authority having jurisdiction issued requirements where applicable.

.2 On flat rooftops, install piping on rubberized support blocks with pipe clamp sized for one size larger than the pipe.

.3 Support spacing to be based on CSA B149. Provide additional supports at threaded joints.

.4 Support piping on sloped roofs with 2”x10” treated wood, refer to ITSM technical bulletins for installation requirements.

.17 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

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.18 Where several pipes are installed at various elevations in the same vertical plane, piping below shall not be supported off the piping above.

.19 Support riser piping independently of connected horizontal piping.

.20 Materials

.1 Provide copper plated hangers and supports for copper piping.

.2 Supports shall be metallic and installed to avoid galvanic action between the piping or tubing and the supports.

.21 Design hangers for pipe movement without disengagement of supported pipe.

.22 All hanger rods shall have sufficient threaded length to allow for vertical adjustment of hangers after pipe is in place. Use 2 nuts on each rod, one above the clevis or angle iron and one below.

.23 Where pipes or equipment are supported from floors or walls, structural steel supports shall be fabricated, using welded joints except where provision is made for adjustment. Where details of construction are not indicated, drawings shall be submitted to Contract Administrator for approval before fabrication.

.24 Clamps should be located immediately below a coupling if possible. Risers up to 50 mm (2") size shall be braced at intervals not over 2100 mm (7').

.25 Vertical piping other than risers through floors shall be provided with suitable supports, sway braces, etc.

.26 Vertical piping shall be supported at the base in an approved manner.

.27 On insulated piping supported by roller supports or trapeze supports (angle iron) provide at each hanger or support an insulation protection shield of 16 ga. galvanized sheet steel, rolled to match the outside diameter of the insulation. The shield shall cover approximately the bottom one third of the circumference of the insulation. The length shall be at least as long as that recommended by the insulation manufacturer as published in their data.

.28 On insulated pipe up to and including 50 mm (2") pipe, clevis hangers shall be sized to suit the O.D. of the pipe. On insulated pipe of 63 mm (2½") and above and on pipe systems carrying water below ambient temperature, the hangers shall be sized to suit the O.D. of the insulation and protection saddles.

.29 Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 Ductwork Hangers and Supports

.1 Ductwork is to be securely supported from building structure.

.2 Do not suspend any ducting or any other mechanical components from formed hollow steel decking.

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.3 Install hanger so that rod or strap is vertical under operating conditions. Repair or replace hangers that are not vertical.

.4 Strap hangers permitted

.5 Adjust hangers to equalize load.

.6 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

.7 Size supports to accommodate the thickness of the insulation thickness of the duct type. Refer to 23 07 13 for thickness requirements. Hangers to be located outside of the insulation and insulation should not interfere with the vertical alignment of the hanger.

3.5 Equipment Bases and Supports

.1 Provide housekeeping pads of concrete, minimum 100 mm (4 inches) thick and extending 150 mm (6 inches) beyond supported equipment.

.2 Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

.3 Construct supports of steel members. Brace and fasten with flanges bolted to structure.

.4 Provide rigid anchors for pipes after vibration isolation components are installed.

3.6 Sleeves

.1 Set sleeves in position in formwork. Provide reinforcing around sleeves.

.2 Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

.3 Extend sleeves through floors 25mm (1 inch) above finished floor level. Caulk sleeves.

.4 All sleeves in mechanical rooms, janitors closets and washrooms shall extend 100 mm (4") above the finished floor level to prevent water seeping down.

.5 Install galvanized oversize pipe sleeves on all pipes passing through walls or partitions, for building into wall construction by other trades.

.6 All sleeves are to be large enough to accommodate pipe insulation as specified.

.7 Division 22 and 23 shall include in tender price all cost of drilling for sleeves up to 175 mm (7") in precast sections relative to mechanical work. Prior to drilling all openings/locations must be checked by the Contract Administrator. Drilling shall be done using diamond core drilling machinery.

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.8 Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with insulation and caulk, air tight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

.9 Install stainless steel escutcheons at finished surfaces.

3.7 Schedules

.1 Maximum spacing between pipe supports:

.1 Hangers shall be installed not more than 12” (300mm) from each change in direction of pipes.

.2 Where there are concentrations of valves and fittings, closer spacing will be necessary.

.3 Steel Pipe:

.1	Up to 50mm (2")	2.4m (8 ft.)
.2	65mm (2½”) to 150mm (6”)	3.6m (12 ft.)

.4 Copper Tubing (Hard):

.1	Up to 25mm (1")	1.8m (6 ft.)
.2	32mm (1½”) to 50mm (2”)	2.4m (8 ft.)
.3	63mm (2 ½”) to 75mm (3”)	3.0m (10 ft.)

.5 Plastic (PVC, CPVC, PEX)

.1	As recommended by manufacturer for corresponding sizes and materials.	
.2	All sizes – do not exceed	1.2m (4 ft).

END OF SECTION

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Part 1 General

1.1 Performance Requirements

.1 Provide vibration isolation on motor driven equipment over 0.35 kW (0.5 hp), plus connected piping and ductwork.

.2 All outdoor mounted equipment shall be restrained for the highest wind speed as specified by the Contract Administrator, the governing building code(s) or the authority having jurisdiction.

.3 Provide minimum static deflection of isolators for equipment as indicated:

.1 400 - 600 rpm: 90 mm (3.5 inch)
.2 600 - 800 rpm: 90 mm (3.5 inch)
.3 800 - 900 rpm: 50 mm (2 inch)
.4 1100 - 1500 rpm: 25 mm (1 inch)
.5 Over 1500 rpm: 12 mm (0.5 inch)

1.2 Submittals

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Locate vibration isolators, with static and dynamic load on each.

.3 Product Data: Provide schedule of vibration isolator type with location and load on each.

.4 Manufacturer's Installation Instructions: Indicate special procedures and setting dimensions.

1.3 Project Record Documents

.1 Section 21 05 00: Submittals for project closeout.

Part 2 Products

2.1 Manufacturers

.1 Vibro-Acoustics.

.2 Amber/Booth.

.3 California Dynamics

.4 Substitutions: Refer to Section 21 05 00.

2.2 Vibration Isolators

.1 Open Spring Isolators:

.1 Spring Isolators:

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.1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

.2 Code: Colour code springs for load carrying capacity.

.2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

.3 Spring Mounts: Provide with levelling devices, minimum 6 mm (0.25 inch) thick neoprene sound pads, and zinc chromate plated hardware.

.4 Sound Pads: Size for minimum deflection of 1.2 mm (0.05 inch); meet requirements for neoprene pad isolators.

.2 Restrained Spring Isolators:

.1 Spring Isolators:

.1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

.2 Code: Colour code springs for load carrying capacity.

.2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

.3 Spring Mounts: Provide with levelling devices, minimum 6 mm (0.25 inch) thick neoprene sound pads, and zinc chromate plated hardware.

.4 Sound Pads: Size for minimum deflection of 1.2 mm (0.05 inch); meet requirements for neoprene pad isolators.

.5 Restraint: Provide heavy mounting frame and limit stops.

.3 Closed Spring Isolators:

.1 Spring Isolators:

.1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

.2 Code: Colour code springs for load carrying capacity.

.2 Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.

.3 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

.4 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 7 mm (0.25 inch) clearance.

.4 Restrained Closed Spring Isolators:

.1 Spring Isolators:

.1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

.2 Code: Colour code springs for load carrying capacity.

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.2 Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.

.3 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

.4 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 7 mm (0.25 inch) clearance and limit stops.

.5 Spring Hanger:

.1 Spring Isolators:

.1 For Exterior and Humid Areas: Provide hot dipped galvanized housings and neoprene coated springs.

.2 Code: Colour code springs for load carrying capacity.

.2 Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

.3 Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators or rubber hanger with threaded insert.

.4 Misalignment: Capable of 20 degree hanger rod misalignment.

.6 Neoprene Pad Isolators:

.1 Rubber or neoprene waffle pads.

.1 30 durometer.

.2 Minimum 13 mm (1/2 inch) thick.

.3 Maximum loading 275 kPa (40 psi).

.4 Height of ribs: maximum 0.7 times width.

.2 Configuration: 13 mm (1/2 inch) thick waffle pads bonded each side of 6 mm (1/4 inch) thick galvanized steel plate.

.7 Rubber Mount or Hanger: Moulded rubber designed for 13 mm (0.5 inches) deflection with threaded insert.

.8 Glass Fibre Pads: Neoprene jacketed pre-compressed moulded glass fibre.

Part 3 Execution

3.1 Installation

.1 Install to manufacturer's written instructions.

.2 Install isolation for motor driven equipment.

.3 Bases:

.1 Set steel bases for 25 mm (1 inch) clearance between housekeeping pad and base.

□

.2 Adjust equipment level.

.4 Where recommended by the manufacturer, isolator base plates shall be bolted to the structure or foundation. Bolting shall incorporate neoprene bushings and washers.

.5 Isolator hangers shall be installed with the housing a minimum of 1/4” (6 mm) below but as close to the structure as possible. Where isolator hangers would be concealed by non-accessible acoustical sub ceiling, install the hangers immediately below the sub ceiling for access.

.6 Install spring hangers without binding.

.7 On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

.8 Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

.9 Provide pairs of horizontal limit springs on fans with more than 1.5 kPa (6.0 inch) static pressure, and on hanger supported, horizontally mounted axial fans.

.10 Support piping connections to isolated equipment resiliently as follows or according to the schedule.

.1 Up to 100 mm (4 inch) Diameter: First three points of support.

.2 125 to 200 mm (5 to 8 inch) Diameter: First four points of support.

.3 250 mm (10 inch) Diameter and Over: First six points of support.

.4 Select three hangers closest to vibration source for minimum 25 mm (1.0 inch) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 25 mm (1.0 inch) static deflection or 1/2 static deflection of isolated equipment.

.11 Connect wiring to isolated equipment with flexible hanging loop.

.12 All piping and ductwork shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved or otherwise formed to allow passage of piping or ductwork, and maintain a minimum of ¾" and maximum of 1¼" clearance around the outside surfaces. This clearance space shall be tightly packed with 1.58 P.C.F. glass fiber and shall be caulked airtight after installation of the piping or ductwork. Penetrations through fire rated walls and floors shall be sealed to maintain the rating.

.13 All outdoor equipment, piping and ductwork shall be restrained to resist wind forces per the applicable building code(s) as a minimum. Restraint attachments shall be made by bolts, welds or a positive fastening method. Friction shall not be considered. All attachments shall be proven capable of accepting the required wind load by calculations.

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.14 Install wind restraint devices per the restraint manufacturer's submittals. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.

END OF SECTION

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Part 1 General

1.1 References

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

.2 CSA/CGA B149.1, Natural Gas and Propane Installation Code.

.3 NFPA 13, Standard for the Installation of Sprinkler Systems.

1.2 Project Record Documents

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of tagged valves.

Part 2 Products

2.1 Nameplates

.1 Description: Laminated three-layer plastic with engraved black letters on light contrasting background colour.

2.2 Tags

.1 Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 40 mm (1-1/2 inch) diameter.

.2 Chart: Typewritten letter size list in anodized aluminum frame.

2.3 Stencils

.1 Stencils: With clean cut symbols and letters of following size:

.1 20-30 mm (3/4 to 1-1/4 inch) Outside Diameter of Insulation or Pipe: 200 mm (8 inch) long colour field, 15 mm (1/2 inch) high letters.

.2 40-50 mm (1-1/2 to 2 inch) Outside Diameter of Insulation or Pipe: 200 mm (8 inch) long colour field, 20 mm (3/4 inch) high letters.

.3 65-150 mm (2-1/2 to 6 inch) Outside Diameter of Insulation or Pipe: 300 mm (12 inch) long colour field, 30 mm (1-1/4 inch) high letters.

.4 Ductwork and Equipment: 65 mm (2-1/2 inch) high letters.

.2 Stencil Paint: As specified in Section 09 91 10, semi - Painting.1.

2.4 Pipe Markers

.1 Colour: Conform to ASME A13.1.

□

.2 Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

.3 Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

.4 Underground Plastic Pipe Markers: Bright coloured continuously printed plastic ribbon tape, minimum 150 mm (6 inches) wide by 0.10 mm (4 mil) thick, manufactured for direct burial service.

System	Background Colour	Text
Glycol Heating Supply	Yellow	GHS
Glycol Heating Return	Yellow	GHR
Ground Loop Supply	Yellow	GLS
Ground Loop Return	Yellow	GLR
Domestic Cold Water Supply	Green	DCW
Domestic Hot Water Supply	Green	DHW
Domestic Hot Water Recirculation	Green	DHWR
Sanitary	Green	SAN
Plumbing Vent	Green	VEN
Storm Sewer	Green	SS
Rain Water Leader	Green	RWL
Refrigeration Suction	Yellow	RL
Refrigeration Liquid	Yellow	RS
Natural gas	to Codes	GAS
Fire Protection Water	Red	FIRE
Sprinklers	Red	SPRINKLER
Supply Air	White	SA
Return Air	White	RA
Exhaust Air	White	EA
Outdoor Air	White	OA

2.5 Adhesive Markings

.1 Colour: Conform to ASME A13.1.

Material	Colour Scheme
Hazardous	Black Text on Yellow Background
Inherently Low Hazard	White text on Green Background
Fire Protection	White Text on Red Background

.2 Plastic Tape Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

Part 3 Execution

3.1 Preparation

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

□

.2 Prepare surfaces to Section 09 91 10 for stencil painting.

3.2 Installation

.1 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

.2 Install tags with corrosion resistant chain.

.3 Apply stencil painting to Section 09 91 10.

.4 Install plastic pipe markers to manufacturer's written instructions.

.5 Install plastic tape pipe markers complete around pipe to manufacturer's written instructions.

.6 Install underground plastic pipe markers 150 to 200 mm (6 to 8 inches) below finished grade, directly above buried pipe.

.7 Identify make-up air units, energy recovery ventilators, condensing units, heat pumps, pumps, boilers, expansion tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

.8 Identify specialized pipe contents where applicable such as grease interceptor pump out piping.

.9 Controls:

.1 Identify control panels and major control components outside panels with plastic nameplates.

.2 Identify thermostats relating to heat pumps or valves with nameplates or adhesive labels.

.3 Provide identification on all conduits and junction box covers indicating associated system, panel and circuit numbering using tags or labels.

.4 Provide identification on all control points indicating point name, panel #/address and part number using tags or labels.

.10 Identify valves in main and branch piping with tags.

.11 Identify air terminal units and radiator valves with numbered tags.

.12 Tag automatic controls, instruments, and relays. Key to control schematic.

.13 Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 20 mm (3/4 inch) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 6 m (20 feet) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

□

.14 Identify ductwork with stencilled painting or adhesive labels. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

□

Part 1 General

1.1 References

.1 AABC - National Standards for Total System Balance.

.2 CAABC – Canadian Associated Air Balance Council

.3 ADC - Test Code for Grilles, Registers, and Diffusers.

.4 ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

.5 CSA B149.1 - Natural Gas And Propane Installation Code

.6 SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.2 Submittals

.1 Section 21 05 00: Procedures for submittals.

.2 Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

.3 Submit draft copies of report for review prior to final acceptance of Project. Draft copies shall be submitted in electronic format (Adobe Acrobat PDF file). Provide final copies for Contract Administrator and for inclusion in operating and maintenance manuals.

.4 Provide final reports in letter size, soft cover or as suitable for insertion in the project Operation and Maintenance manuals, complete with index page and indexing tabs, with cover identification at front and side. Also submit an electronic copy (PDF file) of the same. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

.5 Test Reports: Indicate data on AABC National Standards for Total System Balance forms. Submit data in either S.I. Metric or IP units to match the primary units used on the drawings and schedules.

1.3 Project Record Documents

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of flow measuring stations, balancing valves, balancing dampers, and fire dampers.

1.4 Quality Assurance

.1 Perform total system balance to AABC National Standards for Field Measurement and Instrumentation, Total System Balance.

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1.5 Qualifications

.1 Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years documented experience, and certified by CAABC.

.2 Perform Work under supervision of CAABC Certified Test and Balance Supervisor.

1.6 Sequencing

.1 Sequence work to Section 01 10 00.

.2 Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.7 Scheduling

.1 Schedule work to Section 21 05 00.

.2 Schedule and provide assistance in final adjustment and test of life safety, smoke evacuation, and/or smoke control system with Fire Authority.

1.8 Project Closeout

.1 The Testing, Adjusting and Balancing agency as part of its contract shall act as authorized inspection agency, responsible to list all items that are installed incorrectly, require correction or have not been installed in accordance with contract drawings and/or specifications, pertaining to the air distribution, cooling and heating systems. Contractor shall make good these items.

.2 Final payment on the building will not be issued until the final air balance report has been submitted to the Contract Administrator and has been approved by the Contract Administrator.

Part 2 Products

.1 Not used

Part 3 Execution

3.1 Examination

.1 Verify that systems are complete and operable before commencing work. Ensure the following conditions:

.1 Systems are started and operating in a safe and normal condition.

.2 Temperature control systems are installed complete and operable.

.3 Proper thermal overload protection is in place for electrical equipment.

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.4 Final filters are clean and in place. If required, install temporary media in addition to final filters.

.5 Duct systems are clean of debris.

.6 Fans are rotating correctly.

.7 Fire and volume dampers are in place and open.

.8 Air coil fins are cleaned and combed.

.9 Access doors are closed and duct end caps are in place.

.10 Air outlets are installed and connected.

.11 Duct system leakage is minimized.

.12 Hydronic systems are flushed, filled, and vented.

.13 Pumps are rotating correctly.

.14 Proper strainer baskets are clean and in place.

.15 Service and balance valves are open.

.2 Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

.3 Beginning of work means acceptance of existing conditions.

3.2 Preparation

.1 Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Contract Administrator to facilitate spot checks during testing.

.2 Provide additional balancing devices as required.

3.3 Installation Tolerances

.1 Refer to maximum balanced pressure drop in equipment schedules. Adjust system pressure drop to be at or below the indicated value.

.2 Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

.3 Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

.4 Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 Adjusting

.1 Ensure recorded data represents actual measured or observed conditions.

.2 Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

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.3 Make any changes in pulleys and belts, and add any manual dampers as required for correct balance, at no additional cost to The City.

.4 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

3.5 Air System Procedure

.1 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

.2 Test and record motor full load amperes.

.3 Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

.4 Measure air quantities at air inlets and outlets.

.5 Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

.6 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

.7 All outlets shall be adjusted to provide proper throw and directional distribution in accordance with the requirements on the drawings and/or schedules.

.8 Vary total system air quantities by adjustment of fan speeds.

.1 Provide drive changes required to set airflows on belt driven units.

.2 Adjust fan motor speed using speed control, on electronic commutated (EC) motors and variable speed drives (VSD) serving AC motors. Indicate speed voltage (0-10 DC) on EC motors and hertz (Hz) on VSD

.3 Vary branch air quantities by damper regulation.

.9 Provide system schematic with required and actual air quantities recorded at each outlet or inlet. Each grille, diffuser and register shall be identified as to location and area. Include locations of pitot tube traverse locations, fire damper locations and tags, and balance damper locations.

.10 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

.11 Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 12.5 Pa (0.05 inches) positive static pressure near the building entries.

.12 All pitot-tube openings shall have plastic plugs of proper size in uninsulated or internally insulated ductwork. Insulated ductwork shall be provided with rubber

plugs that extend to the face of the insulation. Cover the plugs on insulated ductwork with strip of grey tape.

.13 After completion of final balance, the Balance Contractor shall permanently fix the damper operator with a strip of contact tape and spray the quadrant with bright paint to permanently mark its balanced position.

3.6 Fire & Smoke Damper Testing & Verification

.1 Testing of Fire Dampers, Ceiling Fire Stops and/or Fire/Smoke Dampers

.1 General

.1 The Testing, Adjusting and Balancing agency shall test this equipment after installation.

.2 Test and verify operation of all fire dampers and ceiling fire stops in this project.

.3 Test shall include manually releasing fusible link; allowing damper to close to ensure that it has tight-fit closing operation without binding; opening fire damper and/or closing ceiling fire stop and resetting fusible link connection.

.4 Instruct Sections 23 31 00 and 23 33 00 to repair all fire dampers and/or ceiling fire stops that have been identified as being faulty.

.2 Identification of Fire Dampers and Ceiling Fire Stops

.1 At all fire dampers and ceiling fire stops, supply and install tags as approved by the Contract Administrator.

.2 Tags shall be mechanically fastened to duct fire damper access door, or onto or on structure near fire dampers or ceiling fire stops which have no connecting ductwork.

.3 After each fire damper has been tested and has been proven to operate satisfactorily as noted in previous clause, a representative of the Testing, Adjusting and Balancing agency shall label unit number and mark date and signature on tag. Tags shall have space for minimum size further dates and signatures for future checking of damper operation by The City's staff.

.3 Test Report for Fire Dampers and Ceiling Fire Stops

.1 The Testing, Adjusting and Balancing agency shall provide a Test Report.

.2 The report shall include following for each fire damper:

.1 Verification that the unit is fully accessible.

.2 Verification that the unit has been successfully tested.

.3 Verification that the unit has been reset.

.4 Name of tester.

.5 Date that the unit tested successfully.

.6 Location schedule of all dampers i.e. each damper must be labelled.

.3 Provide one copy of completed report to the Contract Administrator. After the Contract Administrator has reviewed

report, provide to the Mechanical Subtrade sufficient copies of report to insert one in each Maintenance/Operating Manual.

.4 Testing of Fire/Smoke Dampers

.1 Provide all testing, tagging, and Test Report for all Fire/Smoke Dampers.

.2 Follow instruction noted in previous clause as noted for Fire Dampers and Ceiling fire stops.

3.7 Leak Testing of Air Ducts

.1 Leak test all ductwork.

.2 Co-ordinate with Section 23 31 00. Section 23 31 00 shall repair all leaks found in ductwork before and after testing of systems.

.3 Witness above final leak tests and issue report to the Contract Administrator.

.4 Test shall be performed by this Section.

.5 Section 23 31 00 shall provide all necessary temporary connections, blank-offs and tees required for testing. This Section shall provide all test fans, equipment and labour required for testing.

Section 23 31 00 shall clean all ducts before testing.

.6 During installation of ductwork include separate leakage air tests of each complete air riser; each completed horizontal distribution system, and after ductwork is installed and central station apparatus is erected, leakage testing of pressure side of whole system. Include testing of flexible run-outs (where applicable).

.7 Perform preliminary tests and repair all leaks before notifying the Contract Administrator of final tests.

.8 Maintain log lock of all tests showing dates, personnel observers' initials.

.9 Be responsible for any damage resulting from failure of items under test.

.10 Section 23 31 00 shall repair all leaks in duct systems.

.11 Retest ductwork after leaks have been repaired.

.12 Coordinate with Section 23 31 00 to ensure that all ductwork is tested:

.1 before ducts are insulated.

.2 before ducts are concealed.

3.8 Water System Procedure

.1 Adjust water systems to provide required or design quantities.

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.2 Use calibrated fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

.3 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

.4 Effect system balance with automatic control valves fully open to heat transfer elements.

.5 Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

.6 Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.9 Schedules

.1 Equipment requiring testing, adjusting and balancing:

- .1 Make-Up Air Units
- .2 Exhaust Fans
- .3 Energy Recovery Ventilators
- .4 Heat Pumps (Water-To-Air)
  - .1 Airflow
  - .2 Glycol Fluid Flow
- .5 Hydronic Pumps
- .6 Air Inlets and Outlets

.2 Report Forms

- .1 Title Page:
  - .1 Name of Testing, Adjusting, and Balancing Agency
  - .2 Address of Testing, Adjusting, and Balancing Agency
  - .3 Telephone number of Testing, Adjusting, and Balancing Agency
  - .4 Project name
  - .5 Project location
  - .6 Project Architect
  - .7 Project Engineer
  - .8 Project Contractor
  - .9 Project altitude
  - .10 Report date
- .2 Summary Comments:
  - .1 Design versus final performance
  - .2 Notable characteristics of system

□

.3 Description of systems operation sequence
.4 Summary of outdoor and exhaust flows to indicate amount of building pressurization
.5 Nomenclature used throughout report
.6 Test conditions

.3 Instrument List:
.1 Instrument
.2 Manufacturer
.3 Model number
.4 Serial number
.5 Range
.6 Calibration date

.4 Pump Data:
.1 Identification/number
.2 Manufacturer
.3 Size/model
.4 Impeller
.5 Service
.6 Design flow rate, pressure drop, BHP
.7 Actual flow rate, pressure drop, BHP
.8 Discharge pressure
.9 Suction pressure
.10 Total operating head pressure
.11 Shut off, discharge and suction pressures
.12 Shut off, total head pressure

.5 Air Moving Equipment
.1 Location
.2 Manufacturer
.3 Model number
.4 Serial number
.5 Arrangement/Class/Discharge
.6 Air flow, specified and actual
.7 Return air flow, specified and actual
.8 Outside air flow, specified and actual
.9 Total static pressure (total external), specified and actual
.10 Inlet pressure
.11 Discharge pressure
.12 Sheave Make/Size/Bore
.13 Number of Belts/Make/Size
.14 Fan RPM

.6 Return Air/Outside Air Data:
.1 Identification/location

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.2 Design air flow
.3 Actual air flow
.4 Design return air flow
.5 Actual return air flow
.6 Design outside air flow
.7 Actual outside air flow
.8 Return air temperature
.9 Outside air temperature
.10 Required mixed air temperature
.11 Actual mixed air temperature
.12 Design outside/return air ratio
.13 Actual outside/return air ratio

.7 Exhaust Fan Data:
.1 Location
.2 Manufacturer
.3 Model number
.4 Serial number
.5 Air flow, specified and actual
.6 Total static pressure (total external), specified and actual
.7 Inlet pressure
.8 Discharge pressure
.9 Sheave Make/Size/Bore
.10 Number of Belts/Make/Size
.11 Fan RPM

.8 Duct Traverse:
.1 System zone/branch
.2 Duct size
.3 Area
.4 Design velocity
.5 Design air flow
.6 Test velocity
.7 Test air flow
.8 Duct static pressure
.9 Air temperature
.10 Air correction factor

.9 Duct Leak Test:
.1 Description of ductwork under test
.2 Duct design operating pressure
.3 Duct design test static pressure
.4 Duct capacity, air flow
.5 Maximum allowable leakage duct capacity times leak factor
.6 Test apparatus

□

.1 Blower
.2 Orifice, tube size
.3 Orifice size
.4 Calibrated

.7 Test static pressure
.8 Test orifice differential pressure
.9 Leakage

.10 Terminal Unit Data:
.1 Manufacturer
.2 Type, constant, variable, single, dual duct
.3 Identification/number
.4 Location
.5 Model number
.6 Size
.7 Minimum static pressure
.8 Minimum design air flow
.9 Maximum design air flow
.10 Maximum actual air flow
.11 Inlet static pressure

.11 Air Distribution Test Sheet:
.1 Air terminal number
.2 Room number/location
.3 Terminal type
.4 Terminal size
.5 Area factor
.6 Design velocity
.7 Design air flow
.8 Test (final) velocity
.9 Test (final) air flow
.10 Percent of design air flow

END OF SECTION

□

Part 1 General

1.1 References

.1 ASTM

.1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

.2 ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.3 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.

.4 ASTM C553 - Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.

.5 ASTM C612 - Standard Specification for Mineral Fibre Block and Board Thermal Insulation.

.6 ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation

.7 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

.8 ASTM C1071 - Fibrous Glass Duct Lining Insulation(Thermal Sound Absorbing Material).

.9 ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

.10 ASTM E96 - Water Vapour Transmission of Materials.

.11 ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

.12 ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

.2 NAIMA: North American Insulation Manufacturers Association

.1 National Insulation Standards.

.3 NFPA: National Fire Protection Association

.1 NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems

.2 NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems

.4 South Coast Air Quality Management District

.1 SCAQMD Rule 1113 – Architectural Coatings

.2 SCAQMD Rule 1168 - Adhesive and Sealant Applications

.5 SMACNA: Sheet Metal & Air Conditioning Contractors' National Association

.1 HVAC Duct Construction Standards - Metal and Flexible.

.6 Standards Council of Canada

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.1 CAN/ULC S102 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.2 CAN/ULC-S701 - Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.7 Thermal Insulation Association of Canada (TIAC):

.1 National Insulation Standards.

1.2 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 Applicator Qualifications: Company specializing in performing the work of this section minimum three years documented experience.

1.3 Regulatory Requirements

.1 Materials:

.1 Flame spread/smoke developed rating of 25/50 to CAN/ULC S102.

.2 Where in contact with or exposed to temperatures greater than 120°C, combustible materials must comply with ASTM C411.

1.4 Delivery, Storage, and Protection

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

.3 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.5 Environmental Requirements

.1 Section 21 05 00: Environmental conditions affecting products on site.

.2 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

.3 Maintain temperature during and after installation for minimum period of 24 hours.

Part 2 Products

2.1 General Requirements

.1 Fire and Smoke Rating

.1 To CAN/ULC-S102:

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.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

.2 Biological Resistance to ASTM G21, ASTM G22, ULC 181

2.2 Vapour Barrier External Duct Wrap, Glass Fibre, Flexible

.1 Manufacturers:

.1 Johns Manville Microlite FSK

.2 Owens Corning SoftR Duct Wrap.

.3 Other acceptable manufacturers offering equivalent products.

.1 Knauf.

.2 Insulation: ASTM C553; flexible, non-combustible blanket.

.1 'ksi' ('K') value: ASTM C518, 0.045 W/m-K at 24°C (0.31 Btu-in/(hr ft²-°F) at 75°F).

.2 Maximum service temperature: 121 °C (250°F).

.3 Maximum moisture absorption: 0.20 percent by volume.

.4 Density 12 kg/cu. meter (0.75 lb/cu. Foot).

.3 Vapour Barrier Jacket:

.1 Kraft paper with glass fibre yarn and bonded to aluminized film (FRK).

.2 Moisture vapour transmission: ASTM E96; ASTM C1136: 0.02 perm.

.3 Secure with pressure sensitive tape.

.4 Vapour Barrier Tape:

.1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

.5 Outdoor Vapour Barrier Mastic:

.1 Vinyl emulsion type acrylic or mastic, compatible with insulation, black colour.

.6 Tie Wire: Annealed steel, 1.5 mm (16 gauge).

2.3 Vapour Barrier External Glass Fibre Rigid Insulation Board

.1 Manufacturers:

.1 Johns Manville 800 Series

.2 Owens Corning Series 700

.3 Other acceptable manufacturers offering equivalent products.

.1 Knauf.

.2 Insulation: ASTM C612; rigid, noncombustible blanket.

.1 ‘ksi’ (‘K’) value : ASTM C518, 0.045 W/mK at 24°C (0.31 Btu/hr ft² F inch at 75°F).

.2 Maximum service temperature: 121°C (250°F).

□

.3 Maximum moisture absorption: 0.20 percent by volume.

.4 Density: 48 kg/cu m (3.0 lb/cu ft).

.3 Vapour Barrier Jacket:

.1 Kraft paper with glass fibre yarn and bonded to aluminized film.

.2 Moisture vapour transmission: ASTM E96; ASTM C1136: 0.04 perm.

.3 Secure with pressure sensitive tape.

.4 Vapour Barrier Tape:

.1 Kraft paper reinforced with glass fibre yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

.5 Indoor Vapour Barrier Finish:

.1 Cloth: Untreated; 305 g/sq m (9 oz/sq yd) weight, glass fabric.

.2 Vinyl emulsion type acrylic, compatible with insulation, black colour.

2.4 Jackets

.1 Canvas Jacket: UL listed.

.1 Fabric: ASTM C921, 220 g/sq m (6 oz/sq yd), plain weave cotton treated with dilute fire retardant lagging adhesive.

.2 Lagging Adhesive:

.1 Compatible with insulation.

.2 Aluminum Flexible Self Adhesive Insulation Jacket: UL listed

.1 Manufacturers:

.1 VentureClad 1577CW

.2 Bakor Foilskin

.3 Polyguard Alumaguard

.2 Tensile Strength: 316.5 N/25 mm (70 lb/in)

.3 Puncture: 111 N (25 lbs)

.4 Service Temperature: -50 to 70°C (-58°C to 160°F)

.5 Finish: Embossed

.6 Aluminum foil exterior surface over multilayer laminate, vapour barriered jacket with pressure sensitive adhesive integral to jacket application surface with peel off release liner.

.7 Permeation (ASTM E96): 0.05 perm (maximum)

.8 UV resistant.

.9 Flame based application not acceptable.

.3 Sheet Aluminum Jacket: ASTM B209M.

.1 Thickness: 0.40 mm (0.016 inch) sheet.

.2 Finish: Smooth.

.3 Joining: Longitudinal slip joints and 50 mm (2 inch) laps.

.4 Fittings: 0.4mm (0.016 inch) thick die shaped fitting covers with factory attached protective liner.

□

.5 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.015 mm thick aluminum.

2.5 Glass Fibre Duct Liner, Flexible

.1 Manufacturers:

.1 Johns Manville LinaTex

.2 Owens Corning QuietR Textile Duct Liner.

.3 Other acceptable manufacturers offering equivalent products.

.1 Knauf.

.2 Insulation: ASTM C1071; flexible, noncombustible blanket with poly vinyl acetate polymer impregnated surface and edge coat.

.1 'ksi' ('K') Value: ASTM C518, maximum 0.045 W/m K at 24°C (0.31 Btu/ft ft² F inch at 75°F).

.2 Maximum Service Temperature: 121°C (250°F).

.3 Maximum Velocity on Coated Air Side: 30.5 m/s (6,000 fpm).

.4 Minimum Noise Reduction Criteria: ASTM C1071

Thickness		NRC
12 mm	1/2"	0.30
25 mm	1"	0.45
38mm	1.5"	0.60
50 mm	2"	0.70

.5 Minimum 55% Certified Recycled Content.

.3 Adhesive:

.1 Waterproof , ASTM E162 fire-retardant type. CAN/ULC S102 25/50 compliant on dried surface.

.4 Liner Fasteners: Galvanized steel, with press-on head.

2.6 Glass Fibre Duct Liner, Rigid

.1 Manufacturers:

.1 Johns Manville Linacoustic R-300

.2 Owens Corning QuietR Duct Liner Board

.3 Other acceptable manufacturers offering equivalent products.

.1 Knauf.

.2 Insulation: ASTM C612; rigid, noncombustible board with acrylic polymer meeting ASTM G21 impregnated surface and edge coat.

.1 'ksi ('K') value : ASTM C518, maximum 0.27 W/m K at 24°C (75°F).

.2 Maximum service temperature: 121°C (250°F).

.3 Maximum Velocity on Coated Air Side: 24.5 m/s (5,000 fpm).

.4 Minimum Noise Reduction Criteria: ASTM C1071

Thickness	NRC

□

25 mm	1”	0.55
38mm	1.5”	0.75
50 mm	2”	0.9

.5 Minimum 20% Certified Recycled Content.

.3 Adhesive:

.1 Waterproof , ASTM E162 fire-retardant type. CAN/ULC S102 25/50 compliant on dried surface.

.4 Liner Fasteners: Galvanized steel, with press-on head.

2.7 Glass Fibre Round Duct Liner

.1 Manufacturers:

.1 Johns Manville Spiracoustic Plus

.2 Owens Corning QuietZone Spiral Duct Liner.

.3 Other acceptable manufacturers offering equivalent products.

.1 Knauf.

.2 Insulation: Round, preformed in cylindrical sections with acrylic polymer meeting ASTM G21 impregnated surface coat.

.1 ‘ksi’ (‘K’) value : ASTM C1071, 0.033 W/m K at 24°C (0.23 Btu/hr ft² F inch at 75°F).

.2 Maximum Velocity on Coated Air Side: 30.5 m/s (6,000 fpm).

.3 Maximum service temperature: 121°C (250°F).

.4 Sound Absorption Coefficients based on type A mounting, frequency (Hz), minimum values

Thickness		125	250	500	1000	2000	4000	NRC
25 mm	1”	0.05	0.21	0.71	1.01	1.07	1.09	0.75
38mm	1.5”	0.1	0.39	1.02	1.08	1.04	1.00	0.85
50 mm	2”	0.17	0.63	1.10	1.05	1.09	1.06	0.95

.3 Adhesive:

.1 Waterproof , ASTM E162 fire-retardant type. CAN/ULC S102 25/50 compliant on dried surface.

2.8

2.8 Fire Wrap External Duct Flexible

.1 Manufacturers:

.1 3M Canada

.2 Other acceptable manufacturers offering equivalent products.

.2 Listing

.1 Underwriters’ Laboratories of Canada (ULC)

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.1 Grease Duct Enclosures – Fire Resistant Ducts Guide No. (40 U21) Design No. FRD 4

.2 Ventilation / Pressurization Duct Enclosures – ISO 6944 Fire Resistant Ducts Guide No. (40 U21) Design No. FRD 3 and FRD 5

.3 Insulation:.

.1 'ksi' ('K') value: ASTM C518, 0.045 at 24°C (0.31 at 75°F).

.2 Density 96 kg/cu. meter (6 lb/cu. Foot).

.4 Flammability (CAN/ULC S102)

.1 Foil:

.1 Flame spread 5 & Smoke developed 5

.2 Blanket:

.1 Flame spread & 0 Smoke Developed 0

.5 Application chart

Application	Fire Resistive Rating	Enclosure System	Through-Penetration System
Grease Ducts	1 or 2 hours	2 layers - 3" (7,6 cm) perimeter and longitudinal overlap	ULC-FRD-4
Air Ventilation Duct Systems	1 hour	1 layer - 3" (7,6 cm) perimeter and longitudinal overlap or optional butt joint plus collar wrap method	ULC-FRD-3
Air Ventilation Duct Systems (2 or 3 Sides)	1 hour	1 layer - 3" (7,6 cm) perimeter and longitudinal overlap	ULC-FRD-5
Air Ventilation Duct Systems	2 hours	2 layers - 3" (7,6 cm) perimeter and longitudinal overlap or first layer butt joint with second layer overlap method	ULC-FRD-3
Air Ventilation Duct Systems (2 or 3 Sides)	2 hour	2 layers - 3" (7,6 cm) perimeter and longitudinal overlap OR first layer butt joint with second layer overlap 3" (7,6 cm)	ULC-FRD-5

Part 3 Execution

3.1 Examination

.1 Section 01 70 00 - Examination and Preparation: Verification of existing conditions before starting work.

.2 Verify that duct work has been tested before applying insulation materials.

.3 Verify that surfaces are clean, foreign material removed, and dry.

□

3.2 Installation

.1 Insulation to be applied in applications as specified regardless of whether shown on the drawings. Insulation shown on drawings is for reference, clarification or to indicate conditions not in the specifications.

.2 Silencers are considered integral to ductwork system and shall have insulation applied to match performance of connected ductwork.

.3 Section 01 45 00 - Quality Control: Manufacturer's written instructions.

.4 Install to NAIMA National Insulation Standards.

.5 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.

.6 All duct sizes on the drawings refer to inside duct dimensions. On all acoustically lined ductwork, the external duct dimensions shall be increased by the thickness of the lining.

.7 Insulated duct work conveying air below ambient temperature:

.1 Provide insulation with vapour barrier jackets.

.2 Finish with tape and vapour barrier jacket.

.3 Continue insulation through walls, sleeves, hangers, and other duct penetrations.

.4 Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

.8 Insulated duct work conveying air above ambient temperature:

.1 Provide with or without standard vapour barrier jacket.

.2 Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

.9 External insulation on duct work exposed in Mechanical Equipment Rooms or Finished Spaces below 3 metres (10 feet) above finished floor: Provide canvas jacket ready for finish painting

.10 Exterior Applications: Provide insulation with vapour barrier jacket. Cover the insulation with caulked aluminum jacket with seams located on bottom side of horizontal duct section.

.11 Where ducts are acoustically lined to the equivalent R-value, no exterior duct insulation is required, except where exposed to outside temperature and weather.

.12 External Duct Insulation Application:

.1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.

.2 Secure insulation without vapour barrier with staples, tape, or wires.

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.3 Install without sag on underside of duct work. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct work off trapeze hangers and insert spacers.

.4 Seal vapour barrier penetrations by mechanical fasteners with vapour barrier adhesive.

.5 Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

.13 Duct and Plenum Liner Application:

.1 Adhere insulation with adhesive for 90 percent coverage with adhesive complying with ASTM C916.

.2 Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing.

.3 Seal and smooth joints. Seal and coat transverse joints.

.4 Seal liner surface penetrations with adhesive.

.5 Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

.14 Install Elastomeric Cellular Thermal Duct Liner as per manufacturer's recommendations.

.15 External Fire Wrap Duct Insulation Application:

.1 Install in accordance to manufactures published installation manual.

3.3 Schedules

.1 Duct insulation shall follow the Schedules below as a minimum requirement. These requirements shall apply regardless of whether or not duct insulation is shown on the drawings.

.2 Where duct insulation is shown on the drawings (either with the hatching convention or by means of a key note) and exceeds the requirements of the schedules below, the additional insulation requirements shall be met.

3.4 External Duct Wrap, Glass Fibre, Flexible

DUCT SERVICE	DUCT SIZE <Inch><mm>	THICKNESS <mm><Inch>
All conditioned air supply ductwork in return plenums or un-conditioned interior space or mechanical rooms or electrical rooms (all supply ductwork in building should be insulated if following NECB prescriptive path)	=< 400 mm (16") per side, or round duct	29mm (1 1/8") Installed 38mm (1 ½") Nominal
Round exhaust ducts, relief ducts from external wall or roof back for length of 3000mm (10 feet) or to	All	57mm (2 1/4") Installed 75mm (3") Nominal

□

DUCT SERVICE	DUCT SIZE <Inch><mm>	THICKNESS <mm><Inch>
insulated damper, whichever is greater		
Round duct from insulated damper for length of up the 3000mm (10 feet)	All	38mm (1 1/2") Installed 50mm (2") Nominal
Round ducting to centrifugal exhaust fans on roofs.	All	38mm (1 1/2") Installed 50mm (2") Nominal

3.5 External Glass Fibre Rigid Insulation Board

DUCT SERVICE	DUCT SIZE <Inch><mm>	THICKNESS <mm><Inch>
Air conditioning supply plenums, before, including, and after cooling coils	all	50mm (2")
All conditioned air supply ductwork in return plenums or un-conditioned interior space or mechanical rooms or electrical rooms (all supply ductwork in building should be insulated if following NECB prescriptive path)	> 400 mm (16”) per side	25mm (1")
Rectangular exhaust ducts, relief ducts from external wall or roof back for length of 3000mm (10 feet) or to insulated damper, whichever is greater	All	75mm (3")
Rectangular duct from insulated damper for length of up the 3000mm (10 feet)	All	50mm (2")
Outdoor air ducts located in conditioned space from the intake louver at outside wall or roof to the air handler or mixed air plenum	All	75mm (3")
Rectangular conditioned air ducts located outdoors or where exposed to outdoor temperatures (eg. Attics, roofs).	All	125mm (5")
Rectangular ducting to centrifugal exhaust fans on roofs.	All	50mm (2")

□

3.6 Glass Fibre Duct Liner, Rigid

DUCT SERVICE	DUCT SIZE <Inch><mm>	THICKNESS <mm><Inch>
Rectangular air supply and return air ductwork where indicated on drawings by acoustic hatching symbol.	All	25mm (1")

3.7 Glass Fibre Duct Liner, Flexible

DUCT SERVICE	DUCT SIZE <Inch><mm>	THICKNESS <mm><Inch>
Rectangular air supply and return air ductwork where indicated on drawings by acoustic hatching symbol.	All	25mm (1")
Rooftop goosenecks - exhaust	All	50mm (2")

END OF SECTION

□

Part 1 General

1.1 References

.1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

.2 ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

.3 ASTM C195 - Mineral Fibre Thermal Insulating Cement.

.4 ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

.5 ASTM C411 - Hot-Surface Performance of High-Temperature Thermal Insulation

.6 ASTM C449/C449M - Mineral Fibre Hydraulic-setting Thermal Insulating and Finishing Cement.

.7 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.

.8 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.

.9 ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

.10 ASTM C547 - Mineral Fibre Pipe Insulation.

.11 ASTM C552 - Cellular Glass Thermal Insulation.

.12 ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.

.13 ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).

.14 ASTM C591 - Unfaced Preformed Cellular Polyisocyanurate Thermal Insulation.

.15 ASTM C610 - Moulded Expanded Perlite Block and Pipe Thermal Insulation.

.16 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

.17 ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

.18 ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).

.19 ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

□

.20 ASTM E96 - Water Vapour Transmission of Materials.

.21 CAN/ULC-S102 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 Quality Assurance

.1 Materials

.1 Flame spread/smoke developed rating of 25/50 or less to CAN/ULC S102.

.2 Where in contact with or exposed to temperatures greater than 120°C, all materials shall comply with ASTM C411 or be of non-combustible materials.

1.3 Qualifications

.1 Applicator: Company specializing in performing the work of this section with minimum three years documented experience.

1.4 Delivery, Storage, and Handling

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

.3 Store insulation in original wrapping and protect from weather and construction traffic.

.4 Protect insulation against dirt, water, chemical, and mechanical damage.

1.5 Environmental Requirements

.1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

.2 Maintain temperature during and after installation for minimum period of 24 hours.

Part 2 Products

2.1 Glass Fibre Pre-Formed Pipe Insulation with All-Service Jacket

.1 Manufacturers:

.1 Johns Manville Micro-Lok.

.2 Knauf Earthwool 1000.

.3 Owens Corning FIBREGLAS.

.4 Substitutions: Refer to Section 21 05 00.

.2 Insulation: ASTM C547; rigid moulded, non-combustible.

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.1 'ksi' ('K') value : ASTM C335, 0.035 at 24°C (0.24 at 75°F).

.2 Minimum Service Temperature: -28.9°C (-20°F).

.3 Maximum Service Temperature: 454°C (850°F).

.4 Maximum Moisture Absorption: 0.2 percent by volume.

.3 Vapour Barrier Jacket

.1 ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.

.2 Moisture Vapour Transmission: ASTM E96; 0.03 ng/(Pa s sq m) (0.02 perm inches).

.3 Secure with self sealing longitudinal laps and butt strips.

.4 Secure with outward clinch expanding staples and vapour barrier mastic.

.4 Tie Wire: 1.3 mm (18 gauge) stainless steel with twisted ends on maximum 300 mm (12 inch) centres.

.5 Vapour Barrier Lap Adhesive

.1 Compatible with insulation.

2.2 JACKETS

.1 PVC Plastic

.1 Jacket: ASTM C921, One piece moulded type fitting covers and sheet material, off white colour.

.1 Thickness

.1 Indoor inaccessible: 0.5 mm (0.02”)

.2 Indoor accessible, mechanical rooms: 0.75 mm (0.03”)

.3 Exterior use: 1 mm (0.04”)

.2 Service temperature

.1 Minimum: -40°C (-40°F).

.2 Maximum: 66°C (150°F).

.3 Moisture Vapour Transmission: ASTM E96; 0.002 perm inches.

.4 Maximum Flame Spread: ULC-S102; 25.

.5 Maximum Smoke Developed: ULC-S102; 50.

.6 Connections: installed in accordance with manufacturer’s recommendations using PVC adhesive to seal joints, and tape or butt strips where joined to adjacent pipe covering. Use staples and insulation coating as specified at circumferential joints.

.2 Covering Adhesive Mastic

.1 Compatible with insulation.

.2 Canvas Jacket: UL listed

.1 Fabric: ASTM C921, 220 g/sq m (6 oz/sq yd), plain weave cotton treated with dilute fire retardant lagging adhesive.

.2 Lagging Adhesive

.1 Bakelite 120-18 white fire retardant lagging adhesive.

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.3 Coating

.1 Finish with two full brush coats of Bakelite 120-09 white fire retardant paint.

.3 Aluminum Jacket: ASTM B209.

.1 Generators: Type T-3003 H-14

.2 Thickness: 0.40 mm (0.016 inch) sheet.

.3 Finish: Embossed.

.4 Joining: Longitudinal slip joints and 50 mm (2 inch) laps.

.5 Fittings: 0.4 mm (0.016 inch) thick die shaped fitting covers with factory attached protective liner.

.6 Metal Jacket Bands: 10 mm (3/8 inch) wide; 0.38 mm (0.015 inch) thick aluminum.

.4 Aluminum Flexible Self Adhesive Insulation Jacket

.1 Approvals: UL listed

.2 Manufacturers:

.1 VentureClad 1577CW

.2 Bakor Foilskin

.3 Polyguard Alumaguard

.3 Tensile Strength: 316.5 N/25 mm (70 lb/in)

.4 Puncture: 111 N (25 lbs)

.5 Service Temperature: -50 to 70°C (-58°C to 160°F)

.6 Finish: Embossed

.7 Aluminum foil exterior surface over multilayer laminate, vapour barriered jacket with pressure sensitive adhesive integral to jacket application surface with peel off release liner.

.8 Permeation (ASTM E96): 0.05 perm (maximum)

.9 UV resistant.

.10 Flame based application not acceptable.

Part 3 Execution

3.1 Examination

.1 Verify that piping has been tested before applying insulation materials.

.2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 Installation

.1 Install materials to manufacturer's written instructions.

.2 On exposed piping, locate insulation and cover seams in least visible locations.

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.3 Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:

.1 Provide vapour barrier jackets, factory applied or field applied.

.2 Insulate fittings, joints, and valves with moulded insulation of like material and thickness as adjacent pipe.

.3 Finish with glass cloth and vapour barrier adhesive.

.4 PVC fitting covers may be used.

.5 Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.

.6 Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

.4 For insulated pipes conveying fluids above ambient temperature:

.1 Provide standard jackets, with or without vapour barrier, factory applied or field applied.

.2 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.

.3 Finish with glass cloth and adhesive.

.4 PVC fitting covers may be used, except on steam and condensate piping systems.

.5 For hot piping conveying fluids 60°C (140°F) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

.6 For hot piping conveying fluids over 60°C (140°F), insulate flanges and unions at equipment.

.5 Inserts and Shields:

.1 Application: Piping 40 mm (1-1/2 inches) diameter or larger.

.2 Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

.3 Insert Location: Between support shield and piping and under the finish jacket.

.4 Insert Configuration: Minimum 150 mm (6 inches) long, of same thickness and contour as adjoining insulation; may be factory fabricated.

.5 Insert Material: hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

.6 Finish insulation at supports, protrusions, and interruptions.

.7 At penetrations through fire rated walls, provide firestopping at walls and run insulation to firestopping. Seal insulation ends. Where voids exist between fire stop seals within the cavity, fill void with mineral wool or alternative non-combustible insulation.

.8 Pipe supports:

.1 All piping shall be supported in such a manner that neither the insulation nor the vapor/weather barrier is compromised by the hanger or the effects of the hanger. In all cases, hanger spacing shall be such that the

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circumferential joint may be made outside the hanger. On cold systems, vapor barrier shall be continuous, including material covered by the hanger saddle.

.2 Piping systems 3" (75 mm) in diameter or less may be supported by placing saddles of the proper length and spacing under the insulation as designated by the insulation manufacturer.

.3 For hot piping systems larger than 3" (75 mm) in diameter, operating at temperatures less than +200F (93C) and insulated with fiber glass, high density inserts such as fiberglass or foam with sufficient compressive strength shall be used to support the weight of the piping system. At temperatures exceeding +200F (93C), high temperature pipe insulation shall be used for high density inserts.

.4 For piping conveying fluids below ambient temperature and larger than 3" (75 mm) in diameter provide CFC and HFCF free phenolic insulation supports with sufficient compressive strength shall be used to support the weight of the piping system and with appropriate thickness for the required insulation values.

.5 Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize pipe heat loss. Where possible, the pipe shoe shall be sized to be flush with the outer pipe insulation diameter.

.6 On vertical runs, insulation support rings shall be used as required.

.9 For pipe exposed in mechanical equipment rooms or in finished spaces below 3 metres (10 feet) above finished floor, finish with canvas jacket sized for finish painting.

.10 For all pipe in exposed in occupied areas, finish with PVC jacket.

.11 Exterior piping applications:

.1 For exterior piping applications, provide weather and UV resistant vapour barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.

.2 On outdoor chilled water and refrigerant lines, the insulation system shall be completely vapor sealed before the weather-resistant jacket is applied where jacket is not part of the vapour sealing barrier. The outer jacket shall not compromise the vapor barrier by penetration of fasteners, etc. Vapor stops at butt joints shall be applied at every fourth pipe section joint and at each fitting to provide isolation of water incursion.

.12 Insulate all roof hoppers and storm drain pipe in ceiling spaces or walls of finished areas, and all vent piping and exposed horizontal and vertical storm drain pipe within 3000 mm (10'-0") developed length from roof opening or located in vented attics and soffits.

.13 Where internal roof drains discharge to grade, insulate all piping within 3000 mm (10'-0") developed length from the exterior wall termination. If the pipe is exposed within the building, continue insulation for all exposed lengths of pipe.

.14 Fittings and Valves

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.1 Shall be insulated with pre-formed fiberglass fittings, fabricated sections of fibreglass pipe insulation. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers or as otherwise specified on contract drawings.

.2 Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low-density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Rough cut ends shall be coated with suitable weather or vapor resistant mastic as dictated by the system location and service. On hot systems where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.

.3 On cold systems, particular care must be given to vapor sealing the fitting cover or finish to the pipe insulation vapor barrier. All valve stems shall be sealed with caulking to allow free movement of the stem but provide a seal against moisture incursion. Valve handle extensions are recommended.

.15 ACCESSORY MATERIALS

.1 All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of the Midwest Insulation Contractors Association (MICA) "Commercial & Industrial Insulation Standards."

3.3 Tolerance

.1 Substituted insulation materials: Thermal resistance within 10 percent at normal conditions, as materials indicated.

3.4 Fibrous Glass Insulation Schedule

	PIPING SYSTEMS	PIPE SIZE <Inch><mm>	THICKNESS <Inch><mm>
Plumbing Systems			
	Domestic Hot Water Supply & Domestic Hot Water Recirc	=< 2” (50mm)	1” (25mm)
	Domestic Hot Water Supply & Domestic Hot Water Recirc	> 2” (50mm)	1 ½” (38mm)
	Tempered Domestic Water Supply	=< 2” (50mm)	1” (25mm)
	Tempered Domestic Water Supply	> 2” (50mm)	1 ½” (38mm)
	Domestic Cold Water	=< 2” (50mm)	1” (25mm)
	Domestic Cold Water	> 2” (50mm)	1 ½” (38mm)
	Roof Drain Bodies	all	2” (50mm)
	Roof Drain piping above floor	all	2” (50mm)

□

	PIPING SYSTEMS	PIPE SIZE <Inch><mm>	THICKNESS <Inch><mm>
	within 10 Feet (3 Metres) of the Exterior. Entire length of pipe where not trapped.		
	Plumbing Vents Within 10 Feet (3 Metres) of the Exterior	all	2” (50mm)
Heating Systems			
	Heating water & glycol supply and return, low pressure steam, pumped and gravity steam condensate	=< 2” (50mm)	1” (25mm)
	Heating water & glycol supply and return, low pressure steam, pumped and gravity steam condensate	> 2” (50mm)	1-1/2” (38mm)
	Boiler Feed Water	=< 2” (50mm)	1” (25mm)
Cooling Systems			
	Chilled water & glycol	all	1” (25mm)
	Condenser water	all	1” (25mm)
	Dual Temperature Water	all	Match heating water
	Heat Recovery Water	all	1” (25mm)
	Glycol Cooling Supply and Return	all	1” (25mm)
	Cold Condensate Drains	all	1” (25mm)
	Condensate Drains from Cooling Coils	all	1” (25mm)

END OF SECTION

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Part 1 General

1.1 References

.1 ASME

.1 ASME -Welding and Brazing Qualifications.

.2 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.4 ASME B31.1 - Power Piping

.5 ASME B31.3 – Process Piping

.6 ASME B31.9 - Building Services Piping.

.2 ASTM

.1 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

.2 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

.3 ASTM B32 - Solder Metal.

.4 ASTM B88 - Seamless Copper Water Tube.

.5 ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

.3 American Welding Society (AWS)

.1 AWS A5.8 - Filler Metals for Brazing and Braze Welding.

.2 AWS D1.1 - Structural Welding Code - Steel.

.4 Canadian Standards Association

.1 CSA B51-2019, Boiler and Pressure Vessel Code

.2 CSA B214-2016, Installation code for hydronic heating systems

.3 CSA B149.1, Natural Gas and Propane Installation Code

.4 CSA C282, Emergency Electrical Power Supply for Buildings

.5 Manufacturers Standardization Society

.1 ANSI/MSS SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation

1.2 Project Record Documents

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of valves.

1.3 Operation and Maintenance Data

.1 Submit to Section 21 05 00.

□

.2 Include valve schedule complete with valve tags, location, service, normally open/normally closed.

.3 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.4 Qualifications

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 Carbon steel pipe and fittings manufactured in China or India will not be permitted.

.3 Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.

.4 Welders: Certify to ASME SEC 9 and applicable provincial public safety regulations.

1.5 Regulatory Requirements

.1 All pressure piping systems for use in Manitoba shall be designed and constructed in accordance with the applicable ANSI/ASME Piping Codes, ITSM (Inspection and Technical Services Manitoba) and Steam and Pressure Plants Act.

.2 Conform to CSA B51 and ASME B31.9 code for installation of piping system.

.3 Welding Materials and Procedures: Conform to ASME SEC 9 and applicable provincial public safety regulations.

.4 Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.6 Delivery, Storage, and Handling

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Accept valves on site in shipping containers with labeling in place. Inspect for damage.

.3 Provide temporary protective coating on cast iron and steel valves.

.4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

.5 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

□

1.7 Environmental Requirements

.1 Do not install underground piping when bedding is wet or frozen.

1.8 Extra Materials

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide two repacking kits for each size and valve type.

Part 2 Products

2.1 Buried Geothermal Ground Loop Piping

.1 Refer to Section 23 24 00 – Geothermal Ground Loop.

2.2 Heating Water and Glycol Piping, Above Ground

.1 Steel Pipe: ASTM A53, Schedule 40, black.

.1 Fittings: ASTM B16.3, malleable iron or ASTM A234, forged steel welding type fittings.

.2 Joints: Threaded, or AWS D1.1, welded.

.2 Copper Tubing: ASTM B88, Type L hard drawn. Up to 50mm (2") diameter only.

.1 Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.

.2 Joints: Up to 50mm (2") diameter: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C (430 to 535 degrees F).

.3 Hose: Composite hose with nitrile liner, braided fibre reinforcing, neoprene cover, 1034 kPa (150 psig) operating pressure at 96 degrees C (205 degrees F).

.1 Fittings: Copper.

.2 Joints: Nipple with stainless steel clamp.

Chilled Water Piping, Above Grade

2.3 Equipment Drains and Overflows

.1 Steel Pipe: ASTM A53, Schedule 40 galvanized.

.1 Fittings: Galvanized cast iron, or ASTM B16.3 malleable iron.

.2 Joints: Threaded, or grooved mechanical couplings.

.2 Copper Tubing: ASTM B88, Type L, annealed.

.1 Fittings: ASME B16.22, wrought copper.

.2 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220 to 280 degrees C (430 to 535 degrees F).

□

2.4 Unions, Flanges, and Couplings

.1 Unions for Pipe 50 mm (2 inches) and Under:

.1 Ferrous Piping: 1034 kPa (150 psig) malleable iron, threaded.

.2 Copper Pipe: Bronze, soldered joints.

.2 Flanges for Pipe Over 50 mm (2 inches):

.1 Ferrous Piping: 1034 kPa (150 psig) forged steel, slip-on.

.2 Copper Piping: Bronze.

.3 Gaskets: 1.6 mm (1/16 inch) thick preformed neoprene.

.3 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 Gate Valves

.1 Up To and Including 50 mm (2 inches):

.1 Manufacturers:

.1 Red-White/Toyo Rising Stem, Union Bonnet, Solid Wedge Disc

Class 125: Threaded: 293 Soldered: Use Adaptors

Class 150: Threaded: 298 Soldered: Use Adaptors

Class 300: Threaded: 318 Soldered: Use Adaptors

.2 Kitz Rising Stem, Screwed Bonnet, Solid Wedge Disc

Class 125: Threaded: 24 Soldered: 44

Class 150: Threaded: 25 Soldered: 45

Kitz Rising Stem, Union Bonnet, Solid Wedge Disc

Class 150: Threaded: 42, 42T Soldered: 43

Class 300: Threaded: 37 Soldered: Use Adaptors

.3 Red-White/Toyo Non-Rising Stem, Screwed Bonnet, Solid Wedge Disc

Class 125: Threaded: 280 Soldered: 281

Class 150: Threaded: 204 Soldered: Use Adaptors

.4 Kitz Non-Rising Stem, Screwed Bonnet, Solid Wedge Disc

Class 125: Threaded: 40 Soldered: 41

Class 150: Threaded: 46 Soldered: 64

.5 Substitutions: Refer to Section 21 05 00.

.2 Bronze body, bronze trim, bonnet, rising stem, handwheel, solid wedge disc, solder or threaded ends.

.2 Over 50 mm (2 inches):

.1 Manufacturers:

.1 Red-White/Toyo 421 Rising Stem, Flanged Ends

.2 Kitz 72 Rising Stem, Flanged Ends

.3 Red-White/Toyo 415 Non-Rising Stem, Flanged Ends

.4 Kitz 75 Non-Rising Stem, Flanged Ends

□

.5 Substitutions: Refer to Section 21 05 00.

.2 Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.

2.6 Globe or Angle Valves

.1 Up To and Including 50 mm (2 inches):

.1 Manufacturers:

.1 Red-White/Toyo

.2 Kitz

.3 Crane

.4 Substitutions: Refer to Section 21 05 00.

.2 Bronze body, bronze trim, union bonnet, rising stem and handwheel, renewable composition disc and bronze seat, solder ends.

.2 Over 50 mm (2 inches):

.1 Manufacturers:

.1 Red-White/Toyo

.2 Kitz

.3 Crane

.4 Substitutions: Refer to Section 21 05 00.

.2 Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

2.7 Ball Valves

.1 Up To and Including 50 mm (2 inches):

.1 Manufacturers:

.1 MAS

.2 Red-White/Toyo

.3 Kitz

.4 Crane

.5 Substitutions: Refer to Section 21 05 00.

.2 Bronze one piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle solder ends.

.2 Over 50 mm (2 inches):

.1 Manufacturers:

.1 Kitz

.2 MAS

.3 American 4001

.4 American 4000

.5 Crane

.6 Substitutions: Refer to Section 21 05 00.

□

.2 Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.8 Plug Valves

.1 Up To and Including 50 mm (2 inches):

.1 Manufacturers:

.1 Nordstrom Valves, Inc. MSS SP-78, Type II.

.2 Substitutions: Refer to Section 21 05 00.

.2 Cast-iron or bronze body, bronze tapered plug, full port opening, non-lubricated, teflon packing, threaded ends.

.3 Operator: One plug valve wrench for every ten plug valves minimum of one.

.2 Over 50 mm (2 inches):

.1 Manufacturers:

.1 Nordstrom Valves, Inc. MSS SP-78, Type II.

.2 Substitutions: Refer to Section 21 05 00.

.2 Cast iron body and plug, full port opening, pressure lubricated, teflon packing, flanged ends.

.3 Operator: Each plug valve with a wrench with set screw.

2.9 Butterfly Valves

.1 Manufacturers:

.1 Demco

.2 Kitz

.3 Mueller

.4 Substitutions: Refer to Section 21 05 00.

.2 Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.

.3 Disc: Stainless Steel.

.4 Operator: 10 position lever handle. Valves 8” and larger shall have gear operator with position indicator.

2.10 Swing Check Valves

.1 Up To and Including 50 mm (2 inches):

.1 Manufacturers:

.1 Red-White/Toyo

.2 Kitz

.3 Substitutions: Refer to Section 21 05 00.

.2 Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

□

.2 Over 50 mm (2 inches):

.1 Manufacturers:

.1 Red-White/Toyo

.2 Kitz

.3 Substitutions: Refer to Section 21 05 00.

.2 Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.11 Spring Loaded Check Valves

.1 Manufacturers:

.1 Mueller 71 Series

.2 M.A. Stewart & Sons Moygro W12A-I6V (single plate)

.3 Watts ICV

.4 Substitutions: Refer to Section 21 05 00.

.2 Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

Part 3 Execution

3.1 Preparation

.1 Ream pipe and tube ends. Remove burrs.

.2 Remove scale and dirt on inside and outside before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

.4 Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

.5 After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

3.2 Installation

.1 Install to manufacturer's written instructions.

.2 Install heating water, glycol, chilled water, and condenser water piping to CSA 52 and ASME B31.9.

.3 Route piping in orderly manner, parallel to building structure, and maintain gradient. Grade hydronic piping up in flow direction or as noted.

.4 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

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.1 Pipes carrying fluids at temperatures greater than 100°C (212°F) or steam at pressures greater than 103 kPa (1 psig) shall not be routed through patient care areas or in ceiling spaces above patient care areas.

.2 Install piping to conserve building space, and not interfere with use of space.

.3 Group piping whenever practical at common elevations.

.4 Provide piping on glycol systems from air vents to associated glycol fill tank.

.5 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

.6 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.

.7 Supply and install check valves on steam condensate pump discharges and also where indicated on the drawings.

.8 Use spring loaded check valves on discharge of pumps.

.9 Sleeves

.1 Sleeve pipe passing through partitions, walls and floors.

.10 Valves

.1 Install drain valves (ball valves) c/w hose and cap and chain on each pump (pipe to nearest floor drain), at system low points so that entire system can be drained, and at each zone or branch / riser isolation valve so branch or riser can be drained down completely.

.2 All valves must be installed with stems upright or horizontal; not inverted.

.3 Valve body materials shall be compatible with piping system materials. Valves shall meet all pressure, temperature, and fluid handling requirements of the system.

.4 A valve drain shall be provided at the base of each riser and at the low points of the system. Manual air vents shall be provided at the top of each riser and at the high points of the system.

.5 All valves installed in concealed locations, i.e., ceiling spaces, shall be compactly arranged so that they are easily accessible through common access plates or doors.

.6 On cooling coils supply and install drain valves with hose end connections at the top of the coil header of headers to allow the coils to be filled with glycol.

.7 Use ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

.8 Use globe or butterfly valves for throttling, bypass, or manual flow control services.

.9 Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.

□

.10 Use butterfly valves in in heating, chilled and condenser water systems interchangeably with gate and globe valves providing they meet the pressure, temperature, and fluid handling requirements of the system.

.11 Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.

.12 Use lug end butterfly valves to isolate equipment.

.13 Use 3/4 inch (20 mm) ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain. NOTE: Piping containing glycol or other antifreeze solutions to be piped back to the tank.

.14 Install valves with stems upright or horizontal, not inverted.

.15 Each piece of equipment shall have isolation valves at the supply and return connections.

.16 All hydronic equipment, manifolds, and headers shall be provided with isolation valves at all connections, complete with unions or flanges.

.17 Isolation valves, complete with unions or flanges, shall be provided at junctions or branches of piped HVAC systems and shall be readily accessible.

.11 Hangers and Supports

.1 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19 – Piping Insulation.

.2 Provide pipe hangers and supports to CSA B51 and ASME B31.9 unless indicated otherwise. Refer to Section 23 05 29 – Supports and Anchors.

.12 Couplings, Fittings, Fasteners and Connections

.1 Use grooved mechanical couplings and fasteners only in accessible locations.

.2 Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

.3 Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

.4 Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

.13 Coatings and Protection

.1 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

.2 Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 91 10.

3.3 Pressure Testing

.1 Do not insulate pipe prior to pressure testing. Pressure test in sections if necessary before concealing or insulating pipe.

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.2 Do not introduce water for testing where freezing conditions exist or where piping systems being tested are located above sensitive areas or equipment that may be damaged or contaminated by water leakage.

.3 Hydraulically test all pipe. Pneumatic testing not permitted without prior approval from the Contract Administrator and the Authority Having Jurisdiction.

.4 Hydronic pipe testing shall be in accordance with the applicable ASME and CSA B51 piping code, the Contractor's registered Quality Assurance Program (for systems where applicable), and all requirements of ITSM).

.1 Subject piping to a hydrostatic pressure of at least 1½ times the operating pressure of the system design pressure for a period of at least 12 hours to a minimum 150 psi (1100 kPa). If leaks are detected, such leaks shall be repaired and the test started over. Record results and submit witnessed (by Contract Administrator) reports to the Contract Administrator.

.1 Pressure testing to be limited to the maximum test pressure of the valves, equipment, vessels, pumps or other system components

.2 For buried piping, subject piping to a hydrostatic pressure of at least 1½ times the operating pressure of the system for a period of at least 24 hours and recorded over the test period.

.5 Should leaks develop in any part of the piping system, remove and replace defective sections, fittings and equipment. Pipe dope, caulking, tape, lead wool, dresser couplings, etc. shall not be used to correct deficiencies. The contractor shall be responsible for all cleanup related to leakage during flushing, testing, and chemical treatment of piping, including original building piping if included in the testing.

.6 Test piping system in sections as required by the progress of work.

.7 Register pressures at the highest system point.

.8 Provide at least 48 hours (during working days) notice to Contract Administrator or The City's Representative prior to testing to allow the tests to be witnessed.

END OF SECTION

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Part 1 General

1.1 References

.1 UL 778 - Motor-Operated Water Pumps.

1.2 Performance Requirements

.1 Ensure pumps operate at specified system fluid temperatures without vapour binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.3 Submittals

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

.3 Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

.4 Millwright's Certificate: Certify that base mounted pumps have been aligned.

1.4 Project Record Documents

.1 Section 21 05 00: Procedures for submittals.

.2 Record actual locations of hydronic pumps.

1.5 Operation and Maintenance Data

.1 Section 21 05 00: Procedures for submittals.

.2 Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.6 Quality Assurance

.1 Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum three years documented experience.

.2 Alignment: Align base mounted pumps by qualified millwright.

1.7 Regulatory Requirements

.1 Products Requiring Electrical Connection: Listed and classified by UL or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

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1.8 Extra Materials

.1 Section 21 05 00: Procedures for submittals.

.2 Provide one set of mechanical seals for each pump.

Part 2 Products

2.1 Manufacturers

.1 Bell & Gossett
.2 Armstrong
.3 Taco
.4 Substitutions: Refer to Section 21 05 00.

2.2 Vertical In-Line Pumps

.1 Type: Vertical, single stage, close coupled, radially split casing, for in-line mounting, for 1200 kPa (175 psig) working pressure at 107 degrees C (225 degrees F).

.2 Casing: Cast iron, with suction and discharge gauge port, casing wear ring, seal flush connection, drain plug, flanged suction and discharge.

.3 Impeller: Bronze, fully enclosed, keyed directly to motor shaft or extension.

.4 Shaft: Carbon steel with stainless steel impeller cap screw or nut and bronze sleeve.

.5 Seal: Carbon rotating against a stationary ceramic seat, Buna-Carbon/Ceramic seal 107 degrees C (225 degrees F) maximum continuous operating temperature.

.6 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.

.7 Each pump shall be factory tested and name-plated before shipment.

.8 Pumps shall conform to ANSI/HI standard for Preferred Operating Region (POR) unless otherwise approved by the Contract Administrator. The pump NPSH shall conform to the ANSI/HI standards for Centrifugal and Vertical Pumps for NPSH Margin.

Part 3 Execution

3.1 Preparation

.1 Verify that electric power is available and of the correct characteristics.

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3.2 Installation

.1 Install to manufacturer's written instructions.

.2 Provide the necessary access space around components to allow for servicing, repair, replacement as well as for the balancing technician to take proper readings. Provide no less than minimum as recommended by manufacturer

.3 Pumps shall be sized on the capacities, heads, motor sizes and RPM specified, impeller size selected shall not be greater than 85% of the maximum size impeller.

.4 Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 102 mm (4 inches) and over.

.5 Provide line sized shut-off valve, and strainer on pump suction, and line sized soft seat check valve and balancing valve or combination pump discharge valve on pump discharge.

.6 Provide air cock and drain connection on horizontal pump casings.

.7 Provide drains for bases and seals, piped to and discharging into floor drains or, in the case of glycol, to a suitable container.

.8 Provide drain lines with ball valves from strainers and filters to nearest floor drain or, in the case of glycol, to a suitable container.

.9 Manufacturer approved millwright or agent to check, align, and certify alignment of base mounted pumps prior to start-up.

.10 Lubricate pumps before start-up.

.11 Provide flow measurement ports as shown on drawings, on piping schematics, and in locations as directed by the water balancing specialist.

.12 Provide any pump impeller modifications as recommended by Division 23 05 93 – Testing Adjusting and Balancing.

END OF SECTION

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Part 1 General

1.1 References

.1 ARI 495 - Refrigerant Liquid Receivers.

.2 ARI 710 - Liquid-Line Driers.

.3 ARI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers

.4 ARI 750 - Thermostatic Refrigerant Expansion Valves.

.5 ARI 760 - Solenoid Valves for Use With Volatile Refrigerants.

.6 ASHRAE 15 - Safety Standard for Refrigeration Systems.

.7 ASHRAE 34 - Designation and Safety Classification of Refrigerants.

.8 ASME - SEC 9 - Welding and Brazing Qualifications.

.9 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.10 ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes.

.11 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.

.12 ASME B31.9 - Building Services Piping.

.13 ASME SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.

.14 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

.15 ASTM B88 - Seamless Copper Water Tube.

.16 ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.17 ASTM F708 - Design and Installation of Rigid Pipe Hangers.

.18 AWS A5.8 - Filler Metals for Brazing and Braze Welding.

.19 AWS D1.1 - Structural Welding Code - Steel.

.20 MSS SP89 – Pipe Hangers and Supports – Selection and Application

.21 UL 429 - Electrically Operated Valves.

1.2 System Description

.1 Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

.2 Provide pipe hangers and supports to ASTM B31.5 unless indicated otherwise.

.3 Liquid Indicators:

.1 Use line size liquid indicators in main liquid line leaving condenser.
.2 If receiver is provided, install in liquid line leaving receiver.
.3 Use line size on leaving side of liquid solenoid valves.

.4 Valves

.1 Use service valves on suction and discharge of compressors.
.2 Use gauge taps at compressor inlet and outlet.
.3 Use gauge taps at hot gas bypass regulators, inlet and outlet.
.4 Use check valves on compressor discharge.
.5 Use check valves on condenser liquid lines on multiple condenser systems.

.5 Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

.6 Strainers:

.1 Use line size strainer upstream of each automatic valve.
.2 Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
.3 On steel piping systems, use strainer in suction line.
.4 Use shut-off valve on each side of strainer.

.7 Pressure Relief Valves: Use on ASME receivers and pipe to outdoors unless otherwise noted or restricted according to local code requirements.

.8 Permanent Filter-Driers:

.1 Use in low temperature systems.
.2 Use in systems utilizing hermetic compressors.
.3 Use filter-driers for each solenoid valve.

.9 Replaceable Cartridge Filter-Driers:

.1 Use vertically in liquid line adjacent to receivers.
.2 Use filter-driers for each solenoid valve.

.10 Solenoid Valves:

.1 Use in liquid line of systems operating with single pump-out or pump-down compressor control.
.2 Use in liquid line of single or multiple evaporator systems.

.3 Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.

.11 Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

1.3 Submittals

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

.3 Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalogue data including load capacity.

.4 Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

.5 Test Reports: Indicate results of leak test, acid test.

.6 Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

.7 Submit welders certification of compliance with ASME SEC 9.

1.4 Project Record Documents

.1 Section 21 05 00: Submittals for project closeout.

.2 Record exact locations of equipment and refrigeration accessories on record drawings.

1.5 Operation And Maintenance Data

.1 Section 21 05 00: Submittals for project closeout.

.2 Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.6 Qualifications

.1 Installer: Company specializing in performing the work of this section with minimum 3 years experience.

1.7 Regulatory Requirements

.1 Conform to ASME B31.9 for installation of piping system.

.2 Welding Materials and Procedures: Conform to ASME SEC 9 and applicable provincial labour regulations.

.3 Welders Certification: To ASME SEC 9.

.4 Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

1.8 Delivery, Storage, And Handling

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Deliver and store piping and specialties in shipping containers with labeling in place.

.3 Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

.4 Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

Part 2 Products

2.1 Piping

.1 Copper Tubing: ASTM B280, Type ACR hard drawn.

.1 Fittings: ASME B16.22 wrought copper.

.2 Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 640 to 805 degrees C (1190 to 1480 degrees F).

.2 Copper Tubing to 22 mm (7/8 inch) OD: ASTM B88, Type K, annealed.

.1 Fittings: ASME B16.26 cast copper.

.2 Joints: Flared.

.3 Pipe Supports and Anchors:

.1 Refer to 23 05 29 – Supports and Anchors.

2.2 Refrigerant

.1 Refrigerant: Type shall match equipment that the system serves.

2.3 Moisture and Liquid Indicators

.1 Indicators: Single port type, UL listed, with copper or brass body, flared, sight glass, colour coded paper moisture indicator and plastic cap; maximum working pressure and maximum temperature to match system served.

2.4 Flexible Connectors

.1 Corrugated bronze hose with single layer of stainless steel exterior braiding, minimum 230 mm (9 inches) long with copper tube ends; for maximum working pressure 3450 kPa (500 psig).

2.5 Valves

.1 Valves and Specialties: seal cap type, brass with Teflon seats

.2 Check valves: type CK-1 as manufactured by Refrigeration Specialties or equivalent.

.3 Thermal expansion valves, filter/driers, solenoid valves, moisture indicators: Sporlan. All thermal expansion valves to be provided with external equalizers.

Part 3 Execution

3.1 Preparation

.1 Ream pipe and tube ends. Remove burrs.

.2 Remove scale and dirt on inside and outside before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

3.2 Installation

.1 Install refrigeration specialties to manufacturer's written instructions.

.2 A nitrogen purge shall be maintained when soldering all joints. Copper-to-copper joints shall be made with a brazing alloy similar to Sil-Fos. Copper-to-brass joints shall be made with silver solder.

.3 Main piping fittings for dryers, sight glasses, expansion valves, and controls shall be flare or compression-type fittings.

.4 Prior to being charged with refrigerant, the system shall be evacuated to 500 microns and held for at least 24 hours under this vacuum.

.5 Double-suction risers shall be employed on systems with capacity reduction and where required by lift.

.6 Pre-charged lines are not acceptable.

.7 Isolation valves shall be provided at all specialties.

.8 Installations shall be complete with dryers, sight glass, and thermostatically controlled solenoid valves for pump down operations.

.9 Condensing systems shall be designed for -18°C (0°F) ambient conditions, using variable-frequency fans.

.10 Refrigerant Suction Lines shall slope a minimum of 1/2" per 10 feet. Slope the pipe in the direction of gas flow (discharge line sloping to the condenser, and suction line sloping towards the compressor).

.11 Provide a complete refrigeration piping system by a recognized Contractor regularly employed in commercial and industrial refrigeration.

.12 Size piping equivalent to a maximum of 1.10°C (2ºF) temperature drop.

.13 Size and configure all suction and hot gas piping to ensure oil entertainment under minimum load.

.14 Refrigeration circuits: provide strainer/driers, sight glasses, moisture indicators, shut-off valves, thermal expansion valves, solenoid valves, receiver, refrigerant, oil, safety accessories, etc.

.15 Provide all control wiring and motor control interlocks as described on the drawings and as required by the equipment Manufacturer's installation instructions and control schematics to achieve required operating sequences and maximum equipment protection.

.16 Main piping fittings for dryers, sight glasses, expansion valves, and controls shall be only flare or welded fittings.

.17 Prior to being charged with refrigerant, the system shall be evacuated to 500 microns and held for at least 24 hours under this vacuum.

.18 Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

.19 Install piping to conserve building space and not interfere with use of space.

.20 Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

.21 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

.22 Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required.

.23 Provide clearance for installation of insulation and access to valves and fittings.

.24 Insulate piping; refer to Section 23 07 19.

.25 Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

.26 Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

.27 Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

.28 Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

.29 Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

.30 Fully charge completed system with refrigerant after testing.

.31 Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

.32 Install piping to conserve building space and not interfere with use of space.

.33 Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

.34 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

.35 Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

.36 Provide clearance for installation of insulation and access to valves and fittings.

.37 Flood piping system with nitrogen when brazing.

.38 Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

.39 Insulate piping to Section 23 07 19.

.40 Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

.41 Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

.42 Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

.43 Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

.44 Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

.45 Fully charge completed system with refrigerant after testing.

3.3 Field Quality Control

.1 Test refrigeration system to ASME B31.5.

.2 Pressure test system with dry nitrogen to 1470 kPa (200 psig). Test to no leakage.

END OF SECTION

Part 1 General

1.1 References

.1 ASME B31.9 - Building Services Piping.

.2 ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

.3 ASTM D2513-20 – Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings

.4 CSA C448 – Design and Installation of Earth Energy Systems.

.5 CSA B137.0 – Definitions, General Requirements, and Methods of Testing for Thermoplastic Pressure Piping.

.6 CSA B137.1 – Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.

1.2 System Description

.1 Supply and install all labour, equipment, and materials to provide a complete vertical geothermal Loop Heat Exchanger (GLHE) to couple the geothermal heat pump units specified, to provide a ground source closed-loop heat pump system. GLHE to be sized according to drawings.

1.3 Submittals

.1 Submit shop drawings for GLHE configuration and products, including:

- .1 Site layout indicating borehole locations and routing of piping from boreholes to building.
- .2 Piping schematic indicating overall arrangement, piping sizes, and location and type of fittings/connections.
- .3 Details:
  - .1 Borehole:
    - .1 Indicate depth, diameter, fitting/connections.
  - .2 Trench:
    - .1 Indicate depth, bedding, pipe spacing, backfill material type, lifts, and compaction.
  - .3 Manifold:
    - .1 Indicate pipe sizes, fittings, connections, ports, gauges, and supports.
  - .4 Header:
    - .1 Indicate pipe sizes, fittings, connections, general arrangement.
- .4 Product Data:

□

.1 Piping
.2 Fittings and Valves
.3 Borehole Grout
.4 Anti-Freeze Solution

.5 Manufacturer's installation instructions for joining methods

.6 Drilling log for a minimum of two boreholes

1.4 Project Record Documents

.1 Section: Submittals for project closeout.

.2 Record actual locations of valves.

1.5 Operation and Maintenance Data

.1 Include valve schedule complete with valve tags, location, service, normally open/normally closed.

.2 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 Qualifications

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.

.3 GLHE installer shall be certified with MGEA, CGC, and IGSPHA with at least three years of successful installation experience.

1.7 Regulatory Requirements

.1 Conform to CSA-C448 Series-02 “Design and Installation of Earth Energy Systems”, Manitoba Water Stewardship Water Licensing Branch, and all other local authorities requirements and standards.

1.8 Delivery, Storage, and Handling

.1 Section: Transport, handle, store, and protect products.

.2 Accept valves on site in shipping containers with labeling in place. Inspect for damage.

.3 Provide temporary protective coating on cast iron and steel valves.

.4 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

.5 Fittings shall be stored in their original container or sealed plastic bags.

□

.6 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 Environmental Requirements

.1 Do not install underground piping when bedding is wet or frozen.

1.10 Extra Materials

.1 Section: Submittals for project closeout.

.2 Provide two repacking kits for each size and valve type.

Part 2 Products

2.1 Piping and Fittings, Buried

.1 All underground piping and fitting materials shall meet requirement of CSA Standard B137.1.

.2 All piping for GLHE to be PE 3408 (high density polyethylene) in accordance with ASTM-2513 sect. 4.1 and 4.2, with minimum cell classification 345434C per ASTM D-3350, "Standard Specification for Polyethylene Plastic Pipe and Fitting Materials." Pipe and fittings to be GEOLINK or approved equal. Only the following sizes of PE 3408 piping are acceptable:

.1 3/4" – 1" IPS SDR-11
.2 1-1/4" – 1-1/2" IPS Sched. 40 (SDR-13.5)
.3 2" IPS Sched. 40
.4 3" IPS SDR-11
.5 4" IPS SDR-11

.3 Underground joints shall be butt- or socket-fused in accordance with ASTM Standard D2657 and manufacturer's instructions.

.4 Fittings joined by fusion shall be manufactured to the same specifications and be of the same resin compound type, with cell classifications 345564C or 345434C.

.5 Each GLHE shall be closed by means of a single or double elbow style U-bend at the bottom of the loop. The U-bend shall be constructed and attached to the GLHE using the heat fusion bonding method. No other fusion joints are permitted on the vertical portion of the GLHE.

2.2 Piping and Fittings, Indoor

.1 Refer to Section 23 21 00 - Hydronic Piping

.2 Transition from steel to high density polyethylene in mechanical room.

□

2.3 Valves

.1 Valves shall be full port, line size, polyethylene ball valves.

.2 Designed to minimum pressure of 1024 kPa (150 psi).

2.4 Identification

.1 Pipe:

.1 Label as per CSA C448.

.2 Marked in accordance with CSA Standard B137.1 as “Geothermal”

.2 Fittings:

.1 Label as per CSA C448.

.2 Marked in accordance with CSA Standard B137.1 for plastic insert type and B137.0 for other types.

.3 They shall be marked with CSA Standard Number “C448”

2.5 Bore Hole Grout

.1 All vertical GLHE bore holes shall be grouted completely with high-solids bentonite clay grout (thermally enhanced) in conformance with IGSHPA standards. Contractor shall monitor each bore hole after initial grouting and continue adding grout as required.

.2 Grout shall have a thermal conductivity no less than 2.08 W/(m*K) (1.2 btu/(hr*ft*F)).

2.6 Manifold

.1 Each incoming geothermal loop leg shall be complete with manual shut-off valves to isolate the leg. The main loop supply and return lines shall contain manual isolation ball valves of the same diameter as the main lines and shall be equipped with access ports to allow for loop flushing. Valves shall be arranged so that the loop can be flushed through the access ports without having to flush the entire building piping system. Each incoming geothermal loop leg and the main loop shall be complete with pressure/temperature ports.

.2 Supply and return pipes shall be separated by a minimum distance of 600mm (24”).

2.7 Antifreeze

.1 Refer to Section 23 05 20 for glycol solution.

Part 3 Execution

3.1 Preparation

.1 Ream pipe and tube ends. Remove burrs.

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.2 Remove scale and dirt on inside and outside before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

.4 Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

.5 After completion, fill, clean, and treat systems. Refer to Section 23 25 00.

3.2 Installation

.1 Install to manufacturer's written instructions.

.2 Each vertical pipe loop shall be filled with water, pressure-tested for leaks and integrity, and then sealed, prior to insertion in borehole. Each subheader shall be tested after it is connected to mechanical room header. The entire systems shall be tested once complete, purged, flushed and backfilled. Refer to CSA C448 for further information.

.1 Compressed air shall be used to compress the water to a minimum pressure of 690 kPa (100psi) for at least 15 minutes without any indication of a significant pressure drop or leakage.

.2 Pressure shall be maintained in the pipe for 1 hour after completion of grouting of borehole.

.3 Contractor shall notify the Contract Administrator the day they are planning to do pressure tests and record. Submit report to Contract Administrator.

BORE HOLE	DATE	TIME OF DAY	DEPTH (meters)	TEST RESULT
1				
2				
3				
4				
5				
6				
7				
8				
10				
11				
12				
Headers				
Entire System				

□

.3 A record of the depth of each bore hole must be recorded by the driller and submitted to the Engineer prior to installation of the ground loop heat exchanger. Call 453-1080 and submit report to David Siepman at dsiepman@eppsiepman.com.

.4 Test and balance according to 23 05 93 – Testing, Adjusting, and Balancing.

.5 Testing and Flushing GLHE shall be as per heat pump manufacturer's instructions.

.6 Route piping in orderly manner, parallel to building structure, and maintain gradient. Grade hydronic piping up in flow direction or as noted.

.7 Install piping to conserve building space, and not interfere with use of space.

.8 Group piping whenever practical at common elevations.

.9 Sleeve pipe passing through partitions, walls and floors.

.10 Slope piping and arrange to drain at low points.

.11 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

.12 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.

.13 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with General Contractor.

.14 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

.15 Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting.

.16 Install valves with stems upright or horizontal, not inverted.

.17 Supply and install pumps complete with all controls and electrical. Piping to include manual ball valve and flanged connections before and after pump.

.18 Supply and install expansion tank sized as per the loop design and operating conditions.

.19 Install heating water and glycol piping to ASME B31.9.

END OF SECTION

□

Part 1 General

1.1 Submittals

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

.3 Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.

.4 Manufacturer's Field Reports: Submit to Section 01 45 00.

.5 Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.

.6 Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

1.2 Project Record Documents

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of equipment and piping, including sampling points and location of chemical injectors.

1.3 Operation and Maintenance Data

.1 Section 21 05 00: Submittals for project closeout.

.2 Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.

1.4 Qualifications

.1 Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience. Company to have local representatives with water analysis laboratories and full time service personnel.

.2 Installer: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.5 Regulatory Requirements

.1 Conform to applicable code for addition of non-potable chemicals to building mechanical systems, and for to public sewage systems.

□

.2 Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 Maintenance Service

.1 Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.

.2 Provide regular technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.

.3 Provide laboratory and technical assistance services during this maintenance period.

.4 Include a training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.

.5 Provide on site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

1.7 Maintenance Materials

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide sufficient chemicals for treatment and testing during warranty period.

.3 Provide 10 side-stream filters, 10 micron.

Part 2 Products

2.1 Manufacturers

.1 GE Water and Process Technologies.

.2 Substitutions: Refer to Section 21 05 00.

2.2 MATERIALS

.1 Closed Hot Water, Chilled Water and Glycol Systems Cleaner:

.1 Ferroquest FQ7103 (neutral pH cleaner to remove oil, grease, rust and mill scale)

.2 Closed System Treatment (Hot or Chilled Water):

.1 Corrshield MD4102 (molybdate based scale and corrosion inhibitor with pH adjustment)

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2.3 By-Pass (Pot) Feeder

.1 Manufacturers:

.1 Neptune
.2 Axiom

.2 Closed Hot Water, Chilled Water and Glycol Systems:

.1 2 gallon chemical pot feeder

2.4 Side Stream Filter System

.1 Closed Hot Water, Chilled Water and Glycol Systems:

.1 Pal LMO-10 ¾" filter housing
.2 STS ¾" Filtermate flow indicator.

.2 Manufacturers:

.1 Pal
.2 Axiom
.3 General Filtration
.4 3M (Cuno).
.5 Sumco.
.6 Substitutions: Refer to Section 21 05 00.

.3 System: Flow indicator, filter housing with cartridge filter, shut off valves, and flow control valve.

.4 Performance: Design flow 0.25 L/s (4 gal/min) with maximum pressure drop of 25.6 kPa (4 psig), based on water.

.5 Hot Water and Glycol Filter Housing: Stainless steel housing suitable for 105 degrees C (220 degrees F) and 1380 kPa (200 psig) operating conditions.

.6 Chilled Water Filter Housing: Stainless steel housing suitable for 52 degrees C (125 degrees F) and 860 kPa (125 psig) operating conditions.

.7 Cartridges: Stringwound cartridge filters

.1 Startup: 0.025 mm (25 micron)
.2 Operation: 0.010 mm (10 micron)

2.5 Test Equipment

.1 Closed System (Hot or Chilled Water): Provide complete test kit including L6213 molybdate test kit, pH meter, conductivity tester.

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Part 3 Execution

3.1 Preparation

.1 Systems to be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

.2 Place terminal control valves in open position during cleaning.

.3 Section 23 25 00 shall provide

.4 Verify that electric power is available and of the correct characteristics.

3.2 Cleaning Sequence

.1 Concentration:

.1 As recommended by manufacturer.

.2 Hot Water, Chilled Water, Glycol Systems

.1 Isolate Existing hydronic systems.

.2 All systems must be chemically cleaned and flushed before water treatment is added. This includes partial or complete filling for pressure testing.

.3 After all components of the piping system have been pressure tested and proven to be in full operational condition and leak free, flush entire system with fresh clean make-up water to remove loose mill scale, sediment and construction debris.

.4 Provide drain connections to drain system in one hour. Install totalizing water meter to record capacity in each system

.5 All drains for chemical treatment shall be piped to the nearest floor drain.

.6 After initial flushing has been completed, clean all strainer screens.

.7 Add cleaner to closed systems at concentration levels recommended by the water treatment specialist.

.8 After cleaning, drain system as rapidly as possible. Flush system by opening drain valves and opening bypass valve on water make-up to system. Continue flushing until tests show pH, iron, TDS and chloride levels of water leaving system are the same as entering the system. Refill and immediately add water treatment to proper level.

3.3 Installation

.1 Install to manufacturer's written instructions.

3.4 Closed System Treatment

.1 Provide one bypass feeder and one side stream filter on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

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.2 Introduce closed system treatment through bypass feeder when required or indicated by test.

.3 Start system with 25 micron start-up sidestream filter. Change side stream filter cartridges as required or indicated by the flow indicator. After flushing and circulating the system, replace 25 micron start-up filters with 10 micron side stream filters for normal system operation when start-up filter loading indicates minimal debris capture.

3.5 Quality Assurance

.1 Provide physical or photographic evidence that construction screens have been used during the cleaning and flushing process.

.2 Provide water test results showing acceptable test results performed by qualified personnel as noted in Qualifications section. Provide to Contract Administrator for pipe cleaning, flushing and inhibitor tests.

END OF SECTION

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Part 1 General

1.1 References

.1 ADC - ADC Flexible Duct Performance and Installation Standards

.2 ASTM A36/A36M - Carbon Structural Steel.

.3 ASTM A653/A653M - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.4 ASTM A1008/A1008M - Steel, Sheet, Cold-Rolled Carbon, Structural, High-Strength Low-Alloy and High Strength Low-Alloy with Improved Formability.

.5 ASTM A1011/A1011M - Standard Specification for Steel, Sheet, and Strip Hot-Rolled, Carbon, Structural, High-Strength, Low-Alloy with Improved Formability.

.6 ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.7 AWS D9.1 - Sheet Metal Welding Code.

.8 CAN/CGSB-19.13 - Sealing Compound, One Component, Elastomeric, Chemical Curing

.9 CAN/ULC S102 - Test for Surface Burning Characteristics of Building Materials and Assemblies

.10 CAN/ULC S109 - FlameTests of Flame-Resistant Fabrics and Films.

.11 CAN/ULC S110 - Test for Air Ducts

.12 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

.13 NFPA 90B - Installation of Warm Air Heating and Air-Conditioning Systems.

.14 NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Operations.

.15 SCAQMD Rule 1113 - Volatile Organic Compound (VOC) Limits

.16 SCAQMD Rule 1168 - Adhesive and Sealant Applications

.17 SMACNA - HVAC Air Duct Leakage Test Manual.

.18 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.19 UL 181 – Standard for Factory-Made Air Ducts and Connectors.

.20 UL 181A - Standard for Closure Systems for Use With Rigid Air Ducts

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.21 UL 181B - Standard for Closure Systems for Use With Flexible Air Ducts and Air Connectors

.22 Furnishings

1.2 Performance Requirements

.1 No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

1.3 Project Record Documents

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.4 Quality Assurance

.1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.2 Maintain one copy of document on site.

1.5 Qualifications

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.

.2 Installer: Company specializing in performing the work of this section with minimum three years documented experience.

1.6 Regulatory Requirements

.1 Construct commercial kitchen exhaust duct work to NFPA 96 standards.

.2 All materials to comply with ULC S102 and ULC S110 requirements for ductwork.

.3 Where combustible materials are in contact with or exposed to temperatures greater than 120°C, materials must comply with ASTM C411.

1.7 Environmental Requirements

.1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

.2 Maintain temperatures during and after installation of duct sealants.

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Part 2 Products

2.1 Materials

.1 Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating of to ASTM A90.

.2 Fasteners: Rivets, bolts, or sheet metal screws.

.3 Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 Sealants

.1 Duct joints:

.1 Basis of Design:

.1 Duro-Dyne

.2 Substitutions: Refer to Section 21 05 00.

.2 UL 181 listed, CAN/ULC S102, NFPA 90A/90B

.3 Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

.4 Water, fire, mold and mildew resistant.

.5 Usage to be compatible with low and medium velocity air distributing systems up to 2 w.g.

.6 Suitable for use in both indoor and outdoor applications.

.7 Exceeds SMACNA pressure and sealing classes for the installed ductwork application.

2.3 Duct Work Fabrication

.1 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Unless otherwise indicated fabrication shall conform to standards for duct pressure class rating of +2" w.g. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

.2 Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, provide air-foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fibre insulation.

.3 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

.4 Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints: minimum 100 mm (4 inch) cemented slip joint, brazed or electric welded. Prime coat welded joints.

.5 Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

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.6 All rectangular ducts shall be constructed by breaking the corners and grooving the longitudinal seams using Pittsburgh seam or other approved airtight seam.

.7 All elbows and transformation pieces shall be constructed using Pittsburgh corner seams or double seam corners. All transverse joints shall be constructed using S-slips, Bar Slips, Drive Slips, etc. where recommended in ASHRAE guide. All slips shall be not less than one gauge heavier than duct material. Open corners will not be accepted.

2.4 Manufactured Duct Work and Fittings

.1 Manufacture to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

2.5 Kitchen Hood Exhaust Duct Work

.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible and NFPA 96.

.2 Construct of 1.37 mm (16 gauge) carbon steel or 1.09 mm (18 gauge) stainless steel, using continuous external welded joints to provide a watertight seal.

.3 All ductwork exposed in the kitchen or servery areas shall be constructed of brushed stainless steel.

.4 Cleanout doors of rigid construction using the same gauge of sheet metal as the duct and gaskets to provide a grease tight seal.

Part 3 Execution

3.1 Installation

.1 Install to manufacturer's written instructions.

.2 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible.

.3 Duct sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

.4 No variation of duct sizes will be permitted except by written permission of the Contract Administrator. In the event that additional offsets and changes in direction are required in the duct system, these changes shall be made by the Sheet Metal Trade without additional cost to The City. All ductwork shall be to the recommended practices as laid down by the Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

.5 Where the width of the duct exceeds 450 mm (18") in its largest dimension such ductwork shall be suitably stiffened by breaking the sheets diagonally.

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.6 If ductwork is insulated, cross breaking may be omitted providing the ducts are 2 gauges heavier than shown on the above schedule.

.7 All laps shall be in the direction of air flow. Rivets and bolts shall be used throughout. All edges and slips shall be hammered down to leave a smooth interior duct.

.8 Ductwork Penetrations:

.1 Where low pressure ductwork conflicts with mechanical and electrical piping and it is not possible to divert the ductwork or piping to stay within allowable space limitation, provide duct easements.

.2 Easements are not required on pipes 100 mm (4") and smaller outside dimension, unless this exceeds 20% of the duct area. Any irregular or flat shaped intrusions require a duct easement. Hangers and straps in the ductwork shall be parallel to air flow. If this is not possible, provide an easement. If the easement exceeds 25% of the duct area, the duct shall be split into two ducts with the original duct area being maintained. All easements shall be approved by the Contract Administrator before installation.

.3 Provide openings in duct work where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated duct work, install insulation material inside a metal ring.

.4 Locate pitot tube test openings in ductwork at supply fan discharges, on intake of exhaust/and return air fans, in major duct branches and everywhere pitot tube openings are required for proper balancing of air conditioning, ventilation and exhaust systems. Do not place closer than 1829mm (72 inches) to elbows. Space every 150mm (6 inches) across air stream at each location. Refer to drawings for additional opening requirements.

.9 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

.10 Use crimp joints with or without bead for joining round duct sizes 200 mm (8 inch) and smaller with crimp in direction of air flow.

.11 Duct supports and hanging:

.1 Use only threaded rod for duct support in exposed areas. Strapping not allowed.

.2 Use double nuts and lock washers on threaded rod supports.

.12 Connections

.1 Connect fan powered terminal units to supply ducts with 300 mm (one foot) maximum length of flexible duct. Do not use flexible duct to change direction.

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.2 Connect diffuser boots or light troffer boots to low pressure ducts with 1.5 m (5 feet) maximum length of insulated flexible duct held in place with strap or clamp.

.13 Where interior of duct is visible through grilles, registers or diffusers, paint interior of duct with flat black Tremco paint formulated for galvanized surfaces.

.14 Set plenum doors 150 to 300 mm (6 to 12 inches) above floor. Arrange door swings so that fan static pressure holds door in closed position.

.15 Kitchen Exhaust Systems:

.1 Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out. Use stainless steel for duct work exposed to view and stainless steel or carbon steel for ducts where concealed.

.2 For kitchen hood exhaust ducts, access doors shall be installed at every change in direction in the ductwork, and at intervals not exceeding 3000 mm (10') along the duct run. Access doors shall be installed not less than 38 mm (1½") above the bottom of the duct.

.16 Active construction requirements:

.1 During construction provide temporary closures of metal or taped sheet plastic on open duct work to prevent construction dust from entering duct work system.

.2 Open ductwork exposed to the outdoors during construction shall also be weather proofed c/w insulation at sealed ends for any ducts exposed to sub-zero temperatures.

.17 Duct sealing

.1 Seal ductwork so that it is sufficiently airtight to ensure economical and quiet performance of the system. All ductwork, except where otherwise indicated, shall have seams and joints sealed with an approved duct sealer. Apply duct sealer and duct tape in strict accordance with manufacturer's recommendations to joints and seams to provide an airtight, watertight installation. Prior to application, ductwork to be dry and free of grease, etc. Use 6mm bead of material along joints. Material, when dry, to have 3.2mm depth extending 25mm on each side of joint or seam.

.2 All ductwork located outdoors shall have seams and joints sealed with an approved acrylic UV resistant sealant, applied with caulking gun and levelled with putty knife. Use material in accordance with manufacturer's printed recommendations.

.3 Stainless steel ductwork exposed in finished rooms shall not have duct tape application.

.18 Install ductwork free from pulsation, chatter, vibration or objectionable noises.

.19 Should any of these defects appear after the system is in operation, correct problems by removing, replacing, or reinforcing the work as directed by the Contract Administrator.

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.20 Tape joints of PVC coated metal duct work with PVC tape.

3.2 Cleaning

.1 Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.3 Schedules

3.4 Duct Work Material Schedule

	AIR SYSTEM	MATERIAL
	Low Pressure Supply (Heating Systems)	Steel
	Low Pressure Supply (System with Cooling Coils)	Steel
	Return and Relief	Steel
	General Exhaust	Steel
	Outside Air Intake	Steel
	Kitchen Hood Exhaust	Steel, 304 Stainless Steel

3.5 Duct Work Pressure Class Schedule

	AIR SYSTEM	PRESSURE CLASS
	Supply (Heating Systems)	250 Pa (1 inch)
	Supply (System with Cooling Coils)	500 Pa (2 inch)
	Return and Relief	250 Pa (1 inch)
	General Exhaust	125 Pa (1/2 inch)
	Outside Air Intake	125 Pa (1/2 inch)
	Intake and Exhaust	250 Pa (1 inch)
	Kitchen Hood Exhaust	

END OF SECTION

□

Part 1 General

1.1 References

.1 AABC - National Standards for Total System Balance.

.2 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

.3 AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.4 AMCA 302 - Application of Sone Ratings for Non-Ducted Air Moving Devices.

.5 AMCA 303 - Application of Sound Power Level Ratings for Fans.

.6 ANSI S1.1 - Acoustical Terminology.

.7 ANSI S1.8 - Preferred Reference Quantities for Acoustical Levels.

.8 ANSI S1.13 - Measurement of Sound Pressure Levels in Air.

.9 ARI 270 - Sound Rating of Outdoor Unitary Equipment.

.10 ARI 575 - Measuring Machinery Sound Within an Equipment Space.

.11 ASA 16 (ANSI S1.36) - Survey Methods for Determination of Sound Power Levels of Noise Sources.

.12 ASA 47 (ANSI S1.4) - Specification for Sound Level Meters.

.13 ASA 49 (ANSI S12.1) - Preparation of Standard Procedures to Determine the Noise Emission from Sources.

.14 ASHRAE 68 - Laboratory Method of Testing to Determine the Sound Power in a Duct.

.15 ASHRAE Handbook - Systems Volume, Chapter "Sound and Vibration Control".

.16 ASTM E90 - Method for Laboratory Measurement of Airborne Sound Transmission loss of Building Partitions and Elements.

.17 ASTM E477 - Method of Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

.18 ASTM E596 - Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures.

.19 NEBB - Procedural Standards for Measuring Sound and Vibration.

.20 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.2 SUBMITTALS

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide catalogue information indicating, materials, dimensional data, pressure losses, and acoustical performance. Acoustical performance shall be obtained in accordance with ASTM E477.

.3 Manufacturer's Installation Instructions: Indicate installation requirements which maintain integrity of sound isolation.

1.3 PROJECT RECORD DOCUMENTS

.1 Section 21 05 00: Submittals for project closeout.

1.4 QUALITY ASSURANCE

.1 Perform Work to AMCA 300 standards and recommendations of ASHRAE 68.

.2 Maintain one copy of each document on site.

1.5 QUALIFICATIONS

.1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience.

1.6 REGULATORY REQUIREMENTS

.1 Conform to applicable code for sound levels at property line.

Part 2 Products

2.1 CROSS-TALK "SILENCERS"

.1 Manufacturers:

.1 Price
.2 VAW Industries
.3 Vibro-Acoustics
.4 Vibron Limited

.2 Performance:

.1 STC-46 rated.
.2 Cross Talk Silencer performance characteristics, including insertion loss and pressure drop, shall be attained through testing in accordance with ASTM Standard E477.
.3 Laboratory performance verification in the manufacturer's test facility may be requested, in which case a comparative test report shall be made available to the engineer.
.4 Construction:

.1 Cross Talk silencers shall be constructed in accordance with ASHRAE and SMACNA Standards for the pressure and velocity classification specified for the air distribution system in which it is installed.

.2 Cross Talk silencers shall be constructed of:

.1 22 gauge solid steel casing

.2 26 gauge solid steel internal noses at inlet and outlet 3. ¾ inch dual density absorptive fiberglass media.

.3 Cross Talk silencers shall be fastened with the use of button lock, Pittsburgh lock, and welds. Screws and other types of mechanical fasteners shall not be acceptable.

.4 Acoustic media:

.1 Acoustic media shall be shot-free inorganic glass fiber with long, resilient fibers, bonded with thermosetting resin.

.2 Glass fiber shall be in accordance with erosion requirements of UL 181, and shall conform to the physical properties and requirements of ASTM C1071.

.5 Fire-Performance Characteristics:

.1 Cross Talk silencer assemblies, including acoustic media fill, sealants, and acoustical spacers shall have combustion rating equal to or less than shown below when tested according to ASTM E84, NFPA 255 or UL 723:

.1 Flame-spread index not exceeding 25

.2 Smoke-developed index not exceeding 50

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Support duct silencers independent of duct work with flexible duct connections, lagged with leaded vinyl sheet on inlet and outlet.

.3 Install cross-talk silencers in wall. Caulk wall penetrations.

END OF SECTION

Part 1 General

1.1 References

.1 NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems

.2 NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems

.3 NFPA 92A - Smoke-Control Systems.

.4 NFPA 252 - Standard Methods of Fire Tests of Door Assemblies

.5 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.6 UL 33 - Heat Responsive Links for Fire-Protection Service.

.7 UL 181 - Standard for Factory-Made Air Ducts and Air Connectors

.8 UL 181A - Standard for Closure Systems for Use With Rigid Air Ducts

.9 UL 181B - Standard for Closure Systems for Use With Flexible Air Ducts and Air Connectors

.10 ULC-S505 - Standard For Fusible Links For Fire Protection Service

.11 UL 555 - Fire Dampers.

.12 UL 555S - Smoke Dampers.

.13 CAN/ULC-S112 Standard Method of Fire Test of Fire-Damper Assemblies

.14 CAN/ULC-S112.2, Standard Method of Fire Test of Ceiling Fire Stop Flap Assemblies.

1.2 Submittals

.1 Section 21 05 00: Procedures for submittals.

.2 Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

1.3 Project Record Documents

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of access doors.

□

1.4 Qualifications

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.5 Regulatory Requirements

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., and testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.6 Delivery, Storage, and Handling

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Protect dampers from damage to operating linkages and blades.

Part 2 Products

2.1 Air Turning Devices/Extractors

.1 Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with push-pull operator strap.

2.2 Backdraft Dampers

.1 Gravity Backdraft Dampers, Size 450 x 450 mm (18 x 18 inches) or smaller, provided with Air Moving Equipment: Air moving equipment manufacturers standard construction.

.2 Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: 1.5 mm (16 gauge) thick galvanized steel, with centre pivoted blades of maximum 150 mm (6 inch) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 Duct Access Doors

.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.2 Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated duct work, install minimum 25 mm (one inch) thick insulation with sheet metal cover.

.1 Less than 300 mm (12 inches) Square: Secure with sash locks.

.2 Up to 450 mm (18 inches) Square: Provide two hinges and two sash locks.

.3 Up to 600 x 1200 mm (24 x 48 inches): Three hinges and two compression latches.

.4 Larger Sizes: Provide an additional hinge.

□

.3 Access doors shall be minimum 450 x 350 mm where space permits.

.4 Access doors with sheet metal screw fasteners are not acceptable.

.5 Doors in insulated ductwork to be double panel construction with a 25mm (1") insulating filler.

.6 In certain locations where it is inconvenient to swing access doors, removable doors with 4 cam locks will be accepted. However, all such locations shall be approved by the Contract Administrator prior to installation.

.7 Grease duct access doors shall match the materials used for the grease duct. Manufacture and installation of duct access doors on grease ducts shall comply with all requirements of NFPA 96.

2.4 Duct Test Holes

.1 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

.2 Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation;

2.5 Fire Dampers

.1 Manufacturers:

.1 Price.
.2 Nailor.
.3 Ruskin.
.4 Substitutions: Refer to Section 21 05 00.

.2 Depending on the rating of fire separation, rating, construction and testing of the fire damper will conform to most recent issue of all of following:

.1 National Building Code
.2 ULC S-112
.3 NFPA 252
.4 ULC or ULI 10(b)

.3 Use type 'B' fire dampers, i.e. blades out of air stream, to be used in all ducts passing through fire separations. Combination fire damper-balancing damper, with blades in air stream shall be used on sidewall or return, or floor mounted supply, up to maximum size of 0.372 sq.m (576 sq.in.). For sidewall return above 0.372 sq.m (576 sq.in.) in size, use a type 'A' fire damper, i.e. blades in air stream.

.4 Ceiling Dampers: Galvanized steel, 0.76 mm(22 gauge) frame and 1.5 mm (16 gauge) flap, two layers 3.2 mm (0.125 inch) ceramic fibre on top side with locking clip.

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.5 Horizontal Dampers: Galvanized steel, 0.76 mm (22 gauge) frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

.6 Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except at all locations unless otherwise indicated on the drawings, and for 250 Pa (1.0 inch) pressure class ducts up to 300 mm (12 inches) in height.

.7 Multiple Blade Dampers: 1.5 mm (16 gauge) galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 3.2 x 12.7 mm (1/8 x 1/2 inch) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

.8 Fusible Links: UL 33, separate at 71°C, (160°F) with adjustable link straps for combination fire/balancing dampers.

2.6 Flexible Connectors

.1 Manufacturers:

.1 Duro-Dyne.

.2 Substitutions: Refer to Section 21 05 00.

.2 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.3 Connector: Fabric crimped into metal edging strip.

.1 Fabric: UL listed fire-retardant neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0 kg/sq m (30 oz per sq yd).

.2 Net Fabric Width: Approximately 75mm (3 inches) wide.

.3 Metal: 75 mm (3 inch) wide, 0.6 mm thick (24 gauge) galvanized steel.

2.7 Combination Smoke Dampers

.1 Manufacturers:

.1 Price.

.2 Nailor.

.3 Ruskin.

.4 Substitutions: Refer to Section 21 05 00.

.2 Fabricate to NFPA 90A, 92, and UL 555S, and ULC S 112.

.3 Dampers: UL Class 1 multiple blade type fire damper, normally open automatically operated by electric actuator.

.4 Electro Thermal Link: Fusible link melting at 74 degrees C (165 degrees F); UL listed and labeled.

.5 Actuator: 24 volts, single phase, 60 Hz; rated up to 176 degrees C (350 degrees F), Design life of 30,000 full stroke cycles.

□

2.8 Volume Control Dampers

.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

.2 Splitter Dampers:

.1 Material: Same gauge as duct to 600 mm (24 inches) size in either direction, and two gauges heavier for sizes over 600 mm(24 inches).

.2 Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.

.3 Operator: Minimum 6 mm (1/4 inch) diameter rod in self aligning, universal joint action, flanged bushing with set screw.

.3 Single Blade Dampers: Fabricate for duct sizes up to 150 x 760 mm (6 x 30 inch).

.4 Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 200 x 1825 mm (8 x 72 inch). Assemble centre and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

.5 End Bearings: Except in round duct work 300 mm (12 inches) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

.6 Quadrants:

.1 Provide locking, indicating quadrant regulators on single and multi-blade dampers.

.2 On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

.3 Where rod lengths exceed 750 mm (30 inches) provide regulator at both ends.

2.9 Kitchen Exhaust Hood (Grease Filter Type)

.1 Manufacturer: Quest Metal Products Limited Overhead Filter Hood Model #QLO

.1 Substitutions not permitted.

.2 Stainless steel low profile overhead range hood, removable washable grease filters, rated for 472 l/s (1000 cfm) airflow

.3 Finish: 200 Series Polished Stainless Steel

.4 Size: 1219 mm (48 inch) wide, 914 mm (36 inch) deep, 610 mm (24 inch) height

.5 Features:

.1 Integral fire suppression system (refer to Section 21 23 00 – Wet-Chemical Fire-Extinguishing).

.2 Integrated lighting.

.6 To NFPA 96.

□

.7 ULC labelled.

Part 3 Execution

3.1 Preparation

.1 Verify that electric power is available and of the correct characteristics.

3.2 Installation

.1 Install accessories to manufacturer's written instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

.2 Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

.3 Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust duct work to NFPA 96. Provide minimum 300 x 300 mm (12 x 12 inch) size for all fire dampers. Enlarge duct if necessary to accommodate properly sized access door.

.4 Generally access doors at heating coils shall approximate width of coil for ease of cleaning.

.5 At smoke detectors, provide 450mm x 450mm (18 x 18 inch) access doors.

.6 Provide duct test holes where indicated and required for testing and balancing purposes.

.7 Provide fire dampers, combination fire and smoke dampers and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

.8 Install smoke dampers and combination smoke and fire dampers to NFPA 92A. Coordinate electrical requirements with Electrical Division.

.9 Demonstrate re-setting of fire dampers to The City’s representative.

.10 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators. Refer to Section 23 05 48. For fans developing static pressures of 1250 Pa (5.0 inches wg) and over, cover connections with leaded vinyl sheet, held in place with metal straps.

.11 Use splitter dampers only where indicated.

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.12 Provide balancing dampers on high velocity systems where indicated. Refer to Section 23 36 00.

.13 Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

.14 Do not locate single blade volume dampers immediately behind diffusers and grilles. This application does not allow uniform airflow across the outlet face.

.15 To minimize generated duct noise, locate volume dampers at least two duct diameters from a fitting and as far away as possible from the outlet or inlet.

END OF SECTION

□

Part 1 General

1.1 References

.1 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

.2 AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

.3 AMCA 99 - Standards Handbook.

.4 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.5 ISO 1940 – Mechanical Vibration. Balance quality requirements for rotors in a constant (rigid) state.

.6 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

.7 UL/cUL 762 - Power Roof Ventilators For Restaurant Exhaust Appliances

.8 UL/cUL 705 – Power Ventilators

1.2 Submittals

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate assembly of centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

.3 Product Data: Provide data on centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

.4 Manufacturer's Installation Instructions.

1.3 Operation and Maintenance Data

.1 Section 21 05 00: Submittals for project closeout.

.2 Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.4 Delivery, Storage, and Handling

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 .Protect motors, shafts, and bearings from weather and construction dust.

1.5 Environmental Requirements

.1 Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

1.6 Extra Materials

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide one extra set of belts for each belt driven fan.

Part 2 Products

2.1 Manufacturers

.1 Greenheck

.2 Loren Cook

.3 Ventex

.4 Substitutions: Refer to Section 21 05 00

2.2 General Fan Components

.1 Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

.2 Sound Ratings: AMCA 301, tested to AMCA 300 ,and bear AMCA Certified Sound Rating Seal.

.3 Fabrication: Conform to AMCA 99.

.4 Performance Base: Sea level conditions.

.5 Temperature Limit: Maximum 150 degrees C (300 degrees F).

.6 Static and Dynamic Balance: Balance all wheels to balance grade G6.3 per ANSI S2.19 (ISO 1940). Eliminate vibration or noise transmission to occupied areas.

.7 Performance Requirements on Schedules.

.8 Wheel And Inlet: Refer to individual sections.

.9 Housing

.1 Heavy gauge steel, spot welded, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut-off.

.2 Factory finish before assembly with enamel or prime coat.

.10 Bearings And Drives

.1 Shafts: Hot rolled steel, ground and polished, with key- way, protectively coated with lubricating oil, and shaft guard.

.2 V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 11.2 kW(15 hp) and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for 15 kW(20 hp) and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

.3 Belt Guard: Fabricate to SMACNA Standard; of 2.8 mm(12 gauge) thick, 20 mm(3/4 inch) diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

.11 Electrical Characteristics And Components

.1 Refer to schedule

.2 Motor: Refer to Section 23 05 13.

2.3 Roof Exhausters

.1 Manufacturers:

.1 Greenheck

.2 Loren Cook

.3 Delhi

.4 Substitutions: Refer to Section 21 05 00

.2 Product Requirements:

.1 Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

.2 Sound Ratings: AMCA 301, tested to AMCA 300 ,and bear AMCA Certified Sound Rating Seal.

.3 Fabrication: Conform to AMCA 99.

.4 UL Compliance: UL listed and labeled, designed, manufactured, and tested to UL 705.

.3 Fan Unit: V-belt or direct driven as indicated; forward curved galvanized steel wheel; painted galvanized steel cabinet; resilient mounted motor; 13 mm (1/2 inch) mesh, 2 mm(16 gauge) aluminum birdscreen; square base to suit roof curb with continuous curb gaskets.

.4 Electrical Characteristics and Components

.1 Electrical Characteristics:

.1 See Schedule

.2 Motor: Refer to Section 23 05 13.

.3 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.

.4 Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.

.5 Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with nylon bearings.

.6 Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self aligning pre-lubricated ball bearings.

2.4 Wall Exhausters

.1 Manufacturers:

.1 Greenheck
.2 Loren Cook
.3 Substitutions: Refer to Section 21 05 00

.2 Fan Unit: V-belt or direct driven with spun aluminum housing; resiliently mounted motor; 13 mm(1/2 inch) mesh, 2.0 mm(16 gauge) aluminum bird screen.

.3 Electrical Characteristics and Components

.1 Electrical Characteristics:
.1 See Schedule
.2 Motor: Refer to Section 23 05 13.
.3 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to code.
.4 Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.

.4 Backdraft Damper: Gravity activated, aluminum multiple blade construction, felt edged with nylon bearings.

.5 Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self aligning pre-lubricated ball bearings.

.6 Options, as noted on schedules.

2.5 Inline Exhaust Fans

.1 Manufacturers:

.1 Greenheck
.2 Loren Cook
.3 Substitutions: Refer to Section 21 05 00

.2 Centrifugal Fan Unit:

.1 General Description:
.1 Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.

.2 Fans are to be equipped with lifting lugs.

.3 After fabrication all carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc.

.4 Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM.

.2 Wheel:

.1 Non-overloading, backward inclined centrifugal wheel

.2 Constructed of aluminum

.3 Statically and dynamically balanced in accordance to AMCA Standard 204-05

.4 The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency

.5 Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone.

.3 Housing/Cabinet Construction

.1 Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars

.2 Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.

.4 Housing Supports and Drive Frame:

.1 Housing supports are constructed of structural steel with formed flanges

.2 Drive frame is welded steel which supports the motor

.5 Disconnect Switches:

.1 NEMA rated: 1

.2 Positive electrical shut-off

.3 Wired from fan motor to junction box

.6 Duct Collars:

.1 Square design to provide a large discharge area

.2 Inlet and discharge collars provide easy duct connection

.7 Access Panel:

.1 Two sided access panels, permit easy access to all internal components

.2 Located perpendicular to the motor mounting panel

.8 Options/Accessories:

.1 Dampers:

.1 Types: Gravity

.2 Galvanized frames with prepunched mounting holes

.3 Balanced for minimal resistance to flow

.2 Finishes:

.1 Coating type: Permatector

.3 Inlet Guards:
.1 Constructed of expanded metal mounted in a steel frame to provide protection for non-ducted installations
.4 Insulated Housing
.1 Thickness: 25mm (1 inches)
.2 For noise reduction and condensation control
.3 Constructed of fiberglass liner
.5 Isolation:
.1 Type: Neoprene/Rubber Mount
.2 Sized to match the weight of each fan
.6 Motor Cover:
.1 Constructed of galvanized steel
.2 Covers motor and drives for safety
.3 Standard on unit specified with UL
.9 Wiring Pigtail:
.1 Direct hook-up to the power supply

.3 Electrical Characteristics and Components

.1 See Schedule.

Part 3 Execution

3.1 Installation

.1 Install to manufacturer's written instructions.

.2 Install fans with resilient mountings and flexible electrical leads. Refer to Section 23 05 48.

.3 Install flexible connections specified in Section 23 33 00 between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm(one inch) flex between ductwork and fan while running.

.4 Install fan restraining snubbers as required. Refer to Section 23 05 48. Adjust snubbers to prevent tension in flexible connectors when fan is operating.

.5 Provide fixed sheaves required for final air balance.

.6 Provide safety screen where inlet or outlet is exposed.

.7 Pipe scroll drains to nearest floor drain.

.8 Provide backdraft dampers on discharge of exhaust fans and as indicated. Refer to Section 23 33 00.

END OF SECTION

Part 1 General

1.1 References

.1 CAN/ULC S524 - Standard For Installation Of Fire Alarm Systems

.2 CSA C22.1/C22.2 – Canadian Electrical Code and Sub-Sections

.3 NFPA 13 - Standard for the Installation of Sprinkler Systems

.4 UL 507 - Standard for Electric Fans

1.2 Submittals

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Drawings detailing product dimensions, weight, attachment methods, electrical, controls, air volume and velocities.

.3 Manufacturer's Installation Instructions.

1.3 Operation and Maintenance Data

.1 Section 21 05 00: Submittals for project closeout.

.2 Maintenance Data: Include manufacturer’s operation and instruction instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.4 Quality Assurance

.1 Certifications

.1 The fan assembly, as a system, shall be certified by a testing agency recognized by the Authority Having Jurisdiction and built pursuant to the guidelines set forth by UL standard 507 and CSA standard 22.2.

.2 The fan shall be compliant with NFPA 13, CAN/ULC S524, and Canadian Electrical Code as specified by Division 28.

.3 Ceiling fans comply with 10 C.F.R. Appendix U for energy consumption per Natural Resources Canada Energy Efficiency Regulations.

.4 Controllers shall comply with Canadian Electrical Code and Underwriters Laboratory (UL) standards and shall be labeled where required by code.

1.5 Delivery, Storage, and Handling

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Protect motors, shafts, controls and bearings from weather and construction dust.

□

1.6 Extra Materials

.1 Section 21 05 00: Submittals for project closeout.

Part 2 Products

2.1 Ceiling Fans

.1 Manufacturers: Basis of Design: Canarm CP60DE11N

.1 Alternate manufacturers:

.1 Westinghouse

.2 Substitutions: Refer to Section 21 05 00.

.2 Construction:

.1 Regulatory: CSA labelled, NRCan energy efficiency

.2 1524 mm (60 inch) blade sweep.

.3 Painted steel blades with curved ends deliver maximum airflow over wide areas.

.4 Gasketed with stainless steel hardware.

.5 Performance:

.1 Refer to schedules.

.2 Compliant with minimum cfm/watt requirements meeting Canadian energy efficiency regulations.

.6 Variable speed reversible motors

.1 All motors thermally protected variable speed ECM or equivalent with permanently lubricated bearings.

.3 Controls

.1 Variable speed line voltage controller complete with reversing direction (RREM-DCQ-14-W).

.4 Ceiling fan and controls supplied and installed by Division 26.

Part 3 Execution

3.1 Ceiling Fan Installation

.1 Install on structural members noted on drawings to manufacturer's instructions.

END OF SECTION

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Part 1 General

1.1 References

.1 ADC 1062 - Air Distribution and Control Device Test Code.

.2 AMCA 500 - Method of Testing Louvers for Ratings.

.3 AMCA 511 – Certified Ratings Program

.4 AMCA 5000 - Method of Testing Dampers for Ratings.

.5 ARI 650 - Air Outlets and Inlets.

.6 ASHRAE 70 - Method of Testing for Rating the Performance of Outlets and Inlets.

.7 SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

.8 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

.9 CAN/ULC S102 - Test for Surface Burning Characteristics of Building Materials and Assemblies

.10 CAN/ULC S110 – Test for Air Ducts

1.2 Regulatory Requirements

.1 All materials of construction to comply with CAN/ULC S102 requirements for flame and smoke spread and CAN/ULC S110 Class 1 materials.

1.3 Submittals

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.4 Project Record Documents

.1 Section 21 05 00: Submittals for project closeout.

.2 Record actual locations of air outlets and inlets.

1.5 Quality Assurance

.1 Test and rate air outlet and inlet performance to ADC Equipment Test Code 1062 and ASHRAE 70.

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.2 Test and rate louver performance to AMCA 500

.3 Certified AMCA 511 – Certified Ratings Program

1.6 Qualifications

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

Part 2 Products

2.1 General

.1 Scheduled products are based on the Price Industries product codes as basis of design. Products supplied to the project to meet or exceed the basis of design.

2.2 Manufacturers

.1 Unless otherwise listed:

.1 Price Industries.
.2 Nailor Industries
.3 Titus
.4 Ventex.

.2 Substitutions: Refer to Section 21 05 00.

2.3 Square Ceiling Diffusers

.1 Type: Square, stamped diffuser to discharge air in 360 degree pattern.

.2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

2.4 Ceiling Grid Core Exhaust and Return Registers/Grilles

.1 Type: Fixed grilles of 13 x 13 x 13 mm (1/2 x 1/2 x 1/2 inch) louvers.

.2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

2.5 Ceiling Slot Diffusers Wall Supply Registers/Grilles

.1 Type: Streamlined and individually adjustable blades, 19 mm (3/4 inch) minimum depth, 19 mm (3/4 inch) maximum spacing with spring or other device to set blades.

.2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

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2.6 Wall Exhaust and Return Registers/Grilles

.1 Type: Streamlined blades, 19 mm (3/4 inch) minimum depth, 19 mm (3/4 inch) maximum spacing, horizontal face.

.2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

2.7 Linear Slot Diffusers

.1 The diffusers shall have 1 discharge slot, slot width as scheduled.

.2 The supply diffusers shall have aerodynamically curved “ice-tong” shaped pattern controllers for 180 degree air pattern control and airflow dampering, where scheduled.

.3 The diffuser border shall be extruded aluminum construction with extruded aluminum spacers and mitered end flanges.

.4 Mounting style as scheduled.

.5 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

2.8 Linear Floor Supply/Return Registers/Grilles

.1 Type: Narrow Spacing Streamlined blades, 3.2 x 19 mm (1/8 x 3/4 inch) on 6 mm (1/4 inch) centres. Refer to schedule for deflection angle.

.2 Refer to the schedule for frame, materials of fabrication, finishes, and accessories.

2.9 Louvers

.1 150 mm (6 inch) Fixed Blade Louver:

.1 Type: 150 mm (6 inch) deep with blades on 45 degree slope with centre baffle and return bend, heavy channel frame, aluminum birdscreen with 13 mm (1/2 inch) square mesh for exhaust and 19 mm (3/4 inch) for intake.

.2 Fabrication: 2.1 mm (0.081 inch) extruded aluminum, welded assembly, with factory baked enamel finish - custom colour to be selected by the architect.

.3 Provide with 38mm mounting flange.

.4 Mounting: Refer to schedules for mounting options.

.5 Factory baked enamel finish - custom colour to match exterior cladding to be selected by the architect.

2.10 Penthouse Louvers

.1 150 mm (6 inch) Fixed Blade Louver:

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.1 Type: All welded assembly with 150 mm (6 inch) deep with blades on 45 degree slope, mitred corners, sheet aluminum roof, with factory baked enamel finish - custom colour to be selected by the architect.

.2 Birdscreen with 13 mm (1/2 inch) square mesh for exhaust and 19 mm (3/4 inch) for intake.

Part 3 Execution

3.1 Installation

.1 Install to manufacturer's written instructions.

.2 Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

.3 Install diffusers to duct work with airtight connection.

.4 All diffusers, grilles and registers shall be free of fluttering, chattering and vibration. A felt or sponge rubber gasket shall be provided behind each outlet or inlet and adequate fastenings provided to prevent leakage between the outlet and duct, wall or ceiling.

.5 In all cases where linear diffusers are required to run continuous from one wall to another or between bulkheads, beams or other fascia the schedule size of the diffuser shall be confirmed by site measurements prior to final assembly.

.6 Floor grilles to be set flush with floor coverings except carpet. Frame to lap over carpet.

.7 Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

.8 Paint ductwork visible behind air outlets and inlets matte black.

.9 Care should be taken to install diffusers as per the reflected ceiling plans where available so that the diffusers will fit properly in the ceiling suspension system. The sheet metal subcontractor shall co-ordinate this work with the General Contractor, the suspended ceiling subtrade and electrical subtrade.

.10 Should there be any conflict in the location of grilles, registers and diffusers with lights, etc. the matter shall be referred to the Contract Administrator for directive. If requested by the Contract Administrator, the subcontractor shall relocate grilles, diffusers and registers and ductwork attached, within two feet of locations as indicated on the drawings, without extra cost to The City.

.11 Clearances from air outlets and inlets – coordinate with other divisions of work:

.1 Smoke alarms: edge of grilles, registers and diffusers for supply and return/exhaust to center of smoke alarm: 450 mm or greater.

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.2 Sprinkler heads: to NFPA 13, 762 mm (30 inches) or greater unless otherwise coordinated with the sprinkler contractor or where shown on the drawings.

.3 Gas detection: supply air GRD throw to not directly affect air movement around the gas sensor.

END OF SECTION

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Part 1 General

1.1 References

.1 AGA - Directory of Certified Appliances and Accessories.

.2 AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

.3 ASME SEC 4 - Boiler and Pressure Vessel Codes - Rules for Construction of Heating Boilers.

.4 ASME SEC 8D - Boilers and Pressure Vessel Codes - Rules for Construction of Pressure Vessels.

.5 CSA 4.9/ANSI Z21.13 - Gas Fired Low Pressure Steam and Hot Water Boilers.

.6 CSA B51 – Boiler, pressure vessel and pressure piping code

.7 CSA B149 - Natural Gas and Propane Code

.8 CSA C22.2 – Canadian Electrical Code

1.2 Submittals For Review

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements.

.3 Section 21 05 00: Submittals for information.

.4 Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.

.5 Manufacturer's Field Reports: Indicate condition of equipment after start-up including control settings and performance chart of control system.

.6 Section 21 05 00: Submittals for project closeout.

.7 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.3 Qualifications

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three year’s experience.

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1.4 Regulatory Requirements

.1 Conform to CSA C22.2 for internal wiring of factory wired equipment.

.2 I=B=R Performance Compliance: Condensing boilers must be rated in accordance with applicable federal testing methods and verified by AHRI as capable of achieving the energy efficiency and performance ratings as tested within prescribed tolerances.

.3 Conform to ASME SEC 4 for boiler construction.

.4 Units: ULC labeled. Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction. and tested to UL 795 Commercial-Industrial Gas Heating Equipment.

.5 Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.5 Delivery, Storage, and Protection

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.6 Warranty

.1 Section 21 05 00: Submittals for project closeout.

.2 Warranty Period for Fire-Tube Condensing Boilers

.1 The pressure vessel/heat exchanger shall carry a 10 year from shipment, non-prorated, limited warranty against any failure due to condensate corrosion, thermal stress, mechanical defects or workmanship.

.2 Manufacturer labeled control panels are conditionally warranted against failure for two years from shipment.

.3 All other components, with the exception of the igniter and flame detector, are conditionally guaranteed against any failure for 18 months from shipment

Part 2 Products

2.1 Manufacturers

.1 Basis of Design: Tringle Tube Solo

.2 IBC

.3 Navien

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.4 Viessmann

.5 Substitutions: Refer to Section 21 05 00.

2.2 General

.1 The boiler shall have a minimum Thermal Efficiency of 95% following the ANSI/AHRI 1500-2015 Standard for Performance Rating of Commercial Space Heating Boilers

.2 The boiler thermal efficiency shall be verified through a third party testing agency under the guidance of AHRI and listed in the AHRI Certification Directory.

.3 The boiler shall be assembled by an ISO 9001 registered company and the heat exchanger shall bear the ASME “H” stamp according to Section IV of the ASME Boiler and Pressure Vessel Code.

.1 The stainless steel heat exchanger of the boiler is to be hydrostatically pressure tested at the factory in accordance with ASME requirements.

.2 The maximum allowable working pressure is 30 psig water as listed on the ASME rating plate.

.3 The heat exchanger shall be registered with the National Board and contain a registry number and stamp on the ASME rating plate.

.4 The boiler shall meet the following regulatory requirements:

.1 The boiler shall be ITS / ETL certified and listed to ANSI Z21.13/CSA 4.9 latest edition test standards for U.S. and Canada.

.2 Boiler shall meet or exceed the SCAQMD (South Coast Air Quality Management District of California) Low NOx emission requirement of 14 NG/J.

2.3 Boiler

.1 The heat exchanger shall be a fire tube design constructed with 439 grade stainless steel to provide resistance to corrosion at elevated temperatures.

.2 The heat exchanger body shall be of welded construction and shall not contain any banding materials, bolts, gaskets or O-rings in the construction.

.3 The heat exchanger shall be of a counter flow / vertical design to assure that sediment and any potential lime that may form will fall to the bottom.

.4 The boiler combustion chamber shall be sealed and located at the top of the heat exchanger.

.5 The boiler flue ways shall be of a vertical design that allows condensate to “wash down” the flue surface preventing potential combustion residue from adhering to the flue ways.

.6 The boiler shall be supplied with a gas valve designed for negative pressure regulation.

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.7 The gas valve on the boiler shall operate with an inlet gas pressure of a minimum 5” w.c to a maximum of 13” w.c and shall be independent of the type of gas (natural or propane). If the inlet gas pressure exceeds the maximum allowable 13” w.c. a 100% lock-up type gas pressure regulator, properly sized, must be installed in the gas supply piping and adjust as to prevent an inlet gas pressure in excess of 13” w.c.

.8 The burner shall be a premix combustion type system, made with a burner head constructed of stainless material and able to provide a wide range of modulating firing rates.

.9 The boiler shall be equipped with a variable speed blower system to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency.

.10 The boiler shall be constructed with a heavy gauge steel jacket assembly, painted on both sides.

.11 The boiler control shall have an electronic graphical display for boiler set-up, boiler status and boiler diagnostics.

.12 The condensate pan, internal flue pipe, and vent/air connections shall be constructed of polypropylene.

2.4 Boiler Controls and Trim

.1 All electrical components shall be of the highest quality manufacture and bear a CSA, UL, or UL recognized label.

.2 Supply voltage shall be 120 volt / 60 hertz / single phase.

.3 Pressure gauge dial that is clearly marked and easy to read.

.4 ASME certified pressure relief valve, set to relieve at 30 psig.

.5 Low water protection.

.6 The boiler shall be furnished with control system that provides:

.1 High limit temperature control of 200°F.
.2 Operating temperature limit of 60°F to 188°F (refer to control strategies)
.3 Flue gas, supply and return water temperature sensors.
.4 Outdoor sensor to provide Outdoor Reset Control.
.5 Optional freeze protection feature.
.6 Capability to control one circulator
.7 Alarm and flame status contacts for integration into BMS systems.
.8 BACnet interface for integration into BMS system.
.9 Capability to accept a 0-10 VDC input signal for external modulation control.

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.10 Graphical display shall have an icon based menu system and use plain text so that error code charts are unnecessary.

2.5 Venting and Combustion Air

.1 The boiler shall be vented with a direct vent sidewall system with a horizontal sidewall termination of both the vent and combustion air pipes. The vent and combustion air pipes are not required to terminate on the same outside wall.

.2 The exhaust vent must be UL Listed for use with Category II, III and IV appliances and compatible with operating temperatures up to 230°F, positive pressure, condensing flue gas service. UL listed vents are PVC, CPVC, and AL 29-4C stainless steel. Polypropylene is not permitted due to vent length.

2.6 Condensate Neutralizer

.1 Provide refillable neutralization unit. Neutralization condensate released by the unit will be non-corrosive, and a safe pH level above 6.5. Standard of Acceptance is AXIOM NC-1.

Part 3 Execution

3.1 Installation

.1 Install to manufacturer's written instructions.

.2 Install to CSA B149.1.

.3 Install boiler on concrete housekeeping base, sized minimum 150 mm (6 inches) larger than boiler base.

.4 Provide connection of natural gas service to CSA 149.1.

.5 Provide piping connections and accessories as indicated; refer to drawings and Section 23 05 20 - Hydronic Specialties..

.6 Pipe relief valves to glycol fill station.

.7 Provide for connection to electrical service. Refer to Section 26 05 80 - Equipment Wiring.

3.2 Manufacturer's Field Services

.1 Perform tests and inspections and prepare test reports.

.1 Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies and equipment installations, including connections, and to assist in testing.

.2 Tests and Inspections

.1 Installation and Startup Test: Perform installation and start-up checks according to manufacturer's written instructions.

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.2 Leak Test: Perform hydrostatic test. Repair leaks and retest until no leaks exist.

.3 Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

.4 Controls and Safeties: Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

.1 Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.

.2 Set field-adjustable switches and circuit-breaker trip ranges as indicated.

.3 Remove and replace malfunctioning units and retest as specified above.

.4 Performance Tests

.1 The boiler manufacturer is expected to provide partial load thermal efficiency curves. These thermal efficiency curves must include at least three separate curves at various BTU input levels. If these curves are not available, it is the responsibility of the boiler manufacturer to complete the following performance tests:

.2 Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.

.3 Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.

.4 Repeat tests until results comply with requirements indicated.

.5 Provide analysis equipment required to determine performance.

.6 Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.

.7 Notify Contract Administrator in advance of test dates.

.8 Document test results in a report and submit to Contract Administrator.

.5 Prepare and start systems to Section 01 43 00.

.6 Instruct operating personnel in operation and maintenance of units.

3.3 Schedules

.1 Refer to schedule on drawing.

END OF SECTION

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Part 1 General

1.1 References

.1 ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

.2 ARI 270 - Sound Rating of Outdoor Unitary Equipment.

.3 ASHRAE - 90A - Energy Conservation in New Building Design.

.4 CSA B149.1 – Natural Gas and Propane Code

.5 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

.6 UL 207 - Refrigerant - Containing Components and Accessories, Non-electrical.

.7 UL 303 - Refrigeration and Air-Conditioning Condensing, and Air-Source Heat Pump Equipment.

1.2 Submittals for Review

.1 Section 21 05 10: Procedures for submittals.

.2 Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

.3 Product Data:

.1 Provide literature which indicates dimensions, weights, capacities, ratings, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.

.2 Provide data of filter media, filter performance data, filter assembly, and filter frames.

.3 Provide fan curves with specified operating point clearly plotted.

.4 Submit sound power level data for both fan outlet and casing radiation at rated capacity.

.5 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

.4 Manufacturer's Installation Instructions.

1.3 Submittals at Project Closeout

.1 Section 21 05 00: Submittals for project closeout.

.2 Operation And Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

.3 Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owners name and registered with manufacturer.

1.4 Quality Assurance

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum fifteen years experience, who issues complete catalogue data on total product.

1.5 Regulatory Requirements

.1 All equipment shall where specified and applicable, be pre-wired, and factory certified by an approved testing agency such as CETL, ETLUS, UL, CSA prior to shipment.

1.6 Environmental Requirements

.1 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.7 Electrical Requirements

.1 Pre-wired air handling units shall bear an approved label with all the necessary identification marks, electrical data, and any necessary cautions as required by the Canadian Electrical Code.

.2 Unit must conform to regulations set out in the Canadian Energy Efficiency Act for large air conditioners (condensing units). Packaged units shall be tested to CSA Standard C746-98 and must bear an EEV (energy efficiency verification) label provided by CSA. “Where specified as factory packaged air conditioning unit, factory assembled split systems do not conform to the Canadian Energy Efficiency Act and will not be considered.”

.3 All electrical circuits shall undergo a dielectric strength test, and shall be factory tested and checked as to proper function.

1.8 Extra Materials

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide one set for each unit of fan belts and filters

Part 2 Products

2.1 MANUFACTURERS

.1 Engineered Air

.2 Captive Air

.3 Air Wise

.4 Bousquet

.5 Substitutions: Refer to Section 21 05 20.

2.2 Manufactured Units

.1 MUA-1: Outdoor unit serving Kitchen, with packaged DX cooling, gas direct fired heat.

.2 MAU-2: Indoor unit serving Apparatus Bays, provide with remote outdoor DX condensing unit, gas fire direct heat.

.3 Construction and Ratings: To ARI 210/240 [, and UL 207 and UL 303]. Testing: ASHRAE 14.

2.3 Casing

.1 Unit casing shall be of minimum 18 gauge (1.3mm) satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two-part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated.

.2 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in and on all outdoor units roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.

.3 Units shall be provided with access doors to the following components: fans and motors, filters, dampers and operators, access plenums and humidifiers/wet cells, electrical control panels, burner compressor compartments. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.

.4 Units shall be provided with hinged access doors, with e-profile gasket, fully lined, and a minimum of two lever handles, operable from both sides for all units.

.5 All units shall be internally insulated with 2"(51mm) thick 1 1/2 lb./cu.ft. (24 kg./cu.m.) density insulation.

.6 1 1/2 lb./cu.ft. (24 kg/cu.m.) insulation shall be secured to metal panels with a fire retardant adhesive and welded steel pins at 16" (400mm) o/c. All longitudinal insulation joints and butt ends shall be covered by a sheet metal break to prevent erosion of exposed edges. Drain pans and all floor areas shall be insulated on the underside.

.7 Cooling coil drain pans shall be fabricated of stainless steel and are an integral part of the floor paneling, a minimum of 2" (51mm) deep, with welded corners. Drain pans shall extend a minimum of 6" (152mm) downstream of coil face and be provided with a 1 ½" (38mm) S.S. M.P.T. drain connection. Drain pans must have a fast pan and be sloped and pitched such that there is no standing water. Intermediate fast pans shall be provided between cooling coils where required for effective moisture removal.

.8 Units shall be weatherproofed and equipped for installation outdoors, where indicated. This shall include generally for the prevention of infiltration of rain and snow into the unit, louvers or hoods on air intakes and exhaust openings with 1"(25mm) galvanized inlet screens; rain gutters or diverters over all access doors; all joints caulked with a water resistant sealant; roof joints turned up 2" (51mm) with three break interlocking design; outer wall panels extend a minimum of ¼"(6mm) below the floor panel; drain trap(s) connections for field supply and installation of drain traps. Units mounted on roof curbs incorporate welded floor to base construction. Floors are of three break upstanding design with welded corners and free of penetrations. Unit underside joints are caulked.

2.4 Filters

.1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.

.2 The filter modules shall be designed to slide out of the unit. Side removal 2" (50mm) filters shall slide into a formed metal track, sealing against metal spacers at each end of the track.

.3 2"(50mm) Pleated Panel Disposable Filters: An optimum blend of natural and synthetic fiber media with a rust resistant support grid and high-wet strength beverage board enclosing frame with diagonal support members bonded to the air entering and air exiting side of each pleat. The filter media shall have a minimum efficiency of 30-35% on ASHRAE Standard 52.1-92, and a minimum of MERV 8 per ASHRAE 52.2. Rated U.L. Class 2.

.4 Where filters are provided in air handling units for heat recovery or make-up air applications and where hoar frost may occur, only steel frame filters are acceptable. Where indicated, units shall have both summer (upstream of heating recovery device) and winter (downstream of heat recovery device) filter sections. Only one set of filters is installed depending on ambient conditions.

.5 Filter media shall meet UL Class 2 standards.

2.5 Burners

.1 Assembly: For natural gas, capable of modulating turn down ratio of 25:1, including electric modulating main gas valve, motorized shut down valve, main and pilot gas regulators, pilot electric gas valve, manual shut-off valve and pilot adjustment valve.

.2 Pilot: Electrically ignited by spark rod through high voltage ignition transformer.

.3 Damper: Motorized with end switch to prove position before burner will fire.

2.6 Fan

.1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts

shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.

.2 Single low pressure forward curved fans shall be equipped with greaseable pillow block bearings, supported on a rigid structural steel frame.

.3 Airfoil and/or BI fans shall be equipped with greaseable, self-aligning ball or roller type pillow block bearings.

.4 Airfoil and BI fans shall be plenum type configuration where noted in schedules. Thrust restraint isolators shall be provided parallel to the shaft centerline when required to minimize axial movement and bending movements of the blower assembly(s). Drive side bearings on plenum fans shall be adapter style to ensure even clamping of the bearing sleeve to the shaft.

.5 Drives shall be adjustable on fans with motors 7 1/2 HP (5.6 kW) or smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure.

.1 Provide variable air volume fan control for units where scheduled via adjustable frequency drive which shall be mounted in a NEMA 1 enclosure and shall be labeled by an approved testing agency such as UL.

.2 Sine wave carrier input, PWM output. IGBT transistors. Adjustable acceleration and deceleration timing.

.3 Keypad to be removable, with alphanumeric display able to provide output status monitoring, output frequency, output voltage, output RPM, and output current. Include fault log display with capacity for the recent 30 faults with a time stamp. Diagnostic display menus to include reference speed command, heat sink temp, bus voltage, active I/O command status, time from power up, and current setting.

.4 Unit mounted manual VFD bypass switch locks out VFD, fan runs on maximum set volume. Bypass switch and all interlock contacts are factory mounted and pre-wired.

.5 Line and load reactors required for all 460 and 575 volt applications.

.6 Drive shall be factory supplied and installed.

.7 Provide BACnet card for interface to DDC system.

.8 Minimum CFM of 35% on DX and gas fired heat exchangers systems.

.6 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting shall be adjustable to allow for variations in belt tension.

.7 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The isolators shall be vertical spring type isolators with leveling bolts, bridge bearing waffled pads with minimum 1" (25mm) static deflection designed to achieve high isolation efficiency. Use of separate bumper or snubber is not acceptable. Fans shall be attached to the discharge panel by a

polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

.8 Provide single extended grease line from far side to access side bearing.

.9 Fan motors shall be ODP (open drip proof) Super-E high efficiency type.

2.7 Coils

.1 Coils shall be 1/2" O.D. as manufactured by Engineered Air, constructed of copper tube, aluminum fin, and copper headers.

.2 Fins constructed of aluminum or copper shall be rippled for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a galvanized steel casing. All coils shall be factory tested with air at 300 psig (2070 kPa) while immersed in an illuminated water tank.

.3 Coils shall be removable from the unit at the header end, unless shown otherwise on the drawings.

.4 Refrigerant evaporator type coils shall be equipped with distributors connected to the coil by copper tubes. Where a hot gas bypass is required, the inlet shall be at the refrigerant distributor.

.5 Refrigerant coils with multiple compressors shall be alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions. Provision for use of thermal expansion valves must be included.

2.8 Electrical Characteristics and Components

.1 The air handler(s) shall be ETL (UL) and ETL-Canada (ULC) listed by Intertek Testing Services, Inc. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236.

.2 Electrical Characteristics:

.1 Refer to Section 26 05 80.

.3 Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.

2.9 Dampers

.1 Damper frames shall be U-shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 1/2" (13mm) aluminum shall turn in nylon or bronze bushings. Rods shall be secured to the blade by means of straps and set screws.

.2 Blades shall be 18 gauge (1.3mm) galvanized metal with two breaks on each edge and three breaks on centerline for rigidity. The pivot rod shall "nest" in the centerline break. Damper edges shall interlock. Maximum length of damper between supports shall be 48”(1219 mm). Damper linkage brackets shall be constructed of galvanized metal.

.3 Dampers shall be standard construction and include blade ends sealed with an adhesive backed foamed polyurethane gasketting. Outdoor air dampers also include an all weather PVC seal fastened with a positive lock grip and pliable overlap edge on entering air side of interlocking edges. Dampers are interlocked from the center.

.4 Two position inlet dampers shall be parallel blade type.

2.10 Mechanical Cooling

.1 Compressors shall be high efficiency variable speed hermetic type , designed to continuously provide load matching operation between 30 and 90 Hz. Compressor is set on resilient neoprene mounts and complete with live voltage break internal overload protection and internal pressure relief valve. External crankcase heaters locked out during compressor operation.

.2 Air Cooled Condenser

.1 Condenser coils shall be copper tube type, mechanically expanded into aluminum fins. Coils shall be factory tested with air at 300 psig (2070 kPa) while immersed in an illuminated water tank.

.2 Condenser fans shall be direct driven propeller type arranged for vertical draw through airflow. Motors shall be weather resistant type, with integral overload protection and designed for vertical shaft condenser fan applications. Fan and motor assemblies shall be mounted on a formed orifice plate for optimum efficiency with minimum noise level.

.3 Condenser to form an integral part of the unit.

.4 Coil Section: condensing surface shall incorporate copper tubing throughout with type L copper headers. Multiple passes shall be adequately supported to eliminate droop and vibration.

.3 Packaged Air Conditioning Units

.1 Packaged units shall be CETL, ETLUS approved and operate down to 50°F(10°C) as standard. Where applicable, multiple refrigeration circuits shall be separate from each other. Refrigeration circuits shall be complete with liquid line filter-driers, and service ports fitted with Schraeder fittings. Units shall also incorporate load compensated thermal expansion valves with external equalizers and combination sight glass moisture indicators.

.2 Packaged units shall be supplied with R-410a refrigerant.

.3 Controls for hermetic compressor units shall include compressor and condenser fan motor contactors, supply fan contactors and overload protection, control circuit transformer, cooling relays, ambient compressor lockout, automatic reset low pressure controls, and manual reset high pressure controls on compressors over 6 tons. Head pressure actuated fan cycling control shall be provided on all multiple condenser fan units.

.4 Provide hot gas bypass on the lead compressor to maintain adequate suction pressure in the event of low loads.

.5 Compressors shall be located on the side of the unit in a service enclosure complete with hinged access doors c/w leverlok handles for ease of service.

2.11 Factory Supplied Controls / Wiring

.1 Provide a system of motor control, including all necessary terminal blocks, motor contactors, motor overload protection, grounding lugs, control transformers, auxiliary contactors and terminals for the connection of external control devices or relays.

.2 Gas fired units shall also include high limit and combustion airflow switch.

.3 Fire alarm circuits (where required) shall be powered from a relay in unit circuitry.

.4 Automatic controls shall be housed in a control panel mounted in or on the unit, which will meet that standard of the specific installation.

2.12 Controls

.1 Refer to Section 25 90 00 – Sequence of Operations and controls schematics.

.2 Controls: Pre-wire unit for connection of power supply. Field wiring from unit to remote control panel makes unit operative.

.3 Remote Control Panel: On-off switch, indicating lights for supply fan, pilot operation, burner operation, clogged filter indication and lockout indication.

.4 Interlocks: Unit to start when exhaust fan is running (see control strategies). Burner to operate when flow switch located in exhaust duct proves flow.

.5 Fan Discharge Thermostat: Controls modulating gas valve to maintain supply air temperature.

.6 Safety Controls: Sense correct air flow before energizing pilot and sense pilot ignition before activating main gas valve.

.7 Manual Reset Low and High Limit Controls: Maintain supply air temperature between set points and shut fan down if temperatures are exceeded.

.8 Purge Period Timer: Automatically delays burner ignition and bypass low limit control.

2.13 Performance

.1 Performance Ratings: Energy Efficiency Rating (EER) not less than requirements of ASHRAE 90A.

.2 Refer to schedules.

Part 3 Execution

3.1 Installation

.1 Install to manufacturer's written instructions.

.2 Install to NFPA 90A.

.3 Install to CSA B149.1. Provide connection to fuel gas system; refer to Section 22 10 00.

.4 Provide flexible duct connections on inlet and outlet from unit; refer to Section 23 33 00.

END OF SECTION

Part 1 General

1.1 References

.1 ASHRAE 103 - Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers.

.2 CAN/ULC S605 - Standard for Gas Vents

.3 CAN/ULC S609 - Standard for Low Temperature Vents Type L and PL

.4 CAN/ULC S636 - Standard for Type BH Gas Venting Systems

.5 CSA B149.1 – Natural Gas and Propane Installation Code.

.6 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

.7 NFPA 90B - Installation of Warm Air Heating and Air-Conditioning Systems.

.8 NFPA 211 - Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliances.

1.2 Submittals for Review

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide manufacturer's literature and data indicating rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

.3 Shop Drawings: Indicate assembly, required clearances, and locations and sizes of field connections.

1.3 Submittals for Information

.1 Section 21 05 00: Submittals for information.

.2 Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

1.4 Submittals at Project Closeout

.1 Section 21 05 00: Submittals for project closeout.

.2 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

.3 Warranty: Submit manufacturers warranty and ensure forms have been filled out in The City’s name and registered with manufacturer.

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1.5 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.6 Regulatory Requirements

.1 Products Requiring Electrical Connection: Listed and classified by ULC as suitable for the purpose specified and indicated.

1.7 Warranty

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide five year manufacturers warranty for heat exchangers.

1.8 Extra Materials

.1 Section 21 05 00: Submittals for project closeout.

Part 2 Products

2.1 Gas-Fired Unit Heaters

.1 Manufacturer:

.1 Reznor

.2 Sterling

.3 Substitutions: Refer to Section 21 05 00.

.2 Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner, controls, and accessories:

.1 Heating: Natural gas fired.

.2 Discharge Louvres: Individually adjustable horizontal louvres to match cabinet finish.

.3 Poly-Tube Outlet Adapter: Transition duct to adapt from unit outlet to round outlet flange for polyethylene tube duct.

.4 Air Filters: Filter cabinet with 25 mm (1 inch) type filters.

.3 Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors, glass fibre insulation and reflective liner.

.4 Supply Fan: Centrifugal forward curved type with belt drive.

.5 Heat Exchanger: titanium stabilized aluminized steel construction.

.6 Gas Burner:

.1 Atmospheric type with adjustable combustion air supply,

.2 Gas valve, provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.

.3 Electronic pilot ignition, with electric spark igniter.

.4 Combustion air damper with synchronous spring return damper motor.

.5 Non-corrosive combustion air blower with permanently lubricated motor.

.7 Gas Burner Safety Controls:

.1 Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.

.2 Flame rollout switch: Installed on burner box and prevents operation.

.3 Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.

.4 Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.

.8 Operating Controls

.1 Room Thermostat: Cycles burner to maintain room temperature setting.

.2 Supply Fan Control: Energize from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation.

.9 Performance:

.1 Refer to Schedule. Gas heating capacities are sea level ratings.

2.2 Room Thermostats

.1 Adjustable Room Thermostat: Low voltage, to control burner operation, heater stages in sequence with delay between stages, and supply fan to maintain temperature setting.

Part 3 Execution

3.1 Examination

.1 Section 01 10 00: Verification of existing conditions before starting work.

.2 Verify that space is ready for installation of units and openings are as indicated on shop drawings.

.3 Verify that proper power supply is available.

.4 Verify that proper fuel supply is available for connection.

3.2 Installation

.1 Install to NFPA 90B.

.2 Install gas fired units to CSA B149.1.

□

.3 Provide vent connections to CAN/ULC S605.

.4 Install unit heaters with vibration isolation. Refer to Section 23 05 48

3.3 Schedules

.1 Refer to schedule on drawing.

END OF SECTION

□

Part 1 General

1.1 References

.1 Air Conditioning, Heating and Refrigeration Institute

.1 AHRI 270 Sound Rating of Outdoor Unitary Equipment.

.2 AHRI 340, Performance Rating of Commercial and Industrial Unitary Air-conditioning and Heat Pump Equipment

.3 AHRI 365 Commercial and Industrial Unitary Air Conditioning Condensing Units.

.2 ASHRAE

.1 ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units.

.2 ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings

.3 ASTM International (ASTM)

.1 ASTM A48/A48M, Standard Specification for Grey Iron Castings.

.2 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.3 ASTM A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

.4 ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.

.5 ASTM D520, Standard Specification for Zinc Dust Pigment.

.4 CSA Group (CSA)

.1 CSA B52, Mechanical Refrigeration Code.

.2 CSA C656, Performance standard for split-system and single-package air conditioners and heat pumps

.5 National Electrical Manufacturers Association (NEMA)

.1 NEMA MG 1, Motors and Generators 16th edition.

.2 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

.6 National Research Council

.1 National Energy Code for Buildings

.7 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102.2, Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.

.8 Underwriters Laboratories

.1 UL 207 - Refrigerant-Containing Components and Accessories, Non-electrical.

.2 UL 303 - Refrigeration and Air-Conditioning Condensing, and Air-Source Heat Pump Equipment.

1.2 Submittals For Review

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system. On drawings indicate: connections, piping, fittings, valves, strainers, control assemblies and ancillaries, identifying factory and field assembled, dimensions, construction details, recommended installation and support, mounting bolt hole sizes and locations and point loads; vibration and seismic control measures.

.3 Product Data: Provide rated capacities, weights specialties and accessories, controls, electrical nameplate data, and wiring diagrams. Refer to Section fans, 23 73 23.

1.3 Submittals for Information

.1 Section 21 05 00: Submittals for information.

.2 Design Data: Indicate pipe and equipment sizing.

.3 Submit manufacturer's installation instructions.

1.4 Submittals at Project Closeout

.1 Section 21 05 00: Submittals for project closeout.

.2 Operation and Maintenance Data:

.1 Description of equipment giving manufacturers name, type, model year, capacity, serial number.

.2 Start-up and commissioning procedures and completed commissioning reports.

.3 Details of operation, servicing and maintenance including parts lists, options supplied with equipment and maintenance service interval requirements.

.4 Controls.

.5 Recommended spare parts list.

1.5 Regulatory Requirements

.1 Products Requiring Electrical Connection: Listed and classified by testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

.2 Energy performance rating to requirements of ASHRAE 90.1 or National Energy Code for Buildings, which ever is more stringent.

1.6 Delivery, Storage, and Protection

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

.3 Protect units on site from physical damage. Protect coils.

Part 2 Products

2.1 Air Cooled Condensing Units – 1.5 to 5 Tons

.1 MANUFACTURERS

.1 Carrier
.2 AAON
.3 Lennox
.4 Trane
.5 York
.6 Daikin
.7 Substitutions: Refer to Section 21 05 00.

.2 MANUFACTURED UNITS

.1 Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, and screens.
.2 Construction and Ratings: To ARI 210/240. Testing to ASHRAE.
.3 Performance Ratings: Energy Efficiency Rating (EER) not less than prescribed by ASHRAE 90.1 or NECB, which ever is greater.
.4 Refrigerant charge: 410a

.3 CASING

.1 Unit cabinet, including louvered coil guard, will be constructed of galvanized steel, bonderized, and coated with a powder coat paint.

.4 CONDENSER COILS

.1 Coils: Aluminum fins mechanically bonded to seamless copper tubing.
.2 Coil Guard: Louvred

.5 FANS AND MOTORS

.1 Vertical discharge direct driven propeller type condenser fans with fan guard on discharge.
.2 Condenser fan motors will be totally enclosed, 1—phase type with class B insulation and permanently lubricated..
.3 Fan blades will be statically and dynamically balanced.

.4 Condenser fan openings will be equipped with coated steel wire safety guards.

.6 COMPRESSORS

.1 Compressor: Hermetic scroll type.

.2 Mounting: Statically and dynamically balance rotating parts and mount on rubber-in-shear vibration isolators.

.3 Capacity Reduction Equipment: two-step scroll compressors for load matching cooling and heating and improved part load efficiency

.4 Compressor will be covered with a sound absorbing blanket.

.7 REFRIGERANT CIRCUIT

.1 Provide each unit with one refrigerant circuit, or two independent refrigerant circuits, where shown on the drawings factory supplied and piped.

.2 For each refrigerant circuit, provide:

.1 liquid—line back seating shutoff valve with sweat connections,

.2 vapor--line back seating shutoff valve with sweat connections,

.3 system charge of R-410A refrigerant,

.4 POE compressor oil, accumulator, and reversing valve.

.5 High pressure switch, loss of charge switch, filter drier

.6 Thermostatic Expansion Valve (TXV) Bi—Flow

.7 Snow Stand

.8 Liquid--Line Solenoid Valve (LLS)

.9 Crankcase heater

.10 Compressor Hard Start capacitor and relay

.8 CONTROLS

.1 Control signal to come from associate system with evaporator coil.

.2 Thermostats controlling the condensing unit must not require manufacturer’s proprietary device.

.9 ELECTRICAL CHARACTERISTICS AND COMPONENTS

.1 Electrical Characteristics:

.1 Refer to Section 26 05 80.

.2 Motor: Refer to Section 23 05 13.

2.2 Air Cooled Condensing Units 6 to 20 Tons

.1 Integrated package: to CAN/CSA-C656.

.2 MANUFACTURERS

.1 Engineered Air

.2 Aaon

.3 Carrier

.4 Diakin

.5 Substitutions: Refer to Section 21 05 01.

.3 MECHANICAL COOLING

.4 Compressors:

.1 Digital scroll with infinite capacity modulation from 20% to 100% variable modulation. Set on resilient neoprene mounts and complete with live voltage break internal overload protection. Internal pressure relief valve and external crankcase heaters locked out during compressor operation.

.5 Air Cooled Condenser

.1 Condenser coils shall be copper tube type, mechanically expanded into aluminum fins. Coils shall be factory tested with air at 300 psig (2070 kPa) while immersed in an illuminated water tank.

.2 Condenser fans shall be direct driven propeller type arranged for vertical draw through airflow. Motors shall be weather resistant type, with integral overload protection and designed for vertical shaft condenser fan applications. Fan and motor assemblies shall be mounted on a formed orifice plate for optimum efficiency with minimum noise level.

.6 Split System Condensing Units

.1 Condensing units shall be $_{C}$ETL approved. Condensing units shall operate down to 50°F (10°C) as standard. Multiple compressor/condenser circuits shall be separate from each other. Suction and liquid lines shall be extended to the outside of the cabinet. Service ports fitted with Schraeder fittings shall be connected to the suction and discharge lines for charging or pressure gauge readings.

.2 Controls for hermetic compressor units shall include compressor and condenser fan motor contactors, control circuit transformer, cooling relays, non-recycling pump down relays, ambient compressor lockout, manual reset high pressure controls and automatic reset low pressure controls. Head pressure actuated fan cycling control shall be provided on all multiple condenser fan units.

.3 Provide five minute anti-cycle timers.

.4 Provide interstage time delay timers.

.5 Provide hot gas bypass connection on the lead compressor.

.6 Refrigeration specialties such as solenoid valves, TX valves, etc., to be supplied and installed by refrigeration contractor.

.7 Units shall be supplied with R-410 refrigerant.

.8 Provide hot gas bypass on the lead compressor to maintain adequate suction pressure in the event of low loads. This feature shall be provided on all VAV and Make-Up Air applications with less than four stages of cooling control.

.9 Compressors shall be located on the side of the unit in a service enclosure complete with hinged access doors c/w leverlok handles for ease of service.

.10 Refer to schedules for minimum number of compressors.

.7 PERFORMANCE

.1 Performance Ratings: Energy Efficiency Rating (EER) not less than prescribed by ASHRAE 90.1 or NECB, which ever is greater.

.8 ELECTRICAL

.1 Refer to Electrical Equipment schedules on drawings.

Part 3 Execution

3.1 Installation

.1 Install to manufacturer's installation written instructions.

.2 Complete structural, mechanical, and electrical connections to manufacturer's installation instructions.

.3 Provide for connection to electrical service.

.4 Provide connection to refrigeration piping system and evaporators. Refer to Section 23 23 00. Comply with CSA B52.

.5 Provide charge of refrigerant and oil.

3.2 Demonstration and Instructions

.1 Section 21 05 00: Demonstrating installed work.

.2 Replace losses of oil or refrigerant prior to end of correction period.

.3 Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.

.4 Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

.2 AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

.3 AHRI 260 - Sound Rating of Ducted Air Moving and Conditioning Equipment

.4 AHRI 1060 - Performance rating of Air-to-Air Heat Exchangers for Energy Recovery Equipment.

.5 CAN/ULC-S102 - Standard Method Of Test For Surface Burning Characteristics Of Building Materials And Assemblies

.6 CSA C22.2 – Canadian Electrical Code

.7 CSA 22.2 No 236/UL 1995 – Heating and Cooling Equipment

.8 CAN/CSA C439 - Standard laboratory methods of test for rating the performance of heat/energy-recovery ventilators

.9 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.2 SUBMITTALS

.1 Section 21 05 00: Common Work for Mechanical.

.2 Shop Drawings: Indicate assembly of heat recovery units and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

.3 Manufacturer's Installation Instructions.

1.3 OPERATION AND MAINTENANCE DATA

.1 Section 21 05 00: Common Work for Mechanical.

.2 Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.4 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 All materials in contact with the air stream to be compliant with acceptable CAN/ULC-S102 surface burning characteristics.

.3 Electrical to comply with CSA C22.2 requirements.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Section 21 05 00: Common Work for Mechanical.

.2 Protect motors, shafts, and bearings from weather and construction dust.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Do not operate equipment for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

1.7 EXTRA MATERIALS

.1 Section 21 05 00: Common Work for Mechanical.

.2 Provide two sets of filters.

Part 2 Products

2.1 DUAL CORE REVERSING ENERGY RECOVERY VENTILATORS

.1 Manufacturers

.1 Tempeff
.2 Price
.3 Southampton
.4 BKM

.2 Substitutions: Not Permitted

.3 General

.1 Configuration: Fabricate as detailed on drawings.
.1 Performance:
.1 Conform to ARI 430. Refer to schedules on drawings.
.2 Performance shall be based on a maximum 450 fpm face velocity across the heat exchanger.
.2 Acoustics: Sound power levels (dB) for the unit shall not exceed levels specified in the schedule. The manufacturer shall provide the necessary sound treatment to meet these levels if required.
.2 Where the unit arrangement differs from the drawings, the mechanical contractor is responsible for any additional structural, architectural, electrical and mechanical work that may be required and ensuring that intakes and outlets are arranged to meet code requirements.

.4 Unit Construction

.1 Fabricate unit with extruded aluminum channel posts and galvanized panels secured with mechanical fasteners.

.3 Fabricate curb mounted unit with frameless construction with insulated galvanized panels secured with mechanical fasteners.

.2 Unit shall be capable of having all panels remove simultaneously for servicing without affecting the structural integrity of the unit.

.4 The unit structure shall be self-supporting.

.3 All access doors shall be sealed with permanently applied gaskets.

.5 Panels and access doors shall be constructed as a 50-mm nominal thick; thermal broken double wall assembly, with U_{SI}=0.0222 W/mK equivalent insulation.

.4 The outer panel shall be constructed of 24 gauge G90 galvanized steel. The inner liner shall be constructed of 24 gauge G90 galvanized steel.

.6 Module to module assembly shall be accomplished with gaskets.

.5 Access Doors shall be flush mounted to cabinetry, with minimum of two hinges, locking latch and full size handle assembly.

.5 Fans

.1 Provide direct-drive EC motor supply and exhaust fan(s). Fan assemblies including fan, motor shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Manufacturer must ensure maximum fan RPM is below the first critical speed.

.7 Bearings shall be self-aligning, grease lubricated, ball or roller bearings. Grease fittings shall be attached to the fan base assembly near access door.

.2 Fan and motor shall be mounted internally on a steel base. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on spring vibration type isolators inside cabinetry.

.6 Bearings And Drives

.1 Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards, L-50 life at 200,000 hours – heavy duty pillow block type, self-aligning, grease-lubricated ball bearings.

.8 Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

.7 Particulate Filters

.1 Filter section with filter racks and guides with hinged and latching access doors on either, or both sides, for side loading and removal of filters.

.9 Filter media shall be UL 900 listed, Class I or Class II.

.2 Flat arrangement with 50mm deep pleated disposable panel filters.

.10 See schedule for pre-filter and final filter requirements.

.8 Energy Recovery

.1 Reverse Flow Energy Recovery

.1 Unit shall be equipped with Dual Core energy recovery technology. The unit shall be 90% temperature efficient (+-5%) in winter and up to 80% in summer. Recovery effectiveness based

on equal supply and exhaust airflow rates. It shall also provide up to 70% latent recovery. Unit shall accomplish this recovery without a defrost cycle that will reduce the effectiveness of the device.

.1 Devices employing defrost cycles that bypass the heat recovery device, or reduce the effectiveness are not acceptable. Heat recovery device shall not require frost protection in applications down to -40 degrees C.

.2 Cores shall be comprised of precisely corrugated high-grade aluminum.

.2 Recovery cycles shall be controlled by internal programmed thermostats measuring both supply and exhaust air and optimizing performance of both heat recovery and free cooling modes.

.2 Dampers

.1 Switchover damper section shall be comprised of low leakage dampers with EPDM seals operated by electric damper motors complete with DC braking.

.2 Damper blades, rods and axles shall be galvanized for long life expectancy.

.9 Electrical

.1 Single point power connection.

.11 The ventilators(s) components shall be CSA, UL or CE listed as applicable.

.2 Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. All wires shall be number tagged and cross-referenced to the wiring diagram for ease of troubleshooting.

.12 Fan motors shall be 1800 rpm, open drip-proof (ODP) type. Motors shall be high efficiency to meet EPAct requirements. Electrical characteristics shall be as shown in schedule.

.3 Motors shall be rated for use with variable frequency drives (VFD)

.10 Controls

.1 Provide BacNet MSTP communication to building automation system and integrate with Section 25 90 00 as indicated. Provide the following control points:

.2 Controls must include self diagnostics with fault and PLC error Code. On board fault detection and diagnostics that senses and alerts when the damper is not operating correctly.

.13 Air handler manufacturer shall provide and mount a damper hand-off-auto (HOA) switch.

Part 3 Execution

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install flexible connections specified in Section 23 33 00 between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm (one inch) flex between ductwork and fan while running.

.3 Provide backdraft dampers on discharge of exhaust fans and as indicated. Refer to Section 23 33 00.

.4 Pipe condensate drains to nearest floor drain, as shown in mechanical drawings.

.5 All heat recovery system to be tested as noted in Specification Section 23 05 93 – Testing, Adjusting, And Balancing.

END OF SECTION

Part 1 General

1.1 References

.1 American National Standards Institute/American Society of Heating, Refrigeration and Air-Conditioning Engineers (ANSI/ASHRAE)

.1 ANSI/ASHRAE Standard 15, Safety Standard for Refrigeration Systems.

.2 Air-Conditioning and Refrigeration Institute (ARI)

.1 AHRI/ISO-13256-1, Standard for Water-Source Heat Pumps.

.2 AHRI/ISO-13256-1, Standard for Ground Water - Source Heat Pumps.

.3 CSA And UL International

.1 CAN/CSA-C13256, Water-Source Heat Pumps-Testing and Rating for Performance, Part 1 Water-to-Air and Brine-to-Air Heat Pumps.

.4 ASHRAE/IESNA 90.1 - Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.

.5 National Fire Protection Association (NFPA)

.1 NFPA 90A, Standard for Installation of Air Conditioning and Ventilating Systems.

.2 NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

1.2 Submittals for Review

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide drawings indicating dimensions, rough-in connections, and electrical characteristics and connection requirements.

1.3 Submittals for Information

.1 Section 21 05 00: Submittals for information.

.2 Submit manufacturer's installation instructions. Indicate assembly, support details, connection requirements, and include start-up instructions.

1.4 Submittals for Closeout

.1 Section 21 05 00: Submittals for project closeout.

.2 Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.5 Quality Assurance

.1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.2 Energy-Efficiency Ratio: Minimum as prescribed by ASHRAE/IESNA 90.1.

.3 Coefficient of Performance: Minimum as prescribed by ASHRAE/IESNA 90.1.

.4 Provide equipment that operate using HCFC-free refrigerants.

1.6 Regulatory Requirements

.1 Products Requiring Electrical Connection: Listed and classified by ULC, CSA, as suitable for the purpose specified and indicated.

1.7 Delivery, Storage, and Protection

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Protect finished cabinets from physical damage by leaving factory packing cases in place before installation and providing temporary covers after installation.

1.8 Warranty

.1 Section 21 05 00: Submittals for project closeout.

.2 Warranty Period:

.1 Manufacturer's standard, minimum one year from date of Substantial Completion, including components and labour.

Part 2 Products

2.1 Water-to-Air Source Heat Pumps:

.1 Manufacturers

.1 Basis of Design: Florida Heat Pump

.2 Daikin

.3 Water Furnace

.4 Substitutions: Refer to Section 21 05 00.

.2 HP-1 to HP-12 (Horizontal)

.1 FHP Model LV.

.2 Horizontal type, as indicated, consisting of factory-assembled package containing fan, air-to-refrigerant coil, compressor, reversing valve, water-to-refrigerant heat exchanger, controls for use with R410.

.3 HP-13 (Vertical)

.1 FHP Model EC.

.2 Vertical type, as indicated, consisting of factory-assembled package containing fan, air-to-refrigerant coil, compressor, reversing valve, water-to-refrigerant heat exchanger, controls for use with R410.

.4 Cabinet:

.1 Heavy gauge G-60 galvanized sheet metal

.1 13mm (1/2-inch) thick, 1.5 lb, coated fiberglass insulation. Flame spread of less than 25 and a smoke developed classification of less than 50 per ASTM E-84 and UL 723. Insulation must meet NFPA 90A requirements.

.5 Filters

.1 50mm (2 inch) MERV 8 filter, removable from either side of the unit.

.6 Refrigerant Circuit

.1 R-410A sealed refrigerant circuit

.2 Rotary, reciprocating or scroll compressor with thermal overload protection

.3 Thermostatic expansion valve

.4 Aluminum lanced-fin and rifled copper tube refrigerant-to-air heat exchanger

.5 Reversing valve

.6 Coaxial, fluted, tube-in-tube, refrigerant-to-water heat exchanger.

.1 Copper inner tube

.2 Steel outer tube

.3 Working pressure of 500 psig waterside and 600 psig refrigerant side

.7 Compressor

.1 Hermetic compressor mounted on rubber grommets.

.1 Mass plate under the compressor.

.1 Dual material assembly.

.1 Top heavy gauge galvanized steel.

.2 Bottom is a visoelastic isolation material with 1/8" thick, 1 lb./sq. ft. with a barrier layer

.2 Compressor Safety

.1 Safety controls

.1 3 safety devices;

.2 high refrigerant pressure switch,

.3 low refrigerant pressure switch

.4 low refrigerant suction temperature sensor

.2 Lockout circuit by the thermostat or at the unit disconnect switch.

.3 Factory installed Refrigerant gauge access fittings on high and low pressure refrigerant lines.

.8 Hydronic Connection

.1 Flexible stainless steel braiding over fire rated inner tubing, threaded connection to match unit, sizing to match unit pipe connection, minimum 18”.

.2 Hose package complete with

.1 2 way motorized valve wired to compressor circuit, valve opens when compressor starts.

.2 Ball valves on supply and return

.3 Auto flow control valve

.4 Y strainer and blowdown valve.

.9 Drain Pan

.1 High density polyethylene (HDPE) plastic

.2 Sloped on two planes.

.3 Electronic condensate overflow protection.

.10 Fan and Motor Assembly:

.1 Direct drive centrifugal fan motor assembly.

.1 Removable orifice ring to facilitate fan motor and fan wheel removal without removing the fan housing.

.2 PSC Motor

.11 Electrical

.1 Internal control box

.1 Controls for compressor, reversing valve and fan motor operation and shall have either, a 100VA transformer and a terminal block for low voltage field wiring connections.

.2 Heating or cooling as required by the set points of the wall thermostat.

.3 Output signal to an LED on the thermostat

.4 Central monitoring panel to indicate a “fault” condition from the activation of any one of the safety switches.

2.2 Water-to-Water Source Heat Pump (WSHP-1)

.1 Manufacturers

.1 Florida Heat Pump Model WT

.2 Substitutions: Refer to Section 21 05 00.

.2 General:

.1 Factory-tested and assembled single-piece water source heat pump units shall be factory wired, charged with HFC-410A, contain refrigerant to-water heat exchanger, 4-way reversing valve, compressor, metering device, and all internal controls and safety devices.

.3 Extended Range

.1 Unit shall operate at entering water temperature of 54 to 110°F.

.2 Extended range adds closed cell isolation to internal water lines and provides insulation on suction side refrigeration tubing including refrigerant-to-water heat exchangers.

.4 Cabinet:

.1 Three panel construction

.2 16 gauge G-60 galvanized sheet metal, powder-painted

.3 Lined internally with 1/2-in. thick 1-3/4 lb per cu ft density acoustic type fiberglass Insulation must meet NFPA 90A

.5 Compressor

.1 Heat pump duty, scroll compressors with internal and external isolation.

.6 Heat Exchangers:

.1 Refrigerant-to-water heat exchanger

.1 Steel/copper tube-in-tube type rated for coaxial 625 psig refrigerant, 450 psig water-side pressures.

.2 Powder coated

.7 Refrigerant Circuit

.1 Refrigeration circuit components R-410A

.1 Liquid line service valve

.2 Suction line service valve

.3 Reversing valve

.4 Full charge of compressor oil

.5 Holding charge of refrigerant.

.2 Thermostatic expansion valve

.8 Controls and Safeties:

.1 Safety devices

.1 Low pressure sensor

.2 High-pressure switch

.3 Low water temperature sensor.

.2 Solid-state control system.

.1 Control system microprocessor board protect against building electrical system noise contamination, EMI and RFI interference.

.2 Interface with a heat pump type thermostat.

.3 The control system features:

.1 Anti-short cycle time delay on compressor operation

.2 Random start on power-up.

.3 Low voltage protection.

.4 High voltage protection.

.5 Unit shutdown on high or low refrigerant pressures.

.6 Unit shutdown on low water temperature

.7 Option to reset unit at thermostat or disconnect.

.8 Automatic intelligent reset.

.9 Unit shall automatically restart 5 minutes after shutdown if the fault has cleared. Should a fault occur 3 times sequentially, then lockout will occur.

.10 Ability to defeat time delays for servicing.

.11 Light-emitting diode (LED) to indicate high pressure, low pressure, improper voltage, source freeze protection, load freeze.

Part 3 Execution

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for heat pumps installation in accordance with manufacturer's written instructions.

.1 Inform Contract Administrator of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied

3.2 Installation

.1 Install where indicated and in accordance with manufacturer's instructions.

.2 Make duct connections through flexible connections.

.3 Level unit with fans running. Align duct work. flexible connections. Misalignment with fan stopped not to strain or damage flexible connection.

.4 Make piping connections.

.5 Nothing to obstruct ready access to components or to prevent removal of components for servicing.

3.3 Start-Up and Commissioning

.1 Have manufacturer certify installation.

.2 Have manufacturer representative present tests and start up units and certify performance.

.3 Submit written start-up and commissioning reports to Contract Administrator.

END OF SECTION

Part 1 General

1.1 References

.1 ARI 410 - Forced-Circulation Air-Cooling and Air- Heating Coils.

.2 SMACNA - HVAC Duct Construction Standards, Metal and Flexible.

1.2 Submittals for Review

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

.3 Shop Drawings: Indicate coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

1.3 Submittals for Information

.1 Section 21 05 00: Submittals for information.

.2 Certificates: Certify that coil capacities, pressure drops, and selection procedures meet or exceed specified requirements and that the coils are tested and rated to ARI 410.

1.4 Submittals at Project Closeout

.1 Section 21 05 00: Submittals for project closeout.

.2 Warranty: Submit manufacturer warranty and ensure forms have been completed in The City's name and registered with manufacturer.

1.5 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.6 Regulatory Requirements

.1 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., CSA, and/or any testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.7 Delivery, Storage, and Handling

.1 Section 21 05 00: Transport, handle, store, and protect products.

.2 Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.

□

.3 Protect coils from entry of dirt and debris with pipe caps or plugs.

1.8 Warranty

.1 Section 21 05 00: Submittals for project closeout.

.2 Provide five-year manufacturer warranty for all coils.

Part 2 Products

2.1 Electric Duct Heaters

.1 Description: Duct-mounted electric resistance heater, with terminal and control box, coil, casing, and controls.

.2 Manufacturer: Thermolec

.1 Substitutions: Refer to Section 21 05 00

.3 Assembly: CSA approved, UL listed and labelled, with terminal control box and accessible cover, splice box, coil, casing, and controls.

.4 Performance: refer to schedules.

.5 Construction

.1 Duct mounting shall be flange connection.

.2 Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA.

.6 Coils

.1 Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA. Coils made of high-grade Nickel-Chrome alloy and shall be insulated by floating ceramic bushings from the galvanized steel frame. Coil terminal pins shall be in stainless steel, mechanically secured and insulated from the frame by means of non-rotating ceramic bushing. Coil support bushing shall be made of ceramic and shall be held in the frame by a lock which will keep it floating and stress-free.

.2 Round Tubular: Frame shall be corrosion-resistant and made of galvanized steel of suitable gauge as required by CSA. Heating elements shall be tubular type made of heavy gauge Incoloy 800 filled with compacted magnesium oxide insulating powder. Above 277 Volts or 30KW, each tube shall be of "U" type and shall be removable through the control box without removing the heater from its ductwork.

.7 Controls:

.1 Operating:

.1 All duct heaters shall be complete with the following standard built-in controls:

.1 High limit cut-outs

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.2 Magnetic contactors (as required)

.3 Control transformer

.4 Air flow sensor.

.5 SCR proportional controller

.8 Safety:

.1 High temperature cut-outs

.1 Heaters shall be equipped with fail-safe automatic reset disc-type high temperature thermal cut-out(s) located in the top frame component above the heating elements.

.2 For heaters of 30 kW and less, rated for voltages below 300 volts, in addition to the automatic reset high temperature cut-out, shall be equipped with a fail-safe manual reset disc-type high temperature thermal cut-out, semi-recessed in the terminal box, facing the heating element hairpin as required by CSA 22.2.

.2 The sensing element of the cut-out shall be stream mounted, shall be shielded from mechanical damage and shall face the center portion of the heating section so as to make the heater non-sensitive to air flow direction.

.3 Cut-outs shall de-energize the heater in case of insufficient air flow.

.4 The heater shall be equipped with a built-in line-voltage disconnect to switch the power off at the heater location and protective screens on both sides (where applicable).

.5 Load fuses shall be supplied as required by CSA 22.2.

.9 Airflow:

.1 Duct heaters shall be non-sensitive to air flow direction and interchangeable for horizontal or vertical ducts without impairing safety.

.2 Heaters shall be CSA approved for zero clearance in horizontal ducts.

.10 Electrical Characteristics:

.1 All internal wiring shall terminate on clearly identified terminal blocks.

.2 A wiring diagram shall be installed on the control box cover

.3 Prior to shipping, all units shall withstand tests as required by CSA/UL.

.4 Refer to schedule on drawings for electrical power requirements.

Part 3 Execution

3.1 Installation

.1 Install to manufacturers written instructions. Refer to drawing details.

.2 Install in ducts and casings to SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.1 Support coil sections independent of piping on steel channel or double angle frames and secure to casings.

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.2 Provide frames for maximum three coil sections.

.3 Arrange supports to avoid piercing drain pans.

.4 Provide airtight seal between coil and duct or casing.

.5 Refer to Section 23 31 00.

.3 Protect coils to prevent damage to fins and flanges. Comb out bent fins.

.4 Make connections to coils with unions and flanges.

.5 Electric Duct Coils:

.1 Install to manufacturer's written instructions.

.2 Install a minimum 1200mm from any airflow disturbances such as fan outlets, balancing or VAV dampers or duct directional changes.

.3 Install unit with sufficient clearance from adjacent construction, piping, ductwork, and other obstructions to allow access for service and maintenance.

.4 Connect power and controls to duct heater as specified in Section 26 05 80.

.5 Maintain 4 feet straight duct before coil and 2 feet after coil. Reductions in distances specified are acceptable only if acceptable by the manufacturer.

.6 Field Quality Control:

.1 Verify operation of each electric duct heater by measuring input voltage and current simultaneously for period of ten minutes of continuous operation.

.2 Verify supply air temperature control by measuring supply air temperature after the coil.

.3 Demonstration: Demonstrate location of circuit breakers and switches serving duct heater branch circuits, and location and setting procedures for thermostats and other heating controls.

END OF SECTION

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Part 1 General

1.1 Building Automation System (BAS) Scope

.1 Contractor to provide control system compatible with The City's Johnson Controls system, including Johnson Advanced Field Equipment Controllers (FACs).

.1 Contractor to provide all packaged controls, field controllers, wiring, devices and actuators, and supervisory controller.

.2 Contractor to provide all programming and graphics for a complete system. The contractor will migrate the system including graphics into the existing City of Winnipeg Metasys User Interface (MUI).

.3 Contractor to commission controls system.

.4 The Contractor will connect the supervisory controller to the City of Winnipeg ADX server.

.5 An operator work station (OWS) will not be provided as part of this contract.

.2 Contractor to provide home-run cables from Supervisory Controller to patch panel in IT Room. Cable, conduit, and cable supports to be provided according to Div 26.

.3 Contractor to provide home-run cable from SCBA Room to patch panel in IT Room for future equipment connection. Cable, conduit, and cable supports to be provided according to Div 26.

.4 Refer to Controls Schematics, Controls Network Diagram, and Section 25 90 00 – Sequence of Operations.

.5 The Controls Network Diagram provided on drawings is schematic and is intended to communicate the intent of the system architecture and division of controls work between The City and the Contractor. Actual network architecture and the number of field controllers may vary as shown.

1.2 References

.1 AMCA 500 - Test Methods for Louvres, Dampers and Shutters.

1.3 Submittals for Review

.1 Section 21 05 00: Procedures for submittals.

.2 Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.

.3 Shop Drawings:

.1 Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of

valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.

.2 As part of shop drawing submittals produce a Controls Network Diagram, floorplan indicating controller locations, narrative sequence of operations, and product data for all BAS components.

1.4 Submittals for Information

.1 Section 21 05 00: Submittals for information.

.2 Manufacturer's Instructions: Provide for all manufactured components.

1.5 Submittals at Project Closeout

.1 Section 21 05 00: Submittals for project closeout.

.2 Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.

.3 Revise shop drawings to reflect actual installation and operating sequences.

.4 Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

.5 Warranty: Submit manufacturer’s warranty and ensure forms have been filled out in The City’s name and registered with manufacturer.

1.6 Quality Assurance

.1 All products used in this installation shall be new, currently under manufacture, and shall be applied in standard off-the-shelf products. This installation shall not be used as a test site for any new products unless explicitly approved by the Contract Administrator in writing. Spare parts shall be available for at least 5 years after completion of this contract.

1.7 Regulatory Requirements

.1 All work, materials, and equipment shall comply with the rules and regulations of all codes and ordinances of the local, provincial, and national authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the current editions in effect 30 days prior to receipt of bids of the following codes:

.1 Canadian Electric Code (CEC)
.2 National Building Code (NBC)
.3 ASHRAE 135
.4 Underwriters Laboratories UL916

1.8 Warranty

.1 Section 21 05 00: Submittals for project closeout.

.2 Labor and materials for the control system and components provided by the Contractor shall be warranted free from defects for a period of 12 months after final completion and acceptance. Failure of control system and components, provided by the Contractor, during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to The City. The Contractor shall respond to The City's request for warranty service within 24 hours during normal business hours.

.3 All work shall have a single warranty date, even when The City has received beneficial use due to an early system start-up. If the work specified is split into multiple contracts or a multi-phase contract, then each contract or phase shall have a separate warranty start date and period

.4 At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the Contract Administrator, the Contract Administrator shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this specification. The date of acceptance shall be the start of warranty.

.5 Exception: The Contractor shall not be required to warrant reused devices, except for those that have been rebuilt and/or repaired. The Contractor shall warrant all installation labour and materials, however, and shall demonstrate that all reused devices are in operable condition at the time of Contract Administrator's review.

1.9 Maintenance Service

.1 Maintenance Service of BAS system to be provided by The City.

1.10 System and Component Performance

.1 Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).

.2 Graphic Display. A graphic with 20 dynamic points shall display with current data within 2 sec.

.3 Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.

.4 Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.

.5 Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.

.6 Alarm Response Time. The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds

.7 Object Scan. All changes of state and change of analog values will be transmitted over the high-speed Ethernet network such that any data used or displayed at a controller or workstation will have been current within the previous 2 seconds

.8 Performance. Programmable controllers shall be able to completely execute PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.

.9 Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.

.10 Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5ºC (±1ºF)
Ducted Air	±0.5ºC (±1ºF)
Outside Air	±1.0ºC (±2ºF)
Dew Point	±1.5ºC (±3ºF)
Water Temperature	±0.5ºC (±1ºF)
Delta-T	±0.15ºC (±0.25ºF)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO 2)	±30 ppm

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Space Temperature	±1.0ºC (±2.0ºF)	
Duct Temperature	±1.5ºC (±3ºF)	
Humidity	±5% RH	

Part 2 Products

2.1 Control Panels

.1 Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

.2 NEMA 250, general purpose utility enclosures with enamelled finished face panel.

.3 Provide common keying for all panels.

2.2 Control Valves and Valve Operators

.1 Acceptable manufacturers.

.1 Belimo
.2 Siemens
.3 Honeywell
.4 Schneider Electric
.5 Johnson Controls
.6 Substitutions: Refer to Section 21 05 00.

.2 Where control valves are shown on drawings as provided with a hose package, provide hose package as listed in 23 05 20 – Hydronic Specialties.

.1 Globe Pattern:

.1 Manufacturer: Siemens Model Powermite/Flowrite 599.
.2 Other acceptable manufacturers offering equivalent products.
.1 Substitutions: Refer to Section 21 05 00.
.3 Up to 2 inch (50 mm): Bronze body, brass trim, stainless steel rising stem, all metal plug and seat, EDPM packing, screwed ends.
.4 Over 2 inches (50 mm): Cast Iron body, stainless steel trim, rising stem, plug-type disc, EDPM packing, flanged ends, renewable seat and disc.
.5 Hydronic Systems:
.1 Rate for service pressure of 860 kPa at 121 degrees C (125 psig at 250 degrees F).
.2 Replaceable plugs and seats of brass.
.3 Size for 20 kPa (3 psig) maximum pressure drop at design flow rate unless otherwise noted.
.4 Two way valves with equal percentage characteristics, three way valves with linear characteristics. Size two way valve operators to close valves against pump shut off head.

.2 Valve Operators:

.1 General: Provide smooth proportional control with sufficient power for full shut off at maximum pump differential pressure or maximum head pressure development from the pump, elevation and system pressure.
.2 Spring return to normal position as indicated on freeze, fire, or temperature protection.
.3 Number: Sufficient to achieve unrestricted movement throughout actuation range.
.4 Operators (2 Position): Synchronous motor with enclosed gear train, dual return springs, valve position indicator; 24 v DC. Valves: spring return to normal position for temperature protection.
.5 Operators (Modulating): Self contained, linear motorized actuator with approximately 19 mm (3/4 inch) stroke, 60 second full travel with transformer and SPDT contacts: 24 v DC,.

.6 Accessories

.1 Identification tags shall be available for all valves; tags shall be indelibly marked with Cv, model number, location; tags shall be 76 x 76mm (3" x 3") aluminum.

2.3 Dampers - Motorized

.1 Tamco Model 9000 SC (Insulated)

.2 Other Acceptable Manufacturers:

.1 Alumavent

.2 Johnson Controls

.3 Substitutions: Refer to Tender No. 543-2022B; Part B – Bidding Procedures.

.3 Performance: Test to AMCA 500.

.4 Frames: Extruded aluminum, welded or riveted with corner reinforcement, minimum 2.0 mm (0.081 inch) thick. Damper frame is 100mm (4 inch) deep.

.5 All dampers for duct sizes with a dimension (either width or height) 300 mm (12 inches) or less shall be flanged to the duct. In-duct frames not allowed.

.6 Blades: Extruded aluminum air foil profile, maximum blade size 150 mm (6 inches) wide, maximum blade length section 1200 mm (48 inches).

.7 Entire frame shall be thermally broken by means of polyurethane pockets complete with thermal cuts.

.8 Insulation: Internally insulated with expanded polyurethane foam and are thermally broken. Complete blade has an insulating factor of R-2.29 and a temperature index of 55.

.9 Blade Seals: Extruded silicone mechanically attached, field replaceable.

.10 Frame/Jamb Seals: Extruded silicone mechanically attached, field replaceable.

.11 Bearings: Celcon inner bearing fixed to a 7/16” (11.11 mm) aluminum hexagon blade pivot pin, rotating within a polycarbonate outer bearing inserted in the frame,

.12 Linkage: Installed in frame side and constructed of aluminum and corrosion-resistant, zinc-plated steel, complete with cup-point trunnion screws for a slip-proof grip.

.13 Leakage: Class 1A at 0.25 kPa (1 in. w.g.) static pressure differential. Class 1 at 1 kPa (4 in. w.g.) static pressure differential. Standard air leakage data is certified under the AMCA Certified Ratings Program.

.14 Maximum blade length Static Pressure: 1.0 kPa (4 inches wg)

.15 Temperature Limits: -40 to 100 degrees C (-40 to 212 degrees F).

2.4 Damper Operators

.1 General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.

.2 Electric Operators:

.1 Acceptable manufacturers.

.1 Belimo

.2 Siemens

.3 Honeywell

.4 Schneider Electric

.5 Johnson Controls

.2 Substitutions: Refer to Section 21 05 00.

.3 Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch minimum position potentiometer

.4 Number: Sufficient to achieve unrestricted movement throughout damper range.

2.5 Flow Switches

.1 Water flow

.1 Basis of design: McDonnel & Miller FS4

.2 Flow switch to confirm hydronic fluid flow.

.3 Construction: ULc listed. Threaded connection to piping, sensitivity adjustment, stainless steel paddles to accommodate pipe size. Construction suitable for application.

.2 Air flow

.1 Basis of design: Greystone AFS

.2 Pressure differential switch to confirm air flow.

.3 Construction: CSA approved. Monitors pressure inside and outside duct, adjustable setpoint. Construction suitable for application.

2.6 Humidistats

.1 Duct Humidistat:

.1 Insertion, two position type.

.2 Throttling range: Adjustable 2 percent relative humidity.

.3 Operating range: 20 to 80 percent.

.4 Maximum temperature: 65 degrees C (150 degrees F).

2.7 Carbon Monoxide & Nitrogen Dioxide Detection and Control System

.1 Products:

.1 Detectors: E3Point Model E3SA with E3SCO and E3SNO Sensor Cartiges.

.2 Transmitter will be powered by 24 V AC/DC (E3SA) The gas transmitter must be capable of monitoring a second gas when equipped with an E3SRM remote sensor. The gas transmitter will incorporate an electrochemical cell for toxic gas monitoring and catalytic bead sensor for combustible gases. Unit sensing cell must compensate for variations in relative humidity and temperature to maintain high levels of accuracy.

.3 The transmitter will be capable of transmitting gas concentrations to a DDC system through its 4-20 mA output. For local activation of fans or louvers (or other equipment), two on-board DPDT relays 5 A, 30 Vdc or 250 Vac (resistive load) will be activated at programmable set points (and programmable time delays). An LCD display will provide local gas concentration readings.

.4 Transmitter will be capable of operating within relative humidity ranges of 5-95% non-condensing and temperature ranges of -20° C to 40° C (-4° F to 104° F).

.5 Unit will be certified to ANSI/UL 61010-1 label and CAN/CSA-C22.2 No. 61010-1. Transmitter must be manufactured in an ISO 9001-2000 production environment.

.6 The transmitter should have a plug-in capability for a gas cartridge with a smart sensor capable of self-testing.

.7 For local activation of audible alarms, the transmitter shall have an on-board device able to generate an audible output of 85 dBA @ 10 ft (3m).

.8 Strobe & Horn unit will be capable of operating within relative humidity ranges of 0-100% and temperature ranges of -30° F to 150° F (-35° C to 66° C). Rating of horn will be no less than 72dBA at 10 feet. Intensity of light will be no less than 40W and will flash at a frequency of 1 per second. Unit will be certified by CSA. Honeywell Analytics.

Detector alarm levels are to be activated and the unit is to be installed in accordance with the following parameters:

GASES	1st ALARM SET POINT (TLV-TWA)	2nd ALARM SET POINT (TLV-STEL)	3rd ALARM SET POINT	MOUNTING HEIGHT	COVERAGE RADIUS
Carbon Monoxide (CO)	10 PPM	100 PPM	200 PPM	5 ft (150 cm) above finished floor	50 ft (15 m)
Nitrogen Dioxide (NO2)	0.7 PPM	2.0 PPM	9.0 PPM	1 ft (30 cm) from ceiling	50 ft (15 m)

.2 Accessories

.1 Strobe and Horn type STAS for 24Vac, FHS-240 for 24 Vdc or STACKSTAS for 120 Vac

.1 Strobe & Horn unit will be capable of operating within relative humidity ranges of 0-100% and temperature ranges of -30° F to 150° F (-35° C to 66° C). Rating of horn will be no less than 72dBA at 10 feet. Intensity of light will be no less than 40W and

will flash at a frequency of 1 per second. Unit will be certified by CSA. Honeywell Analytics.

.2 Power Transformer type T100VA, T200VA, T300VA or Class 2 device type T100VAC2, T200VAC2 or T300VAC2

.1 Transformer shall have an input voltage of 120 V AC and an output voltage of 24 Vac with a VA range of 50-300. Operating frequency shall be 60 Hz. Unit will provide insulation systems up to 130° C (50-1300 VA). Unit will operate at sound levels of less than 40 dBA. Transformers shall be of fused type.

.3 Detector Guards

.1 Detector Guards E3PT- GUARD

.1 The grid is made of a 9-gauge steel wire. The guard must be designed to allow calibration without removing the guards.

2.8 Energy Monitors

.1 BTU Metering Devices (Hydronic)

.1 Manufacturer: ONICON.

.1 Substitutions: Refer to Section 21 05 00.

.2 High Accuracy BTU meter provides a local indication of energy, flow and temperature data through an alphanumeric display. Provide with ultrasonic flow meter and temperature sensors. Provide BACnet MSTP communications with BAS. Refer to Section 25 90 00 – Sequences of Operations and control schematics.

2.9 Thermostats

.1 Room thermostats shall be provided with water-to-air heat pump packaged controls. Refer to Section 23 81 40 – Water Source Heat Pumps. Line voltage heating and cooling thermostats shall be provided by Division 26.

2.10 Input/Output Sensors

.1 Temperature:

.1 Resistance temperature detectors with resistance tolerance of plus or minus 0.1 percent at 21 degrees C (70 degrees F), interchangeability less than plus or minus 0.2 percent, time constant of 13 seconds maximum for fluids and 200 seconds maximum for air.

.2 Measuring current maximum 5 mA with maximum self-heat of 0.017 degrees C/mW(0.031 degrees F/mW) in fluids and 0.008 degrees C/mW(0.014 degrees F/mW) in air.

.3 Provide 3 lead wires and shield for input bridge circuit.

.4 Use insertion elements in ducts not affected by temperature stratification or smaller than one square metre. Use averaging elements where larger or prone to stratification sensor length 2.5 m (8 feet) or 5 m (16 feet) as required.

.5 Insertion elements for liquids: with brass socket, minimum insertion length of 60 mm(2-1/2 inches).

.6 Outside air sensors: Watertight inlet fitting, shielded from direct rays of sun.

.2 Humidity Sensors:

.1 Elements: Accurate within 5 percent full range with linear output.

.2 Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

.3 Equipment Operation Sensors:

.1 Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 1250 Pa (0 to 5 inches wg).

.2 Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 50 to 400 kPa (8 to 60 psi).

.3 Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

.4 Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.

2.11 Transmitters

.1 Temperature Transmitters:

.1 One pipe, directly proportional output signal to measured variable, linearity within plus or minus 1/2 percent of range for 93 degrees C (200 degree F) span and plus or minus 1 percent for 10 degrees C (50 degree F) span, with 93 degree C (200 degrees F) temperature range, compensated bulb, averaging capillary, or rod and tube operation on 138 kPa (20 psig) input pressure and 20 to 100 kPa (3 to 15 psig) output.

.2 Humidity Transmitters:

.1 One pipe, directly proportioned output signal to measured variable, linearity within plus or minus 1 percent for 70 percent relative humidity span, capable of withstanding 95 percent relative humidity without loss of calibration.

2.12 Relays

.1 Control Relays. Control relays shall be plug-in type, ULC/CSA listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

.2 Time Delay Relays. Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ±100% from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

2.13 Current Transformers

.1 AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.

.2 Transformers shall be available in various current ratios and shall be selected for ±1% accuracy at 5 A full-scale output.

.3 Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

2.14 Voltage Transformers

.1 AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.

.2 Transformers shall be suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and shall provide ±0.5% accuracy at 24 Vac and 5 VA load.

.3 Windings (except for terminals) shall be completely enclosed with metal or plastic.

2.15 Current Switches

.1 Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and BAS system output requirements.

Part 3 Execution

3.1 General

.1 Refer to controls supplied by manufacturer in equipment specifications for integration with Division 25 work.

3.2 Examination

.1 Verify that systems are ready to receive work.

.2 Beginning of installation means installer accepts existing conditions.

.3 Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

.4 Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

.5 Ensure installation components are complementary to installation of similar components.

.6 Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

.7 The Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate — or if any discrepancies occur between the plans and the Contractor's work, and the plans and the work of others — the Contractor shall report these discrepancies to the Contract Administrator and shall obtain written instructions for any changes necessary to accommodate the Contractor's work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by — and at the expense of — this Contractor.

3.3 Installation

.1 Install to manufacturers written instructions.

.2 Thermostats

.1 Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate 1200mm (47") above floor, typical, and 900mm (36") in barrier free rooms. Align with lighting switches.

.2 Provide thermostats in locking vented enclosures in the following rooms that are accessible to the public:

.1 Vestibule 100

.2 Lobby 101

.3 Training Classroom 102

.4 Universal Toilet Room 103

.5 Washroom 104

.3 Provide valves with position indicators and with pilot positioners where sequenced with other controls.

.4 Dampers and damper motors

.1 Provide isolation (two position) dampers of parallel blade construction.

.2 Provide control (modulating position) dampers of opposed blade construction.

.3 Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.

.5 Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

.6 Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position for equipment not signalled by fire alarm system.

.7 Provide conduit and electrical wiring to Section 26 05 80. Electrical material and installation to appropriate requirements of Division 26.

.8 Gas detection installation

.1 Locate zone gas sensors away from the throw of supply air grilles, registers and diffusers containing fresh air. Locate gas sensors away from being exposed to air velocities greater than 0.25 m/s (50 fpm).

.2 Locate gas sensors minimum 3 meters (10 feet) from sources of combustion and humidity unless otherwise indicated by manufacturer.

.3 After installation of gas detection, test and calibrate equipment to demonstrate operation of functions described above under sequence of operation by manufactures certified service technician or authorized agent complete with commissioning reports

.4 Provide detection unit guards as indicated on the drawings.

3.4 Manufacturer's Field Services

.1 Section 21 05 00: Prepare and start systems.

.2 Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

3.5 Demonstration And Instructions

.1 Section 21 05 00: Demonstrating installed work.

.2 Demonstrate complete and operating system to The City.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Sequences of operation for the following:

.1 Energy Recovery Ventilators
.2 Make-Up Air Units
.3 Boiler
.4 Pumps
.5 Ground Heat Exchanger
.6 Water-to-Air Heat Pumps
.7 Apparatus Bays Ventilation
.8 Water-to-Water Heat Pump / Domestic Hot Water
.9 Mechanical Room Exhaust Fan
.10 Mechanical Room Heating / Cooling
.11 Electric Heaters
.12 Sump Pumps

1.2 System Description

.1 This section defines system control functionality.

.2 Requirements for each type of control system operation are specified.

.3 Equipment, devices, and system components required for control systems are specified in other Sections.

1.3 Submittals for Review

.1 Section 21 05 00: Procedures for submittals.

.2 Shop Drawings: Indicate mechanical system controlled and control system components.

.1 Label with settings, adjustable range of control and limits. Include written description of control sequence.
.2 Include flow diagrams for each control system, graphically depicting control logic.
.3 Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

1.4 Submittals at Project Closeout

.1 Section 21 05 00: Submittals for project closeout.

□

.2 Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

Part 2 Products

2.1 Not Used

Part 3 Execution

3.1 Energy Recovery Ventilator – ERV-1

.1 Packaged controls for supply fan, exhaust fan, reversing core dampers, filter section.

.2 Schedule:

.1 ERV to run continuously (user adjustable).

.3 Operation:

.1 Enable ERV according to schedule.

.2 Outdoor air dampers (external to ERV) to open whenever ERV is enabled and close whenever ERV is disabled.

.4 Economizer Control:

.1 BAS to provide enable signal to economizer when:

.1 Ground heat exchanger entering water temperature is greater than the ground heat exchanger leaving water temperature (building is rejecting heat to ground), and

.2 The enthalpy of the outdoor air (BAS calculated using measured temperature and humidity) is less than the enthalpy of the exhaust air, and

.3 Outdoor air temperature is greater than 8°C (46°F) (user adjustable).

.5 Heating/Cooling Coil HCC-1:

.1 Enable cooling when one or more heat pump (HP-1 to HP-12) thermostats indicate space humidity is greater than 50%. WSHP-1 to modulate to maintain 54F supply air temperature off coil. Refer to WSHP-1 control strategy.

.2 Enable heating when:

.1 One or more heat pumps (HP-1 to HP-13) cannot meet room temperature setpoint and auxiliary electric duct heat (where applicable) is enabled, or

.2 Building switches to emergency generator power supply.

.3 WSHP-1 to modulate to maintain 22°C (72°F) supply air temperature off coil (user adjustable). Refer to WSHP-1 control strategy.

□

.6 Alarms shall be provided as follows:

.1 Outdoor Air Damper Failure: Commanded open, but the status is closed.
.2 Outdoor Air Damper in Hand: Commanded closed, but the status is open.
.3 Low Limit Alarm (dry contact on ERV terminal strip)
.4 Damper Alarm (dry contact on ERV terminal strip)
.5 Supply Fan Alarm (dry contact on ERV terminal strip)
.6 Exhaust Fan Alarm (dry contact on ERV terminal strip)
.7 ERV Damper Alarm (dry contact on ERV terminal strip)
.8 Supply Air Filter: Final differential pressure exceeds limit (user adjustable). (4-20mA signal from ERV terminal strip)
.9 Low Supply Air Temp: If the supply air temperature is less than 5°C (41 °F) (user adjustable).

.7 Monitor:

.1 Display the instantaneous temperature and humidity of each airstream (x4)
.2 Display the position of outdoor air dampers
.3 Display the ERV enable status and alarms
.4 Display the ERV economizer enable status

.8 Trends/Reporting:

.1 Calculate the instantaneous total energy (latent and sensible) recovered using the temperature and humidity sensors on all air paths.
.1 Display the instantaneous energy recovered on OWS graphics
.2 Sum and log the total daily energy recovered for report exports
.2 Calculate the instantaneous latent and sensible recovery efficiency using the temperature and humidity sensors on all air paths.
.1 Display the instantaneous recovery efficiency on OWS graphics
.2 Sum and log the daily average recovery efficiency for report exports
.3 City to store trend and alarm data on remote server.

3.2 Energy Recovery Ventilator – ERV-2

.1 Packaged controls for supply fan, exhaust fan, reversing core dampers, filter section, and economizing functionality.

.2 Schedule:

.1 ERV to run continuously (user adjustable).

.3 Operation:

.1 Enable ERV according to schedule.
.2 Outdoor air dampers (external to ERV) to open whenever ERV is enabled and close whenever ERV is disabled.

.4 Economizer Control:

.1 BAS to provide enable signal to economizer when:

.1 Ground heat exchanger entering water temperature is greater than the ground heat exchanger leaving water temperature (building is rejecting heat to ground), and

.2 The enthalpy of the outdoor air (BAS calculated using measured temperature and humidity) is less than the enthalpy of the exhaust air, and

.3 Outdoor air temperature is greater than 8°C (46°F) (user adjustable).

.5 Duct Heater DH-6:

.1 Modulate DH-6 to maintain 22°C (72°F) minimum supply air temperature.

.6 Alarms shall be provided as follows:

.1 Outdoor Air Damper Failure: Commanded open, but the status is closed.

.2 Outdoor Air Damper in Hand: Commanded closed, but the status is open.

.3 Low Limit Alarm (dry contact on ERV terminal strip)

.4 Damper Alarm (dry contact on ERV terminal strip)

.5 Supply Fan Alarm (dry contact on ERV terminal strip)

.6 Exhaust Fan Alarm (dry contact on ERV terminal strip)

.7 ERV Damper Alarm (dry contact on ERV terminal strip)

.8 Supply Air Filter: Final differential pressure exceeds limit (user adjustable). (4-20mA signal from ERV terminal strip)

.9 Low Supply Air Temp: If the supply air temperature is less than 5°C (41 °F) (user adjustable).

.7 Monitor:

.1 Display the instantaneous temperature and humidity of each airstream (x4)

.2 Display the position of outdoor air dampers

.3 Display the ERV enable status and alarms

.4 Display the ERV economizer enable status

.8 Trends/Reporting:

.1 Calculate the instantaneous total energy (latent and sensible) recovered using the temperature and humidity sensors on all air paths.

.1 Display the instantaneous energy recovered on OWS graphics

.2 Sum and log the total daily energy recovered for report exports

.2 Calculate the instantaneous latent and sensible recovery efficiency using the temperature and humidity sensors on all air paths.

.1 Display the instantaneous recovery efficiency on OWS graphics

.2 Sum and log the daily average recovery efficiency for report exports

.3 City to store trend and alarm data on remote server.

□

3.3 Boiler B-1

.1 Packaged controls for boiler and P-2 circulation.

.2 Operation:

.1 Enable boiler when:

.1 At least one water-to-air heat pump is active in heating mode,

.2 AND ground heat exchanger leaving temperature falls below -1°C (30°F) for 15 minutes continuous (user adjustable).

.2 Boiler enabled:

.1 Packaged boiler controls to modulate firing to maintain 60°C (140°F) boiler water supply temperature.

.2 Packaged boiler controls to activate boiler circulation pump P-2 whenever boiler is enabled.

.3 Modulate three-way injection valve to maintain 2°C (36°F) building water supply temperature (user adjustable). BAS to control adjustable minimum and maximum 3-way valve potions when boiler is enabled.

.4 Monitor boiler operation status

.5 Monitor circulation pump P-2 status

.6 Monitor boiler water supply and return temperatures

.3 Packaged controls to ensure minimum boiler runtime of 30 minutes and a minimum off-time of 15 minutes before being re-enabled.

.3 Alarms shall be provided as follows:

.1 Boiler Alarm Status

.2 Boiler Failure: Boiler enabled, but the status is off.

.3 Pump Failure: Boiler enabled, but Pump P-2 status is off.

.4 Trends/Reporting:

.1 Log daily run time hours and store for report exports

.2 City to store trend and alarm data on remote server.

3.4 Pumps P-1A and P-1B:

.1 Operation:

.1 Pumps P-1A and P-1B to run continuously in duty-standby configuration.

.2 Duty pump to rotate daily.

.3 Duty pump to automatically vary speed to maintain supply pressure.

.4 System bypass valve to modulate open to provide minimum pump flow, as required, measured by pressure sensor installed 2/3 down the longest supply branch

.5 Monitor status of each pump.

.2 Alarms shall be provided as follows:

.1 Pump P-1A Failure: Pump enabled, but the status is off.

□

.2 Pump P-1A In Hand: Pump disabled, but status is on.

.3 Pump P-1B Failure: Pump enabled, but the status is off.

.4 Pump P-1B In Hand: Pump disabled, but status is on.

.5 Bypass valve failure.

3.5 Ground Heat Exchanger:

.1 Packaged BTU Meter Controller to measure and calculate the energy transferred to the ground (-) and from the ground (+). BAS to monitor the following points at the BTU Meter Controller via BACnet:

.1 Ground heat exchanger entering water temperature (°F)

.2 Ground heat exchanger leaving water temperature (°F)

.3 Ground heat exchanger water flow rate (gpm)

.2 Calculate:

.1 Instantaneous energy transfer to ground (-) or from ground (+) BTU/H:

.1 Assume 0.90 BTU/lb°F heat capacity for 35% glycol

.3 Alarms shall be provided as follows:

.1 Low Leaving Water Temperature: water is less than -4°C (25°F)

.2 High Leaving Water Temperature: water is greater than 32°C (90°F)

.3 Low Building Supply Water Temperature: water is less than -2°C (28°F)

.4 Trends/Reporting:

.1 Calculate the instantaneous total energy transferred to the ground (-) or from ground (+) in BTU/H. Assume 0.90 BTU/lb°F heat capacity for 35% glycol.

.1 Display the instantaneous energy transferred on OWS graphics

.2 Sum and log the total hourly energy transferred for report exports

.2 City to store trend and alarm data on remote server.

3.6 Water-to-Air Heat Pumps HP-1 To 12:

.1 Packaged controls heat pump, including room thermostat with temperature, humidity, and occupancy sensors. Heat pump controller to communicate over BACnet IP with remote server via LAN network. Contractor to provide ethernet cable from heat pump controller to LAN network switch (provided by The City).

.2 Operation:

.1 Supply fan to run continuously.

.2 When thermostat detects occupancy:

.1 Heat pump to automatically switch between heating and cooling modes to maintain 22°C (72°F) room temperature setpoint (user adjustable).

.2 Enable electric duct heater (DH-#), where provided, as auxiliary heat when the heat pump cannot maintain room temperature setpoint.

□

.3 When thermostat does not detect occupancy:

.1 Heat pump to automatically switch between heating and cooling modes to maintain room temperature within the range of 18°C (65°F) and 25°C (77°F) (user adjustable).

.4 For heat pumps with multiple sensors, heat pump controller to average measured space temperatures.

.3 Automatic flow control valve to open whenever heat pump is in active heating or cooling modes, close otherwise.

.4 Write the following controller points via BACnet:

.1 Occupied Cooling Setpoint
.2 Occupied Heating Setpoint
.3 Unoccupied Cooling Setpoint
.4 Unoccupied Heating Setpoint

.5 Monitor the following controller points via BACnet:

.1 Zone Temperature
.2 Zone Humidity
.3 Occupancy Status
.4 System Status
.5 Fan Running Status
.6 System Alarm Status
.7 Filter Service Alarm
.8 Current Alarm Condition Status
.9 Leaving Water Temperature
.10 Leaving Air Temperature
.11 High Supply Temperature Alarm
.12 Low Supply Temperature Alarm

.6 Alarms shall be provided as follows:

.1 Heat Pump Alarm Status
.2 Heat Pump Failure: Heat pump enabled, but the status is off.
.3 High Zone Temperature
.4 Low Zone Temperature

.7 Trends/Reporting:

.1 Estimate the instantaneous EER and COP of each heat pump in cooling and heating modes, respectively, by interpolating the manufacturer's performance data tables. Interpolate the tables as follows:

.1 Use design water flow on approved shop drawings.

.2 Assume 24°C (75°F) entering air temperature in cooling and 21°C (70°F) entering air temperature in heating.

.3 Assume the entering water temperature is equal to the building water supply temperature.

□

.4 Display the instantaneous energy transferred on OWS graphics

.5 Sum and log the total hourly energy transferred for report exports

.2 Display the estimated instantaneous EER and COP.

.3 Store the average daily EER and COP for each heat pump.

.4 City to store trend and alarm data on remote server.

3.7 Make-Up Air Unit – MUA-1 (Kitchen)

.1 Packaged controls for supply fan, gas burner, DX cooling, dampers.

.2 Operation:

.1 Enable/disable by user-controlled wall mount on/off switch.

.2 When enabled, packaged controls to activate and modulate heating/cooling elements to maintain 72°F (22°C) supply air temperature (user adjustable on remote control panel)

.3 Packaged controls to prevent simultaneous operation of heating and cooling elements.

.3 Interlocks and Interconnections:

.1 Double reverse interlock operation of Make-Up Air Unit with Kitchen Exhaust Hood Fan EF-2.

.2 Exhaust fan to start when all make-up air motorized damper end switches prove dampers are open.

.3 Upon activation of the automatic fire-extinguishing system, an audible alarm or visual indicator shall be provided to show that the system has activated, according to NFPA 96.

.4 Where a fire alarm system is serving the occupancy where the extinguishing system is located, the activation of the automatic fire-extinguishing system shall activate the fire alarm signaling system, according to NFPA 96.

.4 The following alarms shall be indicated by lights on the remote control panel and monitored by the BAS. Determine fan status by current sensing devices.

.1 MUA Alarm Status

.2 Supply Fan Failure: fan enabled, but the status is off.

.3 Supply Fan in Hand: fan disabled, but the status is on.

.4 Filter Change Required: Final differential pressure exceeds limit (user adjustable).

.5 Low Supply Air Temp: If the supply air temperature is less than 18°C (67°F) (user adjustable).

.6 High Supply Air Temp: If the supply air temperature is greater than 25°C (77°F) (user adjustable).

3.8 Make-Up Air Unit – MUA-2 (Apparatus Bays)

.1 Packaged controls for supply fan, gas burner, DX cooling, dampers.

.2 Operation:

□

.1 Make-Up Air Unit to operate at setpoints between 1600 cfm and 4000 cfm, as described in the 'Apparatus Bay Ventilation' control strategy section.

.2 Packaged controls to activate and modulate heating/cooling elements to maintain 72°F (22°C) supply air temperature (user adjustable on remote control panel) when enabled.

.3 Packaged controls to prevent simultaneous operation of heating and cooling elements.

.3 Interlocks and Interconnections:

.1 Make-Up Air Unit to enable under a reverse double interlock configuration with the following equipment, according to the 'Apparatus Bay Ventilation' control strategy section provided below.

.1 Vehicle Exhaust Fan System 1

.2 Vehicle Exhaust Fan System 2

.3 General Exhaust Fan F-1

.2 Interlock air intake damper with MUA-1 operation.

.4 The following shall be monitored by the BAS. Determine fan status by current sensing devices.

.1 MUA Alarm Status

.2 MAU fan speed / airflow status.

.3 Intake damper position.

.4 Supply Fan Failure: fan enabled, but the status is off.

.5 Supply Fan in Hand: fan disabled, but the status is on.

.6 Filter Change Required: Final differential pressure exceeds limit (user adjustable).

.7 Low Supply Air Temp: If the supply air temperature is less than 18°C (67°F) (user adjustable).

.8 High Supply Air Temp: If the supply air temperature is greater than 25°C (77°F) (user adjustable).

.5 The following alarms shall be indicated by lights on the MUA remote control panel:

.1 MUA Alarm Status

.2 Supply Fan Failure: fan enabled, but the status is off.

.3 Supply Fan in Hand: fan disabled, but the status is on.

.4 Filter Change Required: Final differential pressure exceeds limit (user adjustable).

.5 Low Supply Air Temp: If the supply air temperature is less than 18°C (67°F) (user adjustable).

.6 High Supply Air Temp: If the supply air temperature is greater than 25°C (77°F) (user adjustable).

□

3.9 Heat Pump HP-13 (Apparatus Bays Heating and Cooling):

.1 Packaged controls heat pump, including low voltage thermostat with temperature and humidity sensors. Heat pump controller to communicate over BACnet IP with remote server via LAN network. Contractor to provide ethernet cable from heat pump controller to LAN network switch (provided by The City).

.2 Operation:

.1 Supply fan to run continuously, except when disabled during MAU-1 operation. Refer to 'Apparatus Bay Ventilation' control strategy section.

.2 Heat pump to automatically switch between heating and cooling modes to maintain 23°C (73 °F) room temperature setpoint (user adjustable) in cooling mode and 20°C (68 °F) room temperature setpoint (user adjustable) in heating mode.

.2 Write the following controller points via BACnet:

.1 Cooling Setpoint

.2 Heating Setpoint

.3 Monitor the following controller points via BACnet:

.1 Zone Temperature

.2 Zone Humidity

.3 System Status

.4 Fan Running Status

.5 System Alarm Status

.6 Filter Service Alarm

.7 Current Alarm Condition Status

.8 Leaving Water Temperature

.9 Leaving Air Temperature

.10 High Supply Temperature Alarm

.11 Low Supply Temperature Alarm

.4 Alarms shall be provided as follows:

.1 High Zone Temperature

.2 Low Zone Temperature

.5 Trends/Reporting:

.1 Estimate the instantaneous EER and COP of the heat pump in cooling and heating modes, respectively, by interpolating the manufacturer's performance data tables. Interpolate the tables as follows:

.1 Use design water flow on approved shop drawings.

.2 Assume 24°C (75°F) entering air temperature in cooling and 21°C (70°F) entering air temperature in heating.

.3 Assume the entering water temperature is equal to the building water supply temperature.

□

.4 Display the instantaneous energy transferred on OWS graphics

.5 Sum and log the total hourly energy transferred for report exports

.2 Display the estimated instantaneous EER and COP.

.3 Store the average daily EER and COP for each heat pump.

.4 City to store trend and alarm data on remote server.

3.10 Gas Detection System:

.1 The Gas Detection shall monitor the space and activate the exhaust and makeup air systems when the gas concentrations listed in the table below are exceeded. Refer to 'Apparatus Bay Ventilation' control strategy section. Refer to Section 25 30 00 – Instrumentation and Control Elements for Gas Detection specifications.

GASES	LEVEL
Carbon Monoxide (CO)	10 ppm
Nitrogen Dioxide (NO2)	0.7 ppm

.2 Alarms:

.1 Gas Detector to Alarm Status

3.11 Apparatus Bays Ventilation:

.1 The Apparatus Bays are ventilated by the following equipment:

.1 Vehicle Exhaust System Fan 1

.1 Supplied and installed by The City with dedicated control panel

.2 Expected to operate at 1600 cfm at 5 inch w.c.

.3 Contractor to confirm actual airflow with air balance

.2 Vehicle Exhaust System Fan 2

.1 Supplied and installed by The City with dedicated control panel

.2 Expected to operate at 1600 cfm at 5 inch w.c.

.3 Contractor to confirm actual airflow with air balance

.3 General Exhaust Fan EF-1

.1 Supplied and installed by Contractor

.2 Serves to provide exhaust air for CO/NO2 detection system and general ventilation exhaust when manually activated by occupants

.3 Activated by either of the following (in parallel):

.1 Low voltage twist timer (60 minute max without hold),

.2 CO/NO Gas Detection System

.4 Make-Up Air Unit MUA-2

.1 Supplied and installed by Contractor.

□

.2 Provides make-up air for Vehicle Exhaust Fans and General Exhaust Fans, varying rate depending on exhaust devices active.

.5 Heat Pump HP-13

.1 Heat pump to heat and cool the Apparatus Bays under normal operating conditions. Supply air duct is shared with MUA-2, therefore HP-13 to disable any time MUA-2 is enabled. Refer to HVAC schematic.

.6 Gas Unit Heaters UH-4 and UH-5:

.1 Activate to maintain 20°C (68°F) setpoint (user adjustable), as measured by BAS thermostats.

.2 BAS to prevent UH-4 and UH-5 operation when HP-13 cooling is enabled.

.2 Apparatus Bay ventilation equipment shall operate according to the following Scenarios. Airflows listed assumption that each Vehicle Exhaust Fan System will operate at 1600 cfm. Contractor to confirm actual airflow with air balance and adjust rates of General Exhaust and Make-Up Air to provide balanced airflow.

.1 Scenario 1:

.1 Inputs:

.1 Vehicle Exhaust Fan System 1 Activated

.2 Outputs:

.1 Exhaust:

.1 Vehicle Exhaust System 1 enabled at 1600 cfm

.2 Make-Up Air:

.1 Enabled at 1500 cfm (100 cfm less than exhaust to negatively pressurize Apparatus Bays).

.3 HP-13:

.1 Disabled

.2 Scenario 2:

.1 Inputs:

.1 Vehicle Exhaust Fan System 2 Activated

.2 Outputs:

.1 Exhaust:

.1 Vehicle Exhaust System 2 enabled at 1600 cfm

.2 Make-Up Air:

.1 Enabled at 1500 cfm (100 cfm less than exhaust to negatively pressurize Apparatus Bays).

.3 HP-13:

.1 Disabled

.3 Scenario 3:

.1 Inputs:

.1 Vehicle Exhaust Fan System 1 Activated

.2 Vehicle Exhaust Fan System 2 Activated

.2 Outputs:

□

.1 Exhaust:
.1 Vehicle Exhaust Fan System 1 enabled at 1600 cfm
.2 Vehicle Exhaust Fan System 2 enabled at 1600 cfm
.2 Make-Up Air:
.1 Enabled at 3100 cfm (100 cfm less than exhaust to negatively pressurize Apparatus Bays).
.3 HP-13:
.1 Disabled

.4 Scenario 4:
.1 Inputs:
.1 Vehicle Exhaust System 1 Activated
.2 CO/NO2 Detection or Manual Twist Timer Activated
.2 Outputs:
.1 Exhaust:
.1 Vehicle Exhaust Fan System 1 enabled at 1600 cfm
.2 General Exhaust Fan F-1 enabled at 1500 cfm
.2 Make-Up Air:
.1 Enabled at 4000 cfm (100 cfm less than exhaust to negatively pressurize Apparatus Bays).
.2
.3 HP-13:
.1 Disabled

.5 Scenario 5:
.1 Inputs:
.1 Vehicle Exhaust Fan System 2 Activated
.2 CO/NO2 Detection or Manual Twist Timer Activated
.2 Outputs:
.1 Exhaust:
.1 Vehicle Exhaust Fan System 2 enabled at 1600 cfm
.2 General Exhaust Fan F-1 enabled at 1500 cfm
.2 Make-Up Air:
.1 Enabled at 4000 cfm (100 cfm less than exhaust to negatively pressurize Apparatus Bays).
.3 HP-13:
.1 Disabled

.6 Scenario 6:
.1 Inputs:
.1 Vehicle Exhaust Fan System 1 Activated
.2 Vehicle Exhaust Fan System 2 Activated

□

.3 CO/NO2 Detection or Low Voltage Twist Timer Activated

.2 Outputs:

.1 Exhaust:

.1 Vehicle Exhaust Fan System 1 enabled at 1600 cfm

.2 Vehicle Exhaust Fan System 2 enabled at 1600 cfm

.3 General Exhaust Fan F-1 enabled at 900 cfm (100 cfm less than exhaust to negatively pressurize Apparatus Bays).

.2 Make-Up Air:

.1 Enabled at 4000 cfm

.3 HP-13:

.1 Disabled

.7 Scenario 7:

.1 Inputs:

.1 CO/NO2 Detection or Low Voltage Twist Timer Activated

.2 Outputs:

.1 Exhaust:

.1 General Exhaust Fan F-1 enabled at 4100 cfm

.2 Make-Up Air:

.1 4000 cfm (100 cfm less than exhaust to negatively pressurize Apparatus Bays).

.3 HP-13:

.1 Disabled

.8 Interlock intake air damper with MAU-1 operation.

3.12 Water-to-Water Heat Pump WSHP-1

.1 Normal Operating Conditions occur when:

.1 Boiler B-1 is disabled, and

.2 There is no call for cooling at HCC-1, and

.3 There is no call for heating at HCC-1

.2 Under Normal Operating Conditions:

.1 Packaged heat pump controls to activate heat pump to maintain 43°C (110°F) ‘pre-heat’ water temperature in Storage Tank ST-1.

.2 Control valve to ST-1 to open, control valve to HCC-1 to close.

.3 Domestic hot water tanks DWH-1 and DWH-2 shall be set to maintain 60°C (140°F) water temperature.

.4 Domestic hot water recirculation pump P-5 to run continuously based on line voltage timer (user adjustable.)

.3 When Boiler B-1 is enabled:

.1 Disable domestic hot water pre-heat (switch domestic hot water heating to electric only). This is to prioritize boiler capacity for space heating.

.2 Heat pump to disable unless there is call for heating or cooling at HCC-1.

.4 When there is a call for cooling at HCC-1:

.1 Control valve to ST-1 to close, control valve to HCC-1 to open.

.2 Heat pump to operate according to ERV-1 strategy.

.5 When there is a call for cooling at HCC-1:

.1 Control valve to ST-1 to close, control valve to HCC-1 to open.

.2 Heat pump to operate according to ERV-1 strategy.

.6 The following points shall be monitored by the BAS.

.1 Heat Pump Alarm Status (dry contact on Heat Pump Controller)

.2 Source Water Supply Temperature

.3 Source Water Return Temperature

.4 Load Water Supply Temperature

.5 Load Water Return Temperature

3.13 Mechanical Room Heating/Cooling

.1 Cooling Operation:

.1 Exhaust Fan EF-3 to activate when room temperature exceeds 24°C (75°F), as measured by BAS thermostat.

.2 Motorized dampers on exhaust duct and air intake to open when exhaust fan is activated. Dampers to close after 30 second delay after exhaust fan is deactivated.

.2 Heating Operation:

.1 Unit Heater UH-3 to activate to maintain 18°C (65°F), as measured by BAS thermostat.

.2 BAS to prevent UH-3 from operating when EF-3 enabled for cooling.

.3 Alarm when room temperature falls 5°C (9°F) outside of setpoint.

3.14 SCBA Room Heating/Cooling

.1 Cooling Operation:

.1 Exhaust Fan EF-4 to activate when room temperature exceeds 24°C (75°F), as measured by BAS thermostat.

.2 Motorized dampers on exhaust duct and air intake to open when exhaust fan is activated. Dampers to close after 30 second delay after exhaust fan is deactivated.

.2 Heating Operation:

.1 Unit Heater UH-2 to activate to maintain 18°C (65°F), as measured by BAS thermostat.

□

.2 BAS to prevent UH-3 from operating when EF-3 enabled for cooling.

.3 Alarm when room temperature falls 5°C (9°F) outside of setpoint.

3.15 Baseboard Heaters (EBB-#)

.1 Activate to maintain 22°C (72°F) setpoint (user adjustable), as measured by line voltage thermostats.

3.16 Electric Unit Heaters (UH-#)

.1 Activate to maintain 18°C (61°F) setpoint (user adjustable), as measured by line voltage thermostats.

3.17 Electric Forced Fan Heaters (FFH-#):

.1 Activate to maintain 15°C (59°F) setpoint (user adjustable), as measured by line voltage thermostats.

3.18 Weeping Tile Sump Pumps (P-3A and P-3B)

.1 Controlled by packaged duplex pump controller.

.2 BAS to monitor control panel alarm status (dry contact).

3.19 Apparatus Bay Soffit Cavity Ventilation (F-6)

.1 Activate to maintain 15°C (59°F) setpoint (user adjustable), as measured by line voltage thermostat.

.1 Supply Fan Failure: fan enabled, but the status is off.

END OF SECTION

□

Part 1 General

1.1 Related Sections

.1 Division 0 – Bidding & Contract Requirements

.2 General Requirements

.3 All Electrical Drawings and Division 25, 26, 27, 28 Series Specification Sections.

1.2 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CAN3-C235-83 (R2015) - Preferred Voltage Levels for AC Systems, 0 to 50 000 V.

.3 CSA (Canadian Standards Association).

.4 ULC (Underwriters' Laboratories of Canada).

.5 ASTM E-814, - Fire Tests of Penetration Fire Stops.

.6 ANSI/ UL1479 - Fire Tests of Through Penetration Firestops

1.3 Regulatory Requirements

.1 Conform to CSA-C22.1-18.

.2 Comply with all CSA Electrical Bulletins in force at time of tender submission.

.3 Comply with all provincial by-laws, ordinances, codes, rulings, and other requirements.

.4 Comply with requirements of the electrical supply authority and the local inspection authority.

.5 Products: Listed and classified by CSA, or ULC and as suitable for the purpose specified and indicated. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the appropriate Inspection Departments.

1.4 Definitions

.1 The following are definitions of terms and expressions used in the specification:

.1 Defective: A condition determined exclusively by the Contract Administrator.

.2 Demolish: The complete removal of the existing item identified complete with associated infrastructure back to last remaining device or source as required to accommodate the overall scope of work. Demolished items shall be legally disposed of off site.

.3 Electrical Code: Canadian Electrical Code or Local Code in effect at project location.

.4 Exposed: Any work not concealed in wall, shaft, or ceiling cavities or spaces. Work behind doors, in closets or cupboards or under counters is considered exposed.

.5 Indicated: as shown on contract drawings or noted in Contract Documents.

.6 Inspection Authority: agent of any authority having jurisdiction over construction standards associated with any part of electrical work on site.

.7 Install: To remove from site storage, move or transport to intended location, install in position, connect to utilities, repair site caused damage, and make ready for use.

.8 New: Produced from new materials.

.9 Provide: Wherever the term "provide" is used in relationship to equipment, conduit and other materials specified for the work, it means "supply, install, connect and leave in working order all materials and necessary wiring, supports, access panels, etc., as necessary for equipment indicated." Wherever the terms "provide" is used in connection with services such as testing, load balancing, start-up, preparation of drawings for any part of the work, it means procure, prepare, supervise, take responsibility for, and pay for these services.

.10 Relocate: The complete relocation of the existing item identified to the new location as indicated, modifying the existing infrastructure as required to accommodate the relocation and overall scope of work.

.11 Remove and Reinstall: The temporary removal of the existing item identified complete with associated infrastructure to accommodate the overall scope of work, the temporary storage of the item, preparing the item for reuse, and reinstallation of the item as indicated.

.12 Remove and Replace: The complete removal and replacement of the item identified in its current location, with a new item, modifying the existing infrastructure as required to accommodate the overall scope of work.

.13 Renewed: Produced or rejuvenated from an existing material to like-new condition to serve a new or existing service.

.14 Supply: To acquire or purchase, ship or transport to the site, unload, remove packaging to permit inspection for damage, re-package, replace damaged items, and safely store on-site.

.15 Supply Authority: electrical power utility company responsible for delivery of electrical power to project.

.16 Typical: A representative characteristic that is standard for all installations whether individually noted or not throughout the documents. "Typical" applies to each individual or combined installation except where specifically noted or otherwise indicated that the application is non-typical.

1.5 Permits & Fees

.1 Submit all quantities of drawings and specifications necessary for examination and approval to Electrical Permit Department and Electrical Supply Authority prior to commencement of work.

.2 Obtain and pay for all permits necessary for the electrical installation.

1.6 Inspection

.1 Furnish a Certificate of Acceptance from the Inspection Authorities on completion of work. Copies of Certificate shall be included in Maintenance Manuals.

.2 Certificate of Inspection and Approval shall be submitted before final payment may be considered to be due.

.3 During the course of the project construction, the Contract Administrator will carry out periodic site reviews and prepare a deficiency list for remedial action by the Electrical Subcontractor. When requested, the Electrical Contractor shall respond in writing to the Contract Administrator, stating corrective action and completion date for each item listed as deficient. This response shall be in the hands of the Contract Administrator within three working days of receipt of the Site Review Report.

1.7 Product Changes & Substitutions

.1 Change in Product/Products: Submit request for substitution or alternative in accordance with this Section, the Instructions to Bidders, and Division 01 Product Exchange Procedures Division 01 Substitutions Sections. In case of a discrepancy between this section and Division 00 and Divisions 01, the more stringent requirements shall apply.

.2 The Instructions to Bidders specify time restrictions for submitting requests for Substitutions during the bidding period to requirements specified in this section.

.3 Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

.4 Any substituted item submitted for consideration must not exceed the available space limitations, and all additional costs for mechanical, electrical, structural and architectural revisions required to incorporate the substituted material shall be the responsibility of the Electrical Division. Review maximum dimensions and weights when provided in the specification and schedules, and where not specified review the drawings for space limitations.

.5 A request constitutes a representation that the Bidder:

.1 Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.

.2 Will provide the same warranty for the Substitution as for the specified Product.

.3 Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to The City.

.4 Waives claims for additional costs or time extension which may subsequently become apparent.

.5 Will reimburse The City and Contract Administrator for review or redesign services associated with re-approval by authorities.

.6 Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

1.8 Submittals for Review

.1 Refer to Division 01.

.2 Progress Payment Application Template

.1 Prior to the first application for payment, submit for review a draft progress application template.

.2 Progress Application shall contain separate line items for the following systems:

.1 Site Services

.2 Distribution Equipment including Panels, Distribution Panels, Transformers, etc.

.3 Emergency Generator and Standby Power Systems

.4 Lighting

.5 Lighting Controls

.6 Branch Wiring, Conduit, Raceway, Boxes

.7 Exit & Emergency Lighting

.8 Electric Heat

.9 Electric Vehicle Charging

.10 Photovoltaics

.11 Voice/Data

.12 Paging

.13 Audio/Visual Systems

.14 Intercom

.15 Fire Alarm

.16 CCTV

.17 Intrusion

.18 Access Control

.19 Close Out (As-Builts, O&Ms)

.3 Progress for each system shall break out labor and materials separately.

.3 Shop Drawings Administrative Requirements

.1 Shop drawings shall be submitted electronically in PDF format documents to shopdrawings@eppsiepman.com.

.2 Shop drawing documents shall be grouped by specification section. Clearly list the specification section on the front page or cover sheet of the submittal. Shop drawings related to multiple sections may not be grouped together into a single document. Documents that are groups incorrectly will be returned without being examined and shall be considered rejected.

.1 Each drawing shall include the name of project as found on the drawings or specifications, the equipment supplier and the specification section that the equipment is specified under.

.3 Submit to Contract Administrator submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.4 Work affected by submittal shall not proceed until review is complete.

.5 Present Shop Drawings, product data, samples and mock-ups in SI Metric and/or Imperial inch-pound units, to match the units used in the schedules.

.4 Shop Drawings and Product Data

.1 Submit shop drawings and product data for review by the Contract Administrator. All drawings shall be in English and metric dimensions or in imperial where indicated. Manufacture of equipment shall not commence until shop drawings have been reviewed.

.2 Material submitted for review shall be marked up bear the Contractor's and where applicable the Utility's reviewed stamp.

.3 Shop drawings shall be reviewed by the electrical contractor, general contractor, and where applicable the Utility prior to submittal to Contract Administrator, confirming that they meet all the design requirements. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents.

.4 Submittals not stamped, signed, dated, identified as to specific project, and attesting to their being reviewed will be returned without being examined and shall be considered rejected.

.5 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.

.6 Where applicable, include wiring, single line and schematic diagrams.

.7 Include wiring drawings or diagrams showing inter-connection with work of other sections.

.5 Provide scaled drawings showing layout of all electrical equipment and coordination of same with mechanical equipment in all electrical, electrical/mechanical and voice data rooms.

.6 Submit samples in accordance with General Conditions. Samples shall be forwarded to the Contract Administrator's office and returned. Approved samples will be retained until after tender closing, then all samples will be returned except for the sample submitted by the Manufacturer who has been listed by the successful Contractor in the tender documents. This sample will be used for comparison with the actual production run of successful manufacturer.

.7 Submit shop drawings of service entrance equipment to utilities.

1.9 Closeout Submittals

.1 Refer to Division 01.

.2 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.3 Four weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, one draft copy of operating and maintenance manuals in Canadian English.

.4 Copy will be returned with Contract Administrator's comments.

.5 Revise content of documents as required prior to final submittal.

.6 Two weeks prior to Substantial Performance of the Work, submit to the Contract Administrator, three final copies of operating and maintenance manuals in Canadian English.

.7 Summary audit documents associated with requirements for LEED classification documentation.

.8 Maintenance Data:

.1 Provide operation and maintenance data for incorporation into Maintenance Manuals.

.2 Include details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.

.3 Include technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.

.4 Include all warranty information.

.5 Submit Maintenance Manuals to the Contract Administrator for review. Manuals that are incomplete shall be returned to the Electrical Sub-Contractor for completion. Completed manuals shall be submitted, to the satisfaction of the Contract Administrator, before final payment may be considered to be due.

.6 Format

.1 Refer also to Section 01 78 10 for formats for manuals. Where there is a discrepancy with this section, follow the requirements of 01 78 10.

.2 Organize data in the form of an instructional manual.

.3 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 8.5 x 11 inch (219 x 279 mm) with spine and face pockets.

.4 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

.5 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.6 Arrange content by systems under Section numbers and sequence of Table of Contents.

.7 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.8 Text: Manufacturer's printed data, or typewritten data.

.9 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.7 Contents

.1 Refer also to Section 01 78 10 for formats for contents. Where there is a discrepancy with this section, follow the requirements of 01 78 10.

.2 Table of Contents: Provide:

.1 Title of project.

.2 Date of submission.

.3 Names, addresses, and telephone numbers of Contract Administrator and Contractor with name of responsible parties.

.4 Schedule of products and systems, indexed to content of volume.

.3 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.4 Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.

.5 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control, wiring, and schematic diagrams and performance curves.

.6 Include Systems Certifications where applicable.

.7 Include manufacturer specific warranties where applicable.

.8 Include a list of maintenance materials provided in each related section.

.9 Certificate of Acceptance: Relevant certificates issued by authorities having jurisdiction, including code compliance certificate, life safety systems performance certificate.

.10 Training: Record of The City's representative training as specified.

.9 Maintenance Materials:

.1 Provide maintenance materials as specified. Include a list of the maintenance materials in each related section of the operation and maintenance data.

.2 Turn materials over to The City in an orderly fashion upon completion of installation.

.10 Record Documentation:

.1 Prior to Substantial Performance of the Work, electronically transfer the marked-up information from the as-built documents, as follows:

.1 Drawings: Scan the full-sized field-verified as-built drawing set and save to PDF format. Scans shall be in colour and with good resolution to ensure drawings and markups are legible.

.2 Specifications: Adobe Acrobat (PDF).

.2 Mark revised documents as "RECORD DOCUMENTS". Include all revisions.

.3 Submit completed record documents to Contract Administrator on a CD, DVD, or by electronic transfer.

.4 Project record documents shall comprise a complete and accurate record of the actual electrical installation. Record drawings that are inaccurate or incomplete shall be returned to the contractor for correction and completion.

.5 Record drawings shall contain a stamp bearing the words “Record Drawing” or “As-Built Drawing”, the electrical contractor’s company name, date, and the contractor’s signature.

.6 The Contract Administrator will recommend a suitable deficiency holdback until accurate and complete record drawings have been submitted in acceptable form.

.7 Indicate on record drawings, location of all buried services. This information is to be certified correct by the Contract Administrator before backfilling commences.

.8 Record actual size and location of all cables including depth of cables where buried.

.9 Contractor to take all schedules/details from specification and put onto additional drawing sheets for Record Drawings.

1.10 Examination

.1 Prior to submitting a tender, examine the site and local conditions which will affect the work. Refer to the Architectural, Mechanical and Structural drawings, schedules and specifications for construction details to be certain that the electrical work can be satisfactorily carried out as specified. Claims for extra payments resulting from conditions which could reasonably be foreseen during an examination of the documents and/or site, will not be recognized.

.2 Ensure that all equipment designated as “Existing to Remain” or “Existing to be Relocated” is suitable for its intended re-use, including panelboards and circuits. Report any discrepancies to the Contract Administrator before tender close.

.3 Refer to General Conditions for instructions regarding a prearranged site visit during the tender period.

.4 Notify Contract Administrator of any discrepancies, omissions, etc., prior to the awarding of the contract, otherwise the Electrical Contractor shall perform the work as directed at no additional cost to The City.

1.11 Short Circuit/Coordination/Arc Flash Study

.1 Provide a Short Circuit Study based on the IEEE calculation methods found in IEEE 551. The study shall include a summarized table which lists all equipment included in the short circuit study and their respective short circuit interrupt ratings. The study shall list equipment which marginally passes or fails the short circuit test calculations. The study shall also provide recommendations for mitigating equipment which marginally pass or fail their associated short circuit ratings.

.2 Provide a Protection and Coordination Study based on IEEE 242 and IEEE 1015. The study shall include all circuit breakers, relays, fuses, transformers, and other protective equipment which are fed from all energy sources in the associated distribution. The study shall include time-current curves as necessary to determine all circuit breaker settings. The study shall include an analysis of all time-current curves, an analysis of the coordinated circuit breaker settings, and recommendations for mitigating any potential protection and coordination issues. The study shall include all phase and ground fault curves with recommended settings for full selective coordination on all life safety devices including but not limited to generators, fire pumps, elevators and lifts. The study shall include a table of all circuit breaker settings for every circuit breaker considered in the

study. The study shall be coordinated with the Arc Flash study to mitigate serious potential arc flash incident energies when applicable.

.3 Provide an Arc Flash study based on IEEE 1584 and CSA Z462. The arc flash study shall include all areas in the distribution where an arc-flash hazard is present which includes, but is not limited to, equipment analyzed in the short circuit study. The arc flash study shall be coordinated with the protection and coordination study. The Arc Flash Study shall include, for all considered equipment, worst case arc flash results including the local incident energies, working distances, and arc flash boundaries. The Arc Flash Study shall include recommended settings for any breakers with Arc Flash Maintenance function to limit arc flash levels to targeted levels.

.4 Provide Arc Flash labels based on the results of the Arc Flash Study. Labels shall conform to the requirements set out in CSA Z462.

.5 Submit a preliminary copy of the studies complete with short circuit information and preliminary breaker coordination to the Contract Administrator with distribution shop drawings. Feeder lengths for the preliminary study shall be based on worst case estimates based on the intended installation by the electrical contractor.

.6 Submit a final copy of the Short Circuit/Coordination/Arc Flash Study to the Contract Administrator upon completed installation of all feeders and distribution. Final copy of Short Circuit/Coordination/Arc Flash Study shall be signed and sealed by a Professional Engineer. Feeder lengths shall be based as-installed on site measurements. Arc Flash Study shall be based on real fault data, provided by the utility. All data sources and their respective origins shall be listed and included in the report or appendices.

.7 Include the final copy of the Short Circuit/Coordination/Arc Flash Study in each Maintenance Manual.

.8 Ensure circuit protective devices such as over current trips, relays, fuses, are installed and adjusted to values and settings as recommended in the Studies.

.9 Ensure arc flash labels are affixed to the appropriate equipment and placed on the equipment as per the guidelines set out in CSA Z462.

.10 Arc flash labels shall be placed on the exterior of the electrical equipment; free of moving doors, hinges, and moving parts; and be visible on approach to the electrical equipment. Panelboards in public spaces may have their arc flash labels installed inside of a hinged door provided the equipment is constructed such that with the door open there are no exposed current-carrying parts.

.11 The Short Circuit study shall include all new infrastructure from the secondary side of the utility distribution transformer

1.12 Efficiency Manitoba

.1 Electrical contractor shall make application on behalf of The City for the Efficiency Manitoba Incentive for all available rebates under the Commercial Lighting Program.

.2 Application shall be made and acceptance provided by Efficiency Manitoba prior to commencement of demolition.

.3 Electrical Contractor shall gather all information as required to complete the application.

.4 Electrical Contractor shall provide updates to The City regarding status of the application and expected rebates.

Part 2 Products

2.1 Materials and Equipment

.1 Provide labour, materials, transportation, equipment and facilities, etc., required for the complete electrical installation as indicated or implied on the drawings and specifications.

.2 Electrical equipment shall be new and of type and quality specified.

.3 Request for approval of material, as equal, shall conform to the specification.

.4 Equivalent materials and equipment

.1 Bidders shall submit a tender based on the specified materials and equipment only.

.2 Bidders may submit a tender based on equivalent materials and equipment only if such items have been approved as equals by the Contract Administrator.

.3 Bidders may submit, with their tender, an alternate price based on alternate materials and equipment only if such items have been approved as alternates by the Contract Administrator.

.4 Submissions for equals or alternates shall be received by the Contract Administrator, ten working days prior to tender closing. Submissions shall include sufficient manufacturer's data to clearly show equivalency, as well as an itemized list of equal or alternate items, the items for which they were submitted and a space for the Contract Administrator to indicate "approved equal", "approved alternate", or "not approved". Submittal list will be returned or may be picked up at the Contract Administrator's office. Where submissions are not returned by the Contract Administrator before tender closing or are not received by the Contract Administrator ten working days before close of tender, they are considered not approved.

.5 All submissions shall include the following phrase "We have reviewed all contract documents, contract drawings and specifications relating to the equipment presented herein" and shall bear the name and signature of the manufacturer or their agent.

2.2 Voltage Ratings

.1 Operating voltages: to CAN3-C235-83(R2015).

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

2.3 Finishes

.1 Finish outdoor electrical equipment such as parking lot panels, to match light standards.

.2 Paint indoor switchgear light grey to EEMAC-2Y-1.

.3 Paint indoor distribution enclosure trims light grey to EEMAC-2Y-1. Distribution tub shall be galvanized.

.4 Paint outdoor electrical equipment enclosures with two (2) coats of U.V. resistant Urethane Enamel to minimum 1.5 mil dry coat thickness. Colour shall be "equipment green" to EEMAC 2Y-1.

.5 Clean and touch up surfaces of shop-painted equipment, scratched or marred during shipment or installation, to match original paint.

.6 Clean, prime and paint exposed wiring, conduit, junction and pull boxes, hangers, racking, and fasteners to prevent rusting and to match surrounding finishes where applicable.

2.4 Labels and Warning Signs

.1 Manufacturer's nameplates and CSA labels shall be visible and legible after equipment is installed.

.2 Provide warning signs on equipment, as required, to meet the requirements of the Inspection Authorities, including indication of multiple power sources.

.3 Provide quantity as required of buried cable signs reading "Buried Cable" and "Buried High Voltage Cable". Signs shall be installed at building structure/equipment, at locations as directed on site and as per Canadian Electrical Code.

2.5 Protection

.1 Guards

.1 Provide guards for all electrical equipment and devices in gymnasium and other areas subject to damage.

.2 Sprinkler Proof Equipment

.1 All surface mounted electrical equipment located in sprinklered areas shall be sprinkler proof and shall be provided with suitable hoods and shields.

.2 Entrance of conduits into the top of surface mount electrical panels/cabinets/distributions and motor control centers shall utilize O-rings and watertight connectors.

.3 All recessed mounted branch circuit panels and distribution panels shall be provided with a Type 2 enclosure.

.3 Construction

.1 Protect exposed live equipment during construction for personnel safety.

.2 Shield and mark live part "LIVE ( ) VOLTS", with appropriate voltage.

.3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision.

2.6 Spare Parts and Maintenance Materials

.1 Assemble spare parts as specified.

.2 Include the following:

.1 Part number.

.2 Identification of equipment or system for which parts are applicable.

.3 Installation instructions as applicable.

.3 Provide a written list complete with The City's signature assuring that spare parts have been received by The City.

2.7 Access Doors

.1 Access doors shall be minimum #12 gauge prime coat painted bonderized steel. Each shall be complete with a heavy flush frame and anchor, concealed hinges, positive locking screwdriver lock, and mounting and finishing provisions to suit the finish material for which they are supplied. Access doors in fire rated ceilings, walls, partitions, structures, etc. shall be ULC. listed and labeled and of a rating to maintain the fire separation integrity.

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

.3 Supply access doors in inaccessible construction shall give access to all concealed junction boxes, pullboxes, conductor joints and other similar electrical work which may need maintenance or repair.

.4 Before commencing installation of electrical work, submit to the Architect for approval, a list of required access doors showing the exact sizes and locations of such access doors. Locate access doors in walls and partitions to the Architect's approval, and arrange electrical work to suit. Access doors shall be, wherever possible, of a standard size for all applications. Confirm exact dimensions with the Architect, prior to ordering.

.5 Access doors will be installed by the Division responsible for the particular type of construction in which access doors are required. Supply the access doors to the Division installing same at the proper time to avoid construction delays.

Part 3 Execution

3.1 Coordination With Other Trades

.1 Refer to Mechanical, Structural, Architectural and Interior Design drawings and specifications for additional electrical work in connection with other Divisions. Where such work is included in other sections of the specifications, provide equipment, conduit, wiring, etc. (in accordance with the approved manufacturer's shop drawings), as required, for operation of the specified equipment.

.2 Schedule execution of electrical work with associated work specified in other Divisions.

.3 Coordinate electrical work with work of other trades to avoid conflicts with pipes, air ducts or other equipment. Provide additional supports, wiring, etc., to relocate electrical equipment, as required, where structural members, air ducts, piping or other equipment interferes with the electrical installation.

.4 Prior to installation provide scaled drawings of all mechanical/electrical rooms and communication rooms showing layout of all equipment (mechanical and electrical) for Contract Administrator review.

3.2 Quality Assurance

.1 Do complete installations in accordance with CSA C22.1-18.

.2 While not identified and specified by number in this Division, comply with CSA Electrical bulletins in force at time of tender submission. Comply with the requirements of all Provincial and local laws, rules, ordinances and codes.

.3 Electrical installations shall comply with all requirements of the electrical supply authority and the inspection authority.

.4 Electrical installation shall be in accordance with the applicable versions of the Canadian Electrical Code, Provincial and other codes, rules and regulations. Supply material and labour required to meet the requirements of these codes, rules and regulations even though the work in not shown on the drawings or mentioned in the specifications. Where the electrical installation calls for better quality materials or construction than the minimum requirements of these codes, rules and regulations, the electrical installation shall be as shown on the drawings and as specified.

3.3 Workmanship

.1 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance to the satisfaction of the Contract Administrator. Install conduit and cable runs parallel and perpendicular to building lines in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are to be exposed, install neatly and group in a tidy appearance.

.2 Install equipment/junction boxes and apparatus requiring maintenance, adjustment or eventual replacement, with adequate clearances and accessibility for same.

.3 Provide for all requirements shown on shop drawings or manufacturer's installation instructions.

.4 Work deemed by the Contract Administrator to be unsatisfactory shall be replaced at no additional cost.

3.4 Delivery Storage and Handling

.1 Deliver all materials to site in an orderly fashion.

.2 Store all materials in a clean and dry place, secure from vandalism or theft. All materials shall be left in shipping containers until required for use.

.3 Provide additional protection such as tarps, padding, wood skids, etc., as required to ensure protection of equipment and as directed by the Architect.

3.5 Excavation and Backfilling

.1 Excavate and backfill as required for underground electrical services as indicated. Provide protective materials around and over services and be present at all times during excavation and backfilling to supervise work. Backfilling shall restore the excavated area to the original condition and shall include sodding where required.

.2 Work shall be in accordance with the current CSA Bulletin.

.3 Include all costs for excavation and backfilling, for any underground electrical installation, unless otherwise indicated.

.4 Work shall be arranged in such a manner that will not interfere with regular pedestrian or vehicular traffic patterns.

.5 Provide trenching, cable installations and backfill promptly. Open trenches shall be barricaded in an appropriate manner.

.6 Cables required to cross under roadways, paved areas, sidewalks, etc. shall be installed in PVC conduits pushed under such areas.

.7 Six (6") of sand shall be provided surrounding installed cables and 2" x 4" treated plank installed 6" above the cables. Install cable marker tape in all trenches, minimum 12" above cables. The remainder of the trench shall be backfilled with granular base course. All backfill material shall be thoroughly tamped and compacted to at least 90% of maximum density at optimum moisture. The ground shall be left free from ruts and rough spots. In any asphalt areas, backfill shall be granular material only.

.8 All sodded areas disturbed or damaged during trenching and backfilling shall be repaired with manured soil mix and resodded. Make all repairs to damaged asphalt and/or concrete surfaces to match existing.

.9 Care shall be taken when excavating near existing services. Existing trees and shrubbery in work area shall be protected from damage.

.10 Install buried cable signs as per CEC and Manitoba Electrical addendums.

3.6 Conduit Sleeves and Holes

.1 Install conduit, and sleeves, prior to pouring of concrete. Sleeves through concrete shall be sized for free passage of conduit.

.2 Holes through exterior walls and roof shall be flashed and made weatherproof.

.3 Make necessary arrangements for cutting of chases, drilling of holes and other structural work required to install electrical conduits, cables, pullboxes and outlet boxes.

.4 Install cables, conduits, and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

.5 Provide a minimum of two (2) separate conduit sleeves embedded in each concrete lighting fixture base. At least one (1) unused conduit shall be for possible future extension of wiring.

.6 All conduits and cables shall be entered into the building above grade unless otherwise noted.

.7 All coring in buildings with electrical in the slab shall be scanned at contractor’s expense to prevent damage.

3.7 Cutting and Patching

.1 Pay the costs of all cutting and patching required for the installation of electrical work. Payment for cutting and patching shall be made through the General Contractor.

.2 Cutting and patching required for the installation of electrical work shall be done by the particular trade whose work is involved. No cutting or patching shall be carried out by the tradesman employed on the electrical work.

.3 Obtain the approval of the Architect before arranging for any cutting. Patching shall restore the affected area to the original condition; materials and methods used for patching shall be in accordance with the requirements of the corresponding Divisions of the specification.

3.8 Device Installation

.1 Device Location

.1 Locate devices as indicated.

.2 Do not install devices back-to-back in wall.

.3 Drawings are schematic only and do not indicate all architectural or structural elements.

.4 Change location of devices at no extra cost or credit, providing distance does not exceed 10'-0" (3 m) and information is provided before installation.

.5 Locate light switches on latch side of doors.

.6 Vertically align devices of different systems when shown in close proximity to each other and occurring at different mounting heights.

.7 Coordinate mounting heights and location of all equipment with Architectural, Mechanical and Structural Drawings prior to installation of rough-in boxes.

.2 Mounting Heights

.1 Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.

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

.3 Install electrical equipment at the following heights unless indicated or directed otherwise:

Device / Equipment	Mounting Height	
Devices above counters	150mm	6”****
Receptacles:		
- General	400mm	16”
- General (Accessible Height)	450mm	18”
- Mechanical/Shop Areas	1000mm	40”
- Clock	2150mm	84”
- Above top of continuous baseboard heater	200mm	8”
- Exterior	1000mm	40”
Switches, Dimmers, push buttons, Luxo bracket	1200mm	47”
- General		
- Accessible Suites	900mm	36”
Clocks	2150mm	84”

Exit Signs	25mm*****	1”*****
Emergency Lighting Battery Banks/Remote Headers	2350mm* or 150mm**	92”* or 6”**
Automatic Door Operator Pushbuttons	900mm	36”
Occupancy Sensors – Switch based with manual override controls.	1200mm	47”
Occupancy Sensors – General	Per manufacturers recommendations	
Fire Alarm Visual, Audible, & Combination Devices	2350mm* or 150mm**	92”* or 6”**
Fire Alarm Manual Pullstations	1100mm	43”
Fire Fighter Handsets	1500mm	59”
Thermostats - General - Accessible Suites	 1200mm 900mm	 47” 36”
Intercom Stations	1200mm	47”
Proximity/Card Readers	900mm	36”
Communication Outlets (Accessible Height)	450mm	18”
Hand Dryers	1200mm	47”
Branch Circuit Panelboards, Control Panels, Annunciators. Install panels taller than 1800mm (72”) with bottom no more than 100mm (4”) above floor.	2000mm*	78”*
Enclosed circuit breakers	1600mm***	60”***
Lighting	Refer to Architectural Drawings.	

*Measured to top of device/equipment

**Measured from Ceiling to top edge of device where mounting height would be lower than required specification.

***Measured to operating handle of device.

****Coordinate counter backsplash heights with architectural drawings prior to rough-in. Maintain minimum 1” clearance above backsplash height.

*****Measured above door trim to underside of device.

.1 Coordinate all mounting heights with Architectural elevations.

.2 Where installed in block or brick, mounting heights shall be as above or at bottom of nearest course.

.4 Circuiting is representational within a panel only. Circuit all electrical equipment and devices to their individually respective, intended panels.

.5 Panelboards and other equipment which are to be surface mounted shall be installed on minimum 19mm (3/4”) good one side, fir plywood mounting backboards. Treat backboards with wood preservative prior to

installation and paint with primer and two (2) coats gray enamel before any equipment is mounted. Provide plywood mounted boards unless specified otherwise in other sections.

.6 Panelboards mounted on exterior concrete/block walls shall have minimum 3/4" air gap behind enclosure (to minimize condensation).

.7 All transformers, motor control centers and floor-mounted distribution panels shall be mounted on 100mm (4") concrete housekeeping pads. The Electrical Contractors shall be responsible for provision of these pads.

3.9 Fireproofing

.1 Where cables or conduits pass through block or concrete walls and floors and any fire-rated assembly, seal openings with firestopping systems that have been tested for specific fire-resistance-rated construction conditions conforming to the construction assembly type, penetrating item type, annular space requirements, and fire-rating involved in each instance.

.2 Provide products that upon curing, do not 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 and after construction.

.3 Openings within walls and floors designed to accommodate cabling systems subjected to frequent cable changes shall be provided with re-enterable products.

.4 Fire proofing of electrical cables, conduits, trays, etc, passing through fire barriers shall conform to local codes and inspection authorities.

.5 Fire stop materials shall be asbestos free and have been tested in accordance with ASTM E-814, and ULC 1479.

.6 Fire stop and smoke seals shall be done in accordance with Section 07 84 13.

.7 Approved manufacturers:

.1 Nelson Firestop Products

.2 Specified Technologies

.3 Hilti Firestop

3.10 Load Balance

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

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

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

.4 Include load balance test results in maintenance manuals.

3.11 Testing

.1 Conduct and pay for tests including, but not limited to, the following systems:

- .1 High voltage distribution equipment in accordance with relevant sections of specification.
- .2 Power generation and distribution system.
- .3 Circuits originating from branch distribution panels.
- .4 Lighting and its control.
- .5 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
- .6 Heating cables and mats.
- .7 Systems:
  - .1 Fire Alarm
  - .2 Public Address
  - .3 Communication cabling systems.
  - .4 Intrusion Detection
  - .5 Access Control
  - .6 CCTV
- .8 Grounding systems.

.2 Insulation Resistance Testing

- .1 Hi-pot all H.V. cable and equipment over 600 volts, to manufacturer's specifications.
- .2 Megger circuits, feeders and equipment up to 350V with a 500V instrument.
- .3 Megger 350-600V circuits, feeders and equipment with a 1000V instrument.
- .4 Check resistance to ground before energizing.

.3 Furnish Manufacturer's Certificate or letter confirming that entire installation, as it pertains to each system, has been installed to manufacturer's instructions. Submit letter in accordance with this section.

.4 Carry out tests in presence of Contract Administrator where directed.

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

.6 Submit test results in Maintenance Manuals.

3.12 Care, Operation and Start-up

.1 Instruct The City's operating personnel in the operation, care and maintenance of equipment. Arrangement of such instructional sessions shall be done at a time convenient to The City.

.2 Arrange and pay for services of Manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.

.3 Provide these services for such a period, and for as many visits as necessary to put equipment into operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

3.13 Cleaning

.1 Final cleaning shall be done in accordance with the specification.

.2 Final cleaning shall include, but not be limited to, all lighting reflectors, lenses, and other lighting surfaces that have been exposed to dust and dirt throughout the course of construction.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Electrical demolition.

1.2 Related Sections

.1 Section 02 41 19 - Selective Demolition.

Part 2 Products

2.1 Materials and Equipment

.1 Materials and equipment for patching and extending work: As specified in individual Sections.

Part 3 Execution

3.1 Examination

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Verify field measurements and circuiting arrangements are as shown on Drawings.

.3 Verify that abandoned wiring and equipment serve only abandoned facilities.

.4 Electrical drawings are based on existing record documents and/or casual field observations. Coordinate full extent of demolition work with all disciplines. Coordinate on site with all trades prior to commencement of demolition.

.5 Report discrepancies to the Contract Administrator, and City before disturbing the existing installation.

.6 Beginning of demolition means installer accepts existing conditions.

3.2 Preparation

.1 Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

.2 Reroute/extend/re-feed existing electrical as required to maintain existing systems not indicated to be removed.

.3 Coordinate utility service outages with Utility Company.

.4 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.

.5 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 the City at least forty eight (48) hours before partially or completely disabling system. Disable system at a time suitable to the City only. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area as required.

.6 Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable existing system only to make switch overs and modifications. Notify City and local fire service and at least forty eight (48) hours before partially or completely disabling system. Disable system at a time suitable to the City only. Minimize outage duration and make all arrangements for fire watch during outage. Make temporary connections and relocations to maintain service in areas adjacent to and in the work area as required. Where existing devices are covered to minimize dust infiltration during construction, ensure all dust caps are removed during non-construction periods.

.7 Where existing luminaires, equipment or devices are to be temporarily relocated, and are to remain in service, provide an apparatus suitable to support the equipment.

3.3 Demolition and Extension of Existing Electrical Work

.1 Demolish and extend existing electrical work to this Section and as indicated.

.2 The construction documents indicate major items of equipment, fixtures and devices, that exist and may not indicate every item or supporting wiring and conduit to be removed and/or relocated.

.3 Carefully examine the site and construction documents to verify the extent of work defined in the construction documents. Be responsible for determining which existing equipment and/or devices are to be removed and/or relocated.

.4 Remove, relocate, and extend existing installations to accommodate new construction including all existing equipment and/or devices indicated within the construction documents.

.5 Where existing equipment and/or devices are to be temporarily relocated, coordinate the required structure to support the equipment.

.6 Remove abandoned wiring to source of supply.

.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 Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

.14 Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 Cleaning and Repair

.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, broken electrical parts and lenses.

3.5 Finishes

.1 Clean, prime and paint exposed wiring, conduit, junction and pull boxes, hangers, racking, and fasteners to prevent rusting and to match existing finishes where applicable.

3.6 Installation

.1 Install, wire, and connect relocated materials and equipment under the provisions of Section 26 05 00.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Building wire and cable.

.2 Non-metallic sheathed cable.

.3 Direct burial cable.

.4 Armoured cable.

.5 Metal clad cable.

.6 Variable frequency (speed) drive cable.

.7 Fire rated cable.

.8 Wiring connectors and connections.

1.2 Related Sections

.1 Section 26 05 53 - Electrical Identification.

.2 Section 31 23 18 - Trenching: Trenching and backfilling for direct burial cable installation.

1.3 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 C22.2 No. 0.3-09 (R2014) - Test Methods for Electrical Wires and Cables.

.3 CSA C22.2 No. 48-15 - Non-metallic Sheathed Cable.

.4 CSA C22.2 No. 51-14 - Armoured Cables.

.5 CSA C22.2 No. 52-15 - Underground Secondary and Service Entrance Cables.

.6 CAN/CSA-C22.2 No. 65-18 - Wire Connectors.

.7 CSA C22.2 No. 75-17 - Thermoplastic-Insulated Wires and Cables.

.8 CSA C22.2 No. 123-16 - Metal Sheathed Cables.

.9 CAN C22.2 No.131-17 - Type TECK 90 Cable.

.10 CSA C22.2 No. 208-14 - Fire Alarm and Signal Cable.

.11 NECA (National Electrical Contractors Association) - National Electrical Installation Standards (NEIS).

.12 NETA (InterNational Electrical Testing Association) - ANSI/NETA ATS-2017 - Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.

.13 CSA (Canadian Standards Association).

.14 ULC (Underwriters' Laboratories of Canada).

1.4 Administrative Requirements

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Coordination:

.1 Coordinate with other work having a direct bearing on work of this section.

.2 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

1.5 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: Provide for Fire Rated Cable.

1.6 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.

.3 Installation Data: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.7 Storage and Handling

.1 Cables shall be stored and handled in accordance with manufacturer's recommendations.

1.8 Closeout Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Record Documentation:

.1 Record actual locations of components and circuits.

.2 Record routing of all equipment and panelboard feeders.

.3 Testing

.1 Fire Rated Cabling

.4 Manufacturer's Certification and Extended Warranty

.1 Fire Rated Cabling

1.9 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.10 Regulatory Requirements

.1 Conform to CSA-C22.1.

.2 Provide products listed and classified by CSA or ULC and as suitable for the purpose specified and indicated.

1.11 Project Conditions

.1 Conductor sizes are based on copper unless indicated as aluminum or "AL".

.2 If aluminum conductor is substituted for copper conductor, size to match circuit requirements for conductor ampacity and voltage drop.

Part 2 Products

2.1 Building Wire and Cable

.1 Description: Single conductor insulated wire RW90.

.2 Conductor: Copper unless otherwise noted.

.3 Insulation Voltage Rating: 600 volts.

.4 Insulation: Cross-Linked Polyethylene material rated 90 degrees C.

2.2 Armoured Cable

.1 Description: Type ACWU90 and AC90.

.2 Conductor: Copper unless otherwise noted.

.3 Insulation Voltage Rating: 600 volts.

.4 Insulation Temperature Rating: 90 degrees C.

.5 Insulation Material: Cross-Linked Polyethylene.

.6 Rating: CSA FT4

2.3 Metal Clad Cable

.1 Description: Type TECK90.

.2 Conductor: Copper unless otherwise noted.

.3 Insulation Voltage Rating: 600 volts.

.4 Insulation Temperature Rating: 90 degrees C.

.5 Conductor Insulation Material: Cross-Linked Polyethylene (XPLE), type RW90.

.6 Armour Material: Aluminum.

.7 Armour Design: Interlocked metal tape.

.8 Outer jacket: PVC.

.9 Rating: Hazardous Location, CSA FT4

2.4 Variable Frequency (Speed) Drive Cable:

.1 Provide variable frequency drive cables meeting the requirements of CSA C22.2 No. 123 and CSA C22.2 No. 174 from all VFD's to each designated motor load, comprised as follows:

.1 Sectored ground design consisting of 3 bare bonding conductors.

.2 1000 volt rated cross linked polyethylene insulated phase conductors.

.3 FT4 rated PVC outer jacket.

.4 Sized to suit project requirements.

2.5 Fire Rated Cable

.1 Manufacturers:

.1 Pyrotenax; Product: Type MI (mineral insulated) for use in System 1850.

.2 Substitutions: Not permitted.

.2 Description: Mineral Insulated

.3 Conductor: Copper

.4 Insulation Voltage Rating: 600V.

.5 Insulation: Magnesium Oxide

.6 Outer Jacket: Copper

.7 Additional Warranty: 30 Years from date of sale.

2.6 Connectors

.1 Pressure type connectors, fixture type splicing connectors, cable clamps and lugs, as required.

Part 3 Execution

3.1 Examination

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Verify that field measurements are as indicated.

.3 Verify that interior of building has been protected from weather.

.4 Verify that mechanical work likely to damage wire and cable has been completed.

.5 Verify that raceway installation is complete and supported.

3.2 Preparation

.1 Completely and thoroughly swab raceway before installing wire.

3.3 Wiring Methods

.1 Concealed Dry Interior Locations: Use only armoured cable and building wire in raceway.

.2 Exposed Dry Interior Locations: Use only building wire in raceway.

.3 Above Accessible Ceilings: Use only armoured cable, metal clad cable, and building wire in raceway.

.4 Wet or Damp Interior Locations: Use only metal clad cable, armoured cable with jacket, and building wire in raceway.

.5 Exterior Locations: Use only building wire Type RWU90 insulation in raceway, metal clad cable, and armoured cable with jacket.

.6 Underground Installations: Use only direct burial cable, armoured cable with jacket, and metal clad cable.

.7 Use wiring methods indicated.

3.4 Installation

.1 Route wire and cable as required to meet project conditions.

.2 Install cable to the CSA-C22.1.

.3 Use solid conductor for feeders and branch circuits 10 AWG and smaller.

.4 Use stranded conductors for control circuits.

.5 Use conductor not smaller than 12 AWG for power and lighting circuits and sized for maximum 3% voltage drop as per the following Table:

Maximum Conductor Length for 120V Branch Circuits

Breaker Size (A)	Conductor	
	Size (AWG)	Max Length (m)
15A	#12	20
	#10	35
	#8	55
	#6	90
20A	#12	15
	#10	25
	#8	40
	#6	65
	#4	110
30A	#10	15
	#8	25
	#6	45
	#4	70

.1 Where conductors are required to meet voltage drop requirements that are too large for proper termination at breakers or end devices, a transition to a suitable sized conductor may be made within 3m (10') of the termination with a minimum smaller conductor size of #10AWG.

.6 Use conductor not smaller than 16 AWG for control circuits.

.7 Pull all conductors into raceway at same time.

.8 Use suitable wire pulling lubricant for building wire 4 AWG and larger.

.9 Protect exposed cable from damage.

.10 All cable routed below grade shall enter/exit the building below grade unless noted otherwise.

.11 Where cabling is installed on building exterior, or direct buried, make provision for differential settling of exterior grade, buildings, and other structures and supports. Provide slack within cabling systems as required.

.12 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.

.13 Single conductor cables shall be installed one cable diameter apart on suspended cable tray or channel supports and shall be clamped with aluminum cable clamps. Cables shall be terminated using non-magnetic connectors and shall be watertight for top entry. Cable armour shall be grounded via an

aluminum plate at the supply end and isolated via an insulating plate, at the load end of the cable. A #3/0 AWG insulated (unless otherwise noted) copper ground wire shall be installed with each set of feeder cables. Cable bending radius shall be at least twelve times the overall cable diameter and bend shall not damage or distort the outer sheath.

.14 Armoured cable shall be used for connections from conduit systems to recessed luminaires in accessible ceilings. Cable shall be of sufficient length to allow the lighting fixture to be relocated to any location within an 1800mm (6') radius. Cable shall be clamped before entering the lighting fixture and shall be clipped before entering the conduit system junction box. (Minimum requirements).

.15 Armoured cable may be used for connections from conduit systems to wiring devices in steel stud partitions and for interconnection of wiring devices within steel stud partitions. Cables shall be clipped before entering junction or outlet boxes.

.16 Fire Rated Cabling

.1 Fire Rated Cable shall be installed in complete unbroken lengths parallel with building lines. Cabling shall be installed and terminated as per manufacturer's instructions in accordance with its ULC System designation. Care shall be taken at all times to prevent the entry of moisture into the ends of the cable.

.2 Fire Rated Cable shall be supported as per it's ULC System designation requirements. Coordinate all routing and mounting requirements with manufacturer's written instructions.

.3 Preinstallation Testing:

.1 Prior to pulling wiring cable into place, an insulation resistance test shall be performed by installing contractor to ensure integrity of wiring cable as described in the installation manual.

.2 Proceed with installation only after any unsatisfactory conditions have been corrected.

.17 VFD Cabling

.1 Provide VFD cable between the VFD and associated motor for all for all VFD driven motors. Coordinate VFD locations with mechanical. VFD cable lengths shall be kept as small as practically possible to reduce electromagnetic interference. Maintain as much separation as possible between noise-susceptible cables and VFD cables: a minimum of 1 ft. for shielded instrumentation cables and 3 ft. for unshielded instrumentation cables. If the VFD cables and noise-susceptible cables must lie close to each other, parallel runs shall not exceed 3 m (10 ft.). If VFD cable must cross other cable type, cables shall cross perpendicularly, at a single point.

.18 Use suitable cable fittings and connectors.

.19 Use bonding bushings at both ends of armoured cables.

.20 Neatly train and lace wiring inside boxes, equipment, and panelboards.

.21 Clean conductor surfaces before installing lugs and connectors.

.22 Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

.23 Aluminum Conductors

.1 Terminate aluminum conductors with tin-plated aluminum- bodied compression connectors only. Fill with anti- oxidant compound before installing conductor.

.2 Use suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.

.24 Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

.25 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

.26 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

.27 Trench and backfill for direct burial cable installation as specified in Section 32 23 18 and Section 32 23 23. Install warning tape along entire length of direct burial cable, within 75 mm(3 inches) of grade.

.28 Identify wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

3.5 Testing

.1 Fire Rated Cabling

.1 Complete Insulation Resistance

.1 Megger all cables at the following stages.

.1 When received at Project site before installation.

.2 After sealing termination prior to being attached to the termination point.

.2 Maintain and submit records of testing

.3 Insulation resistance must exceed 200 megohms at 500 V dc.

.4 All results must meet manufacturer's specification.

.2 Inspections:

.1 After installing conductors and cables and before electrical circuitry has been energized, test all conductors for compliance with requirements.

.2 Perform each of the following visual and electrical tests:

.1 Inspect exposed sections of conductor and cable for physical damage and correct connection in accordance with the single-line diagram.

.2 Test bolted connections for high resistance using one of the following:

.1 Low-resistance ohmmeter.

.2 Calibrated torque wrench.

.3 Inspect for correct identification.

.4 Inspect cable jacket and condition.

.5 Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500V (dc) for 300V and 600V cable for a one-minute duration.

.6 Continuity test on each conductor and cable.

.7 Uniform resistance of parallel conductors.

.3 Installation will be considered failed if it does not pass tests and inspections.

.4 Prepare test and inspection reports to record the following:

.1 Procedures used.

.2 Results that comply with requirements.

.5 Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements. Provide manufacturer's review and test report confirming that cabling system has been installed per their recommendations and meets performance requirements.

.6 Provide manufacturer's certification of extended warranty.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Grounding electrodes and conductors.

.2 Equipment grounding conductors.

.3 Bonding.

1.2 Related Sections

.1 Section 26 00 00 – Basic Electrical Materials and Methods.

.2 Section 26 41 00 - Lightning Protection.

.3 Section 33 79 19 - Site Utilities Grounding.

1.3 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CSA-Z32-09 Electrical Safety & Essential Electrical Systems in Health Care Facilities.

.3 IEEE 81-2012 IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

1.4 System Description

.1 Metal and underground water pipe.

.2 Metal frame of the building.

.3 Ground ring specified in Section 33 79 19.

.4 Metal and underground gas piping system.

.5 Rod electrode.

1.5 Performance Requirements

.1 Maximum Grounding System Resistance: 5 ohms.

1.6 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: Provide for grounding electrodes and connections.

1.7 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Test Reports: Indicate overall resistance to ground.

1.8 Closeout Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Record Documentation: Record actual locations of components and grounding electrodes.

.3 Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.9 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years experience.

1.10 Regulatory Requirements

.1 Products: Listed and classified by ULC and/or CSA as suitable for the purpose specified and indicated.

Part 2 Products

2.1 Rod Electrodes

.1 Material: Copper-clad steel.

.2 Diameter: 15.8mm (5/8 inch) minimum.

.3 Length and Quantity: As required to meet performance requirements.

2.2 Mechanical Connectors

.1 Material: Bronze.

2.3 Wire

.1 Material: Stranded copper.

.2 Grounding Electrode Conductor: Size to meet CSA-C22.1 requirements.

Part 3 Execution

3.1 Examination

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 Installation

.1 Install rod electrodes as indicated. Install additional rod electrodes as required to achieve specified resistance to ground.

.2 Provide bonding to meet Regulatory Requirements.

.3 Exposed conductors shall be protected from mechanical injury.

.4 Mechanical connections shall be used for bonding connections to equipment. Soldered joints shall not be permitted.

.5 Buried connections of grounding and bonding conductors shall be made using exothermic welding process.

.6 Provide bonding wire connected to both ends of flexible conduit. Neatly attach to exterior of flexible conduit.

.7 Provide separate ground conductors for all exterior pole mounted luminaires.

.8 Interface with site grounding system.

.9 Interface with lightning protection system.

.10 Bonding connections shall be made using a star configuration. Loop connections shall be avoided.

.11 Single conductor cables with metallic armour shall be bonded at the supply end only. Provide non-metallic entry plates for load end terminations. Provide a separate bonding conductor.

.12 Provide separate bonding conductor in all non-metallic raceways.

.13 Bond together metal siding not attached to grounded structure; bond to ground.

.14 Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

.15 Provide additional separate bonding conductor within branch circuit raceways where indicated on the drawings. Terminate each end on suitable lug, bus, or bushing.

3.3 System Grounding

.1 Install system and circuit grounding connection to neutral points of 600V and 208V systems.

.2 Grounding conductors shall be routed in or adjacent to primary conduits or cables.

.3 Provide grounding connection to utility pad mounted transformer in accordance with the requirements of the supply authority.

3.4 Equipment Bonding

.1 Install bonding connections to typical equipment included in, but not necessarily limited to:

.1 Service equipment
.2 Distribution Panels
.3 Transformers
.4 Generators
.5 Motor Frames
.6 Motor Control Centres
.7 Starters
.8 Control Panels
.9 Building Steel Work
.10 Elevators
.11 Outdoor lighting

3.5 Communication Systems

.1 Install communications grounding system for bonding of all telephone, data, fire alarm, paging as follows:

.1 Provide minimum #6 AWG ground (or larger as indicated on drawings) from all voice/data, server, and IT communications rooms to main building ground.

.2 Provide grounding for utility telephone and data demarcation locations in accordance with utility requirements.

.3 Sound, fire alarm, and other communication systems as indicated.

3.6 Field Quality Control

.1 Perform ground continuity and resistance tests using fall-of-potential measurement system method per IEEE 81-2012 standards. A report shall be submitted to the Contract Administrator from the testing agency.

.2 Perform tests before energizing electrical system.

.3 Disconnect ground fault indicator, if provided, during tests.

.4 A ground electrode with an unsatisfactory resistance test result shall be altered as necessary until the required resistance reading is achieved.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Conduit and equipment supports.

.2 Anchors and fasteners.

1.2 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CECA - Canadian Electrical Contractors Association.

.3 CSA (Canadian Standards Association).

.4 ULC (Underwriters' Laboratories of Canada).

1.3 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: Provide manufacturer's catalogue data for fastening systems.

1.4 Regulatory Requirements

.1 Provide products listed and classified by CSA and as suitable for purpose specified and shown.

Part 2 Products

2.1 Product Requirements

.1 Materials and Finishes: Provide adequate corrosion resistance.

.2 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.

.3 Anchors and Fasteners:

.1 Concrete Structural Elements: Use expansion anchors.

.2 Steel Structural Elements: Use beam clamps and spring steel clips.

.3 Concrete Surfaces: Use expansion anchors.

.4 Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.

.5 Solid Masonry Walls: Use expansion anchors.

.6 Sheet Metal: Use sheet metal screws.

.7 Wood Elements: Use wood screws.

2.2 Steel Channel

.1 U-shape, galvanized steel or stainless steel as indicated, sized to suit installation, surface-mounted, suspended or set in poured concrete walls and ceilings as required.

.2 Provide appropriate anchors, fasteners, fittings and supports for a complete supporting system.

2.3 Roof Installations

.1 For roof mounted conduit and wiring, provide supports equivalent to MIFAB C-Port Series. Minimum 6 1/2" in height, supports to be constructed of recycled rubber, UV resistant and designed to support rooftop equipment. Supports to be selected, sized, and configured to match equipment installation requirements and roof construction with pipe clamps. All metal work including strut or pipe clamps to be stainless steel.

2.4 Installation

.1 Provide anchors, fasteners, and supports to CSA-C22.1.

.2 Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

.3 Do not use powder-actuated anchors.

.4 Do not drill or cut structural members.

.5 Do not use plastic cable ties.

.6 Use stainless steel channel for exterior or wet applications.

.7 Use galvanized steel channel for interior dry location applications.

.8 Fabricate supports primarily from steel channel systems. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

.9 Where the structural system is open web steel joists, supporting device shall be by means of structural steel angles or channel system spanning the top chords of adjacent joists. The number of joists to be spanned in this way shall be determined by the incident load of the system or equipment being supported.

.10 In no case shall the hanging of the electrical supporting devices be directly from roof or ceiling decking, be allowed, unless special permission is obtained from the Contract Administrator.

.11 Install surface-mounted cabinets and panelboards with minimum of four anchors.

.12 In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm (1 inch) off wall.

.13 Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Metal conduit.

.2 PVC coated metal conduit.

.3 Flexible metal conduit.

.4 Liquid tight flexible metal conduit.

.5 Electrical metallic tubing.

.6 Non-metallic conduit.

.7 Electrical non-metallic tubing.

1.2 Related Sections

.1 Section 07 84 00 - Firestopping.

.2 Section 26 05 34 - Boxes.

.3 Section 26 05 37 - Duct Bank.

.4 Section 26 05 26 - Grounding And Bonding.

.5 Section 26 05 29 - Electrical Supporting Devices.

.6 Section 26 05 53 - Electrical Identification.

1.3 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 18.1-13 (R2018) - Metallic Outlet Boxes.

.3 CSA C22.2 No. 45.1-07 (R2017) - Electrical Rigid Metal Conduit - Steel.

.4 CSA C22.2 No. 56-17 - Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.

.5 CSA-C22.2 No. 83.1-07 (R2017) - Electrical Metallic Tubing - Steel.

.6 CSA C22.2 No. 211.1-06 (R2016) - Rigid Types EB1 and DB2/ES2 PVC Conduit.

.7 CSA C22.2 No. 211.2-06 (R2016) - Rigid PVC (Unplasticized) Conduit.

.8 CSA C22.2 No. 2420-09 (R2014) - Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

.9 CSA C22.2 No. 227.2.1-14 - Liquid-Tight Flexible Nonmetallic Conduit.

.10 CSA C22.2 No. 327-18 - HDPE Conduit, Conductors-in-conduit, and Fittings

.11 CSA (Canadian Standards Association).

.12 ULC (Underwriters' Laboratories of Canada).

1.4 Administrative Requirements

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Coordination:

.1 Coordinate with other work having a direct bearing on work of this section.

.2 Coordinate location with roofing installation

1.5 Closeout Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Record Documentation:

.1 Accurately record actual routing of conduits equal to or larger than 35mm (1-1/4").

.2 Accurately record actual routing of backbone conduit runs.

.3 Accurately record actual routing of all conduit in slab.

1.6 Regulatory Requirements

.1 Design conduit size to CSA-C22.1.

.2 Provide products listed and classified by CSA or ULC as suitable for purpose specified and shown.

1.7 Delivery, Storage, and Protection

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Accept conduit on site. Inspect for damage.

.3 Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

.4 Protect PVC conduit from sunlight.

Part 2 Products

2.1 Conduit Requirements

.1 Minimum Size: 21 mm (3/4 inch) unless otherwise specified.

.2 Underground Installations:

.1 More than 1525 mm (5 ft) from Foundation Wall: Use thick wall non-metallic conduit.

.2 Within 1525 mm (5 ft) from Foundation Wall: Use rigid steel conduit.

.3 In or Under Slab on Grade: Use thick wall non-metallic conduit.

.4 Minimum Size: 27 mm (1 inch).

.5 Provide a separate ground wire in all below-grade conduits.

.6 Provide an exterior trace wire for all conduits containing non-current carrying cabling.

.7 Use waterproof fittings.

.3 Outdoor Locations, Above Grade: Use rigid steel conduit.

.4 In Slab:

.1 Use electrical non-metallic tubing.

.2 Maximum Size Conduit in Slab: 27mm (1 inch)

.5 Wet and Damp Locations: Use non-metallic conduit.

.6 Dry Locations:

.1 Concealed: Use electrical metallic tubing.

.2 Exposed: Use electrical metallic tubing.

.7 Hazardous Areas: Use rigid steel conduit or TECK cable complete with conduit seal fittings and compound.

.8 Raised Floor Systems: Liquid-tight flexible metal conduit or TECK cable.

2.2 Metal Conduit

.1 Rigid Steel Conduit: C22.2 No. 45.1.

.2 Fittings and Conduit Bodies: All steel fittings.

2.3 Flexible Metal Conduit

.1 Description: Interlocked steel construction.

.2 Fittings: CSA C22.2 No. 56.

.3 Provide a separate ground wire in all flexible metal conduit.

2.4 Liquid Tight Flexible Metal Conduit

.1 Description: Interlocked steel construction with PVC jacket.

.2 Fittings: CSA C22.2 No. 56.

.3 Provide a separate ground wire in all liquid tight flexible metal conduit.

2.5 Electrical Metallic Tubing (EMT)

.1 Description: CSA C22.2 N0. 83.1; galvanized tubing.

.2 Fittings and Conduit Bodies: CSA C22.2 No. 83.1; steel, set screw type in dry locations, watertight connectors in sprinklered areas

.3 Refer to Section 26 05 53 for colour requirements.

2.6 Non-Metallic Conduit

.1 Description:

.1 CSA C22.2 No. 211.2; PVC.

.2 CSA C22.2 No. 327-18; HDPE

.2 Fittings and Conduit Bodies:

.1 CSA C22.2 No. 211.2.

.2 CSA C22.2 No. 327-18

.3 Provide a separate ground wire in all non-metallic conduit

2.7 Fittings

.1 Fittings shall be manufactured for use with conduit specified.

.2 Insulated throat liners on connectors.

.3 Steel raintight connector fittings complete with O-rings, for use on weatherproof or sprinkler proof enclosures. Steel raintight couplings shall be used for surface conduit installation exposed to moisture or sprinkler heads. Steel raintight connectors shall be used for all top entries to panels, contactors and motor control centres.

.4 Expansion fittings

.1 Outdoor locations - Weatherproof expansion fittings with internal bonding assembly, suitable for 100 mm (4") or 200 mm (8") linear expansion.

.2 Wet and Damp Locations - Watertight expansion fittings with integral bonding jumper suitable for linear expansion, and 21 mm (3/4") deflection in all directions, as required.

.3 Panel Entry - Weatherproof expansion fittings for linear expansion as required.

.4 PVC Conduit - O-ring type expansion fittings.

.5 Flexible watertight conduit between junction boxes with integral bonding jumper suitable for linear and lateral movement greater than 19 mm (3/4”).

Part 3 Execution

3.1 Examination

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Verify that field measurements are as shown on Drawings.

.3 Verify routing and termination locations of conduit prior to rough-in.

.4 Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

.5 Drawings do not contain all conduits. Provide all conduit as required for a complete system.

.6 All conduit sizes indicated on drawings are minimum sizes unless otherwise noted. Where larger conduit sizes are required to meet Canadian Electrical Code requirements, contractor shall provide larger size at no additional cost. Increase conduit size at no extra costs where required to accommodate length of run and voltage drop requirements in accordance with Canadian Electrical Code requirements.

3.2 Installation

.1 Install conduit to CSA C22.1.

.2 Install non-metallic conduit to manufacturer's written instructions.

.3 Arrange supports to prevent misalignment during wiring installation.

.4 Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

.5 Group related conduits; support using conduit rack.

.6 Construct rack using steel channel. Provide space on each for 25% additional conduits.

.7 Fasten conduit supports to building structure and surfaces to Section 26 05 29.

.8 Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

.9 Do not attach conduit to ceiling support wires.

.10 Arrange conduit to maintain headroom and present neat appearance.

.11 Provide flexible metal conduit for all connections to motors, recessed lighting, suspended lighting, transformers, and equipment subject to movement or vibration.

.12 Provide conduit systems for all home run and main branch wiring in ceiling spaces. AC-90 shall be used only for connections from conduit systems to wiring devices in steel stud partitions and lighting fixtures for a maximum of 1830 mm (6 feet) horizontally from the conduit system junction box.

.13 Conduit Routing:

.1 All conduit shall be concealed except in mechanical and electrical rooms or as otherwise noted.

.2 Where surface conduit is installed:

.1 Locate more than 2000 mm (78 inches) from infrared or gas-fired heaters.

.2 Group conduits on suspended or surface rack support.

.3 Route conduit parallel and perpendicular to walls.

.4 Route conduit installed above accessible ceilings parallel and perpendicular to walls.

.5 Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.

.6 Route conduit in and under slab from point-to-point.

.7 Do not route conduits through structural members unless otherwise indicated.

.8 Do not route conduit through terrazzo or concrete toppings unless otherwise indicated.

.9 Do not route conduit horizontally in masonry walls unless otherwise indicated.

.10 Do not cross conduits in slab.

.14 Conduits in Poured Concrete:

.1 Submit marked up drawings of proposed conduit routing complete with conduit sizes to Structural and Electrical Contract Administrators for approval prior to installation.

.2 Coordinate installation of conduit to suit reinforcing steel.

.3 Locate in centre third of slab.

.4 Provide minimum separation of 150 mm (6”) between parallel conduit runs.

.5 Do not install conduit in drop panels, beams, or columns unless approved by the Structural Contract Administrator.

.6 Where conduits are grouped, or do not follow perpendicular to parallel to building lines, provide photos in electronic format (minimum resolution 1920x1080) of conduit installation prior to concrete pour.

.7 Record drawings shall indicate location of all conduit embedded in concrete, or run below slab complete with dimensions to building lines.

.8 For slab-on-grade, conduit larger than 27 mm (1") shall be routed below slab and encased in minimum 75 mm (3") of concrete.

.15 All conduit below grade shall be sloped to provide drainage away from the building.

.16 Where conduit is installed on building exterior, or direct buried, make provision for differential settling of exterior grade, buildings and other structures and supports. Provide expansion fittings as required.

.17 Maintain adequate clearance between conduit and piping.

.18 Maintain 300 mm (12 inch) clearance between conduit and surfaces with temperatures exceeding 40 degrees C (104 degrees F).

.19 Cut conduit square using saw or pipe cutter; de-burr cut ends.

.20 Bring conduit to shoulder of fittings; fasten securely.

.21 Where threaded connections are used, threads shall be of sufficient length to ensure a tight connection.

.22 Where conduit becomes blocked, remove and replaced blocked sections.

.23 Join non-metallic conduit using cement as recommended by manufacturer.

.1 Wipe non-metallic conduit dry and clean before joining.

.2 Apply full even coat of cement to entire area inserted in fitting.

.3 Allow joint to cure for 20 minutes, minimum.

.24 Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

.25 Install no more than equivalent of two 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 and factory elbows for bends in metal conduit larger than 53 mm (2 inch) size.

.3 All metallic conduit shall be bent cold. Replace sections where conduit is kinked or flattened by more than 10% of its original diameter.

.26 Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

.27 Ensure conduit systems are dry prior to installation of wiring.

.28 Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic and control expansion joints, and where conduit transitions from below to above grade.

.29 Provide polypropylene pull string in each empty conduit except sleeves and nipples.

.30 Use suitable caps to protect installed conduit against entrance of dirt and moisture.

.31 Ground and bond conduit to Section 26 05 26.

.32 Identify conduit to Section 26 05 53.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Wall and ceiling outlet boxes.

.2 Parking lot outlet boxes.

.3 Floor boxes.

.4 Pull and junction boxes.

1.2 Related Sections

.1 Section 07 84 00 - Firestopping.

.2 Section 08 31 13 - Access Doors And Frames.

.3 Section 26 27 26 - Wiring Devices.

.4 Section 26 27 16 - Cabinets And Enclosures.

1.3 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 18.1-13 (R2018) - Metallic Outlet Boxes.

.3 CSA C22.2 No. 40-17 - Junction and Pull Boxes.

.4 CSA C22.2 No. 85-14 - Rigid PVC Boxes and Fittings.

.5 CSA (Canadian Standards Association).

.6 ULC (Underwriters' Laboratories of Canada).

1.4 Administrative Requirements

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Coordination:

.1 Coordinate with other work having a direct bearing on work of this section.

.2 Coordinate installation of outlet box for equipment connected under Section 26 05 80.

1.5 Closeout Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Record Documentation: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.6 Regulatory Requirements

.1 Products: Listed and classified by CSA or ULC, and as suitable for the purpose specified and indicated.

Part 2 Products

2.1 Outlet Boxes

.1 Sheet Metal Outlet Boxes: CSA-C22.2 No. 18, galvanized steel.

.1 Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 13 mm (1/2 inch) male fixture studs where required.

.2 Concrete Ceiling Boxes: Concrete type.

.2 Non-metallic Outlet Boxes: CSA-C22.2 No. 18.

.3 Cast Boxes: CSA-C22.2 No. 18, Type FS or FD as required, cast ferric alloy. Provide gasketed cover by box manufacturer. Provide threaded hubs.

.4 In-wall Boxes: 18 gauge white powder coated steel complete with trim ring, will accept standard single gang outlet boxes, wiring devices and cover plates, complete with screw-on steel cover with cable exit.

.5 Wall Plates for Finished Areas: As specified in Section 26 27 26.

2.2 Parking Lot Outlet Box:

.1 Wall or Fence Mounted: CSA-C22.2 No. 18, type 3R rated, while in use 45 degree receptacle mounting flange, 6” x 6” x 4” galvanized steel body, ground lug type A, spot welded construction, for use with IPLC receptacle.

.2 Manufacturers:

.1 ACE Manufacturing Metals Ltd.: APB-WIA Series

2.3 Floor Boxes

.1 Floor Boxes: CSA-C22.2 No. 18, fully adjustable, four compartments with feed through tunnel compartment, standard 87 mm (3-7/16 inches) deep, suitable for concrete or wood floor applications.

.2 Manufacturers:

.1 Legrand Wiremold: RFB4 series.

.2 Thomas & Betts Steel City: 665 series.

.3 Substitutions: Refer to 26 05 00 Common Work Results for Electrical.

.4 Material: Steel.

.5 Shape: Rectangular.

.6 Service Fittings: As specified in Section 26 27 26.

.7 Shape: Rectangular.

.8 Service Fittings: As specified in Section 26 27 26.

2.4 Pull and Junction Boxes

.1 Sheet Metal Boxes: CSA-C22.2 No. 18, galvanized steel.

.2 Hinged Enclosures: As specified in Section 26 27 16.

.3 Surface Mounted Cast Metal Box: CSA-C22.2 No. 18, Type 4 or Type 6 as required or as indicated; flat-flanged, surface mounted junction box:

.1 Material: Galvanized cast iron.

.2 Cover: Provide with ground flange, neoprene gasket, and stainless steel cover screws.

.4 In-Ground Cast Metal Box: CSA-C22.2 No. 18, Type 6, flanged, recessed cover box for flush mounting:

.1 Material: Galvanized cast iron.

.2 Cover: Non-skid cover with neoprene gasket and stainless steel cover screws.

.3 Cover Legend: "ELECTRIC".

.5 Fibreglass Hand Holes: Die moulded glass fibre hand holes:

.1 Cable Entrance: Pre-cut 150 x 150 mm (6 x 6 inch) or as indicated, cable entrance at centre bottom of each side.

.2 Cover: Glass fibre weatherproof cover with non-skid finish.

Part 3 Execution

3.1 Examination

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Verify locations of floor boxes and outlets throughout prior to rough-in.

3.2 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 specified in section for outlet device and as indicated. Coordinate locations with architectural drawings.

.4 Electrical boxes are shown on drawings in approximate locations unless dimensioned. Adjust box location up to 3 m (10 ft) 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 inches) 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 specified in Section 07 84 00.

.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 (6 inches) separation. Provide minimum 600 mm (24 inches) 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 In-wall boxes:

.1 Use in-wall boxes for wall mounted television and smart board power and communications applications.

.20 Do not install in-wall box back-to-back in walls; provide minimum 150 mm (6 inches) separation. Provide minimum 600 mm (24 inches) separation in acoustic rated walls.

.21 Secure in-wall box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Use stamped steel bridges to fasten in-wall outlet box between studs.

.22 Install in-wall mounting box without damaging wall insulation or reducing its effectiveness.

.23 Use adjustable steel channel fasteners for hung ceiling outlet box.

.24 Do not fasten boxes to ceiling support wires.

.25 Support boxes independently of adjacent or connecting conduit systems.

.26 Use gang box where more than one device is mounted together.

.27 The use of sectional boxes is not permitted.

.28 Use gang box with plaster ring for single device outlets.

.29 Use cast outlet box in exterior locations where exposed to the weather and wet locations.

.30 Set floor boxes level.

.31 Large Pull Boxes: Where pull boxes have a long dimension of 305 mm (12 inches) or more, use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

.32 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.33 Vacuum clean interior of outlet boxes before installation of wiring devices.

3.3 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.

3.4 Cleaning

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Clean interior of boxes to remove dust, debris, and other material.

.3 Clean exposed surfaces and restore finish.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Nameplates and labels.

.2 Wire markers.

.3 Conduit markers.

.4 Underground warning tape.

1.2 References

.1 CSA (Canadian Standards Association).

.2 ULC (Underwriters' Laboratories of Canada).

1.3 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: Provide catalogue data for nameplates, labels, and markers.

.3 Installation Data: Provide list of all equipment requiring nameplates complete with associated nameplate configuration for review.

1.4 Regulatory Requirements

.1 Provide products listed and classified by CSA or ULC and as suitable for purpose specified and shown.

1.5 Language

.1 All identification shall be in English.

Part 2 Products

2.1 Nameplates and Labels

.1 Nameplates:

.1 Exterior –Stainless steel, etched and color filled with stamped product specific labelling.

.2 Interior - Engraved three-layer laminated plastic, white letters on blue background for normal power and systems, white letters on red background for life safety power and systems, and white letters on orange background for standby power and systems.

.3 Locations:

.1 Electrical distribution, motor control centres, disconnect switches, panelboards and control equipment enclosures.

.1 Nameplate shall include:

.1 Distribution Name

.2 Distribution Voltage, Phase, Wires, Amperage

.3 Room Location

.4 Fed From:
.1 Panel Name
.2 Supplying Breaker Size/Poles
.3 Room Location

.2 Electrical distribution and motor control centres.
.1 Nameplates at individual breakers shall include:
.1 Load Name
.2 Room Location of Load
.3 Breaker Size/Poles

.3 Electrical distribution and panelboards where breakers are applied in series ratings shall also include:
.1 “BREAKERS ARE INSTALLED IN A SERIES RATED COMBINATION AND SHALL ONLY BE REPLACED WITH COMPONENTS OF THE SAME TYPE AND RATING.”

.4 Circuit breakers and fused switches which directly feed a single conductor cable shall include the maximum continuous load allowed:
.1 “MAXIMUM CONTINUOUS LOAD: X AMPS”

.5 Adjustable circuit breakers shall include the maximum continuous load allowed:
.1 “MAXIMUM CONTINUOUS LOAD: X AMPS”

.6 Mechanical equipment disconnect switches:
.1 Nameplate shall include:
.1 Mechanical Equipment Mark
.2 Panel Name & Circuit number

.7 Communication/Systems Racks & Cabinets
.1 Nameplate shall include:
.1 System Name
.2 Room Number
.3 Rack/Cabinet Number (if applicable)
.4 Fed From:
.1 Room Number.
.2 Rack/Cabinet Number (if applicable)
.3 Patch Panel and/or Rack Position (if applicable)

.8 Fire Alarm System Equipment
.1 Nameplate shall include:
.1 Room Number
.2 Equipment Name
.3 Fed From:
.1 Room Number.
.2 Panel Name and Circuit Number

.9 Fire Alarm Equipment Branch Circuit Breakers

.1 Nameplate shall be red using white lettering and meet AHJ requirements. Nameplate shall indicate “FIRE ALARM PANEL”, “NACPS” etc. or approved wording.

.10 Pole mounted luminaires.

.1 Nameplate shall include:

.1 Manufacturer & Model # of Pole

.2 Manufacturer & Model # of Luminaire

.3 Voltage

.4 Ballast Model #

.5 Lamp Wattage & Model #

.6 Fed From Panel & Circuit Number

.11 Emergency Lighting Units.

.1 Nameplate shall include:

.1 Unit #

.2 Manufacturer & Model # of unit equipment

.3 AC circuit supplying unit

.4 AC lighting circuits monitored (voltage relay)

.5 Date installed

.12 Parking receptacles.

.1 Nameplate shall include:

.1 Circuit number

.4 Letter Size:

.1 Use 6mm (1/4 inch) letters for identifying equipment mark designations and system types.

.2 Use 3mm (1/8 inch) letters for identifying supporting information.

.3 Use 6mm (1/4 inch) letters for identifying grouped equipment and loads.

.5 Nameplates on exterior equipment shall be UV & weather resistant.

.6 Wording on nameplates shall be approved prior to manufacture. Submit schedule of nameplates and wording.

.2 Labels: Plastic self-adhesive non-smear labels with 5mm (3/16 inch) black letters on white background.

.1 Locations:

.1 Wiring devices, including lighting control devices and receptacles.

.1 Label shall include:

.1 Indicate associated panel and circuit number.

.2 E.g. “A-32” (A is for Panel-A, and 32 is the circuit number)

.3 Lighting controls to include brief description of lighting being controlled.

.4 E.g. “Pendants”

.2 Voice/Data Outlets

.1 Label shall include:

.1 Indicate associated rack or cabinet name

.2 Indicate associated patch panel and drop number

.3 E.g. “IDC-A-13” (IDC is for rack name, patch panel A, drop number 13)

.3 Voice/Data Patch Panels

.1 Label shall include:

.1 Indicate associated rack or cabinet name

.2 Indicate patch panel name.

.3 E.g. “IDC-A” (IDC is for rack name, patch panel A)

2.2 Wire Markers

.1 Wire Markers: Permanent tape type wire markers not susceptible to thermal or mechanical influence.

.2 Locations:

.1 Each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.

.1 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 Voice/Data drops including both ends of cable.

.1 Label shall include:

.1 Indicate associated rack or cabinet name

.2 Indicate associated patch panel and drop number

.3 E.g. “IDC-A-13” (IDC is for rack name, patch panel A, drop number 13)

2.3 Conduit Markers

.1 Manufacturers:

.1 Brady; Product: BMP71 Indoor/Outdoor Vinyl Labels.

.2 Substitutions: Refer to Section 26 05 00.

.2 Description: Vinyl label.

.3 Location: Provide markers for each conduit longer than 4.7m (10 ft).

.4 Spacing: 6m (20 ft) on centre.

.5 Colour:

.1 Normal Power System: Blue

.2 Life-Safety Power System: Red

.3 Standby Power System: Orange

.4 Fire Alarm System: Red.

.5 Communication System: Yellow

.6 Security Systems: Black

.7 Nursecall Systems: Pink

.8 Controls System: White

.6 Legend:

.1 600 Volt System: 600V.

.2 120/208 Volt System: 120/208V.

.3 Fire Alarm System: FIRE ALARM.

.4 Communication System:

.1 VOICE

.2 DATA

.3 VOICE/DATA

.5 Public Address System: PA

.6 CCTV System: CCTV

.7 Access Control System: ACCESS CONTROL

.8 Intrusion System: INTRUSION

.9 Nursecall System: NURSECALL

.10 Controls System: CONTROLS

2.4 Underground Warning Tape

.1 Manufacturers: Brady

.1 Product: Detectable Identoline.

Part 3 Execution

3.1 Preparation

.1 Degrease and clean surfaces to receive nameplates and labels.

3.2 Application

.1 Install nameplate and label parallel to equipment lines.

.2 Secure nameplate to equipment front using rivets or screws.

.3 Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

.4 Conduit shall be integrally colour coded through a colouring process applied by the conduit manufacturer.

.5 Identify underground conduits using underground warning tape. Install one tape per trench at 75mm (3 inches) below finished grade.

.6 Provide identification on all junction box covers indicating associated system, panel and circuit numbering using permanent marker.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Electrical connections to equipment specified under other sections.

1.2 Related Sections

.1 Section 26 05 00 - Common Work Results for Electrical.

.2 Section 08 33 23 - Overhead Coiling Doors.

.3 Section 22 47 00 - Plumbing Equipment.

.4 Section 23 81 13 - Unitary Air Conditioners.

.5 Section 26 05 33 - Conduit.

.6 Section 26 05 19 - Building Wire And Cable.

.7 Section 26 05 34 - Boxes.

1.3 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 127-18 - Equipment and Lead Wires.

.3 ANSI/NEMA WD 6-2016 Wiring Devices—Dimensional Specifications.

.4 NEMA WD 1-1999 (R2015) - General Colour Requirements for Wiring Devices.

.5 CSA (Canadian Standards Association).

.6 ULC (Underwriters' Laboratories of Canada).

1.4 Administrative Requirements

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Coordination:

.1 Coordinate with other work having a direct bearing on work of this section.

.2 Obtain and review shop drawings, product data, and manufacturer's instructions for equipment provided under other sections.

.3 Determine connection locations and requirements.

.3 Sequencing:

.1 Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

.2 Sequence electrical connections to coordinate with start-up schedule for equipment.

1.5 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: Provide wiring device manufacturer's catalogue information showing dimensions, configurations, and construction.

1.6 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Installation Data: 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.

1.7 Regulatory Requirements

.1 Products: Listed and classified by CSA or ULC, and as suitable for the purpose specified and indicated.

Part 2 Products

2.1 Mechanical Equipment Connections

.1 Include motor starters, disconnects, conduit, wire, fittings, interlocks, outlet boxes, junction boxes, and all associated equipment required to provide power wiring for mechanical equipment, unless otherwise indicated.

.2 Include pushbutton stations, motor protective switches, interlocks, conduit, wire, devices, and fittings required to provide control wiring for mechanical equipment, except for temperature/humidity control systems.

.3 Unless otherwise noted, motors and control devices shall be supplied by Division 21, 22, and 23. Motor horsepower ratings shall be as shown in the Division 21, 22, and 23 specifications.

.4 Provide the Mechanical Contractor with a copy of the Motor Schedule and ensure conformance with voltage shown.

.5 All equipment, mounted on the exterior of the building, shall be weatherproof.

2.2 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, multi-conductor 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 over-current protection.

2.3 Automatic Door Operators

.1 Power: Wire and connect motorized door operators as indicated.

.2 Controls: Wire and connect all associated controls including but not limited to entry pushbuttons, vertical kick bars, motion sensors, electric strikes, electric locks, key switches etc. Confirm controls requirements with automatic door shop drawings and automatic door contractor.

.3 Interface with Other Systems:

.1 Interface with access control system and intrusion alarm system as indicated. Coordinate sequencing of door operators with other systems to City's requirements.

.2 Where fire doors equipped with power-operators are installed in rated wall assembly partitions, wire and connect the power-operator fire alarm releasing device to the fire alarm system using an addressable relay control module. Power-operator shall release on ALARM event only.

.4 Execution: Coordinate complete installation with automatic door shop drawings and automatic door contractor.

2.4 Overhead Door Operators

.1 Power: Provide a disconnect switch at overhead door motor electrical connection.

.2 Controls: Wire and connect overhead door up/down controls complete with all safety controls including but not limited to remote control panel, open/close drive loops and infrared safety beams. Confirm controls requirements with overhead door shop drawings and overhead door contractor.

.3 Interface with Other Systems: Interface with access control system and intrusion alarm system as indicated. Coordinate sequencing of door operators with other systems to City's requirements.

.4 Execution: Coordinate complete installation with overhead door shop drawings and overhead door contractor.

2.5 Fuel-Fired Appliance Emergency Shut-Off

.1 Provide red emergency push button with yellow back-box to disconnect power to all fuel-fired equipment throughout the space.

.2 Emergency shut-off shall incorporate a 24V control scheme using contactors for designated appliances.

.3 Identify shut-off with "FUEL-FIRED APPLIANCE EMERGENCY SHUT-OFF".

.4 Provide a manual control device vandal guard complete with clear vandal resistant, UV Stabilized polycarbonate shield and frame complete with integral 95db piezo horn and battery. Vandal guard shall be equal to STI Stopper II series.

Part 3 Execution

3.1 Examination

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 Electrical Connections

.1 Make electrical connections to equipment manufacturer's written instructions.

.2 Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.

.3 Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

.4 Provide receptacle outlet where connection with attachment plug is indicated or as required. Provide cord and cap where field-supplied attachment plug is indicated or as required.

.5 Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

.6 Install disconnect switches, controllers, control stations, and control devices as indicated or as required by the manufacturer of the associated equipment.

.7 Modify equipment control wiring with terminal block jumpers as indicated or as required.

.8 Provide interconnecting conduit and wiring between devices and equipment where indicated or as required.

.9 Provide ground fault circuit interrupter type circuit breakers for circuits supplying hot tubs, whirlpool tubs, tub lifts etc. Wire and connect associated controls as required by the equipment shop drawings.

.10 Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

.11 Illuminated Signage: Provide a disconnect switch for illuminated signage.

.12 Pre-Wired Powered Furniture:

.1 Power Wiring:

.1 Provide a termination box suitable for furniture whip power connection. Coordinate locations and quantities of termination boxes for furniture whip connections with furniture supplier.

.2 Coordinate lengths of all furniture whips with furniture supplier such that furniture whips are supplied at appropriate lengths, pre-cut and CSA certified from factory.

.3 Where furniture whips require field cutting, include all costs necessary for CSA field certification of furniture whip field modifications.

.13 Mechanical Equipment:

.1 Power Wiring

.1 Install power feeders, starters, disconnects, and associated equipment and make connections to all mechanical equipment.

.2 Wire and connect all loose line and load side reactors to associated drives as required. Coordinate locations and quantities with mechanical contractor.

.3 Install branch circuit wiring for mechanical system control panels, time clocks, and control transformers.

.4 Install main power feeders to starter/control panels furnished by Division 21, 22, and 23. Install branch wiring from starter/control panels to controlled equipment such as motors, electric coils, etc.

.5 Flexible connections to motors shall not exceed 6 feet (1.83 m), unless approved by Contract Administrator.

.2 Controls

.1 Install all electrical controls as indicated on the drawing schedules.

.2 Wire and connect line voltage remote thermostats and P/E switches for furnaces, condensing units, force flows, gas-fired unit heaters, electric heaters and rooftop units.

.3 Wire and connect float switches, pressure switches, alternators, alarms, etc. for sump pumps, sewage pumps, domestic hot water recirculating pumps, booster pumps, jockey pumps and compressors.

.4 Wire and connect electrical interlocks for starters supplied by Division 21, 22, and 23.

.5 Wire and connect hi-limit cutouts for remotely mounted electric heating coils provided by Division 21, 22, and 23.

.3 Disconnects

.1 Disconnects shall be mounted independently from the equipment that it's serving.

.14 Fuel-Fired Appliance Emergency Shut-Off:

.1 For room entrances located within the building, the switch shall be located immediately outside the room containing the appliances, adjacent the door.

.2 For room entrances located outside of the building, the switch shall be located immediately inside the room containing the appliances by adjacent the door.

.3 For rooms with more than one (1) door, a disconnect shall be provided at each door.

.4 Power shall disconnect to all fuel-fired appliances within the room, using the single emergency shut-off control point.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Two-winding transformers.

1.2 Related Sections

.1 Section 26 05 26 - Grounding And Bonding.

.2 Section 26 05 33 - Conduit: Flexible conduit connections.

1.3 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CSA-C9-17 - Dry-Type Transformers.

.3 CSA C22.2 NO. 47-13 (R2018) - Air-Cooled Transformers (Dry Type).

.4 NEMA ST20-1992 (R1997) - Dry Type Transformers for General Applications. (Rescinded Standard - included for information only)

.5 CSA (Canadian Standards Association).

.6 ULC (Underwriters' Laboratories of Canada).

1.4 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, power, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.5 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Test Reports: Indicate loss data, efficiency at 25%, 50%, 75% and 100% rated load, and sound power level per octave band from 63Hz – 8kHz.

1.6 Closeout Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Record Documentation: Record actual locations of transformers in project record documents.

1.7 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.8 Regulatory Requirements

.1 Products: Listed and classified by CSA and as suitable for the purpose specified and indicated.

1.9 Delivery, Storage, and Protection

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

.3 Handle to manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

Part 2 Products

2.1 Two-Winding Transformers

.1 Manufacturers:

.1 Delta

.2 Hammond

.3 Bmag

.4 Substitutions: Refer to Section 26 05 00.

.2 Description: NEMA ST20, factory-assembled, air cooled dry type transformers ratings as indicated.

.3 Primary Voltage: 600 volts, 3 phase.

.4 Secondary Voltage: 208Y/120 volts, 3 phase.

.5 Insulation system and average winding temperature rise for rated kVA as follows:

.1 1-15 kVA: Class 185 with 115 degrees C (200 degrees F) rise.

.2 16-500 kVA: Class 220 with 150 degrees C (277 degrees F) rise.

.6 Case temperature: Do not exceed 35 degrees C (60 degrees F) rise above ambient at warmest point at full load.

.7 Winding Taps:

.1 Transformers Less than 15 kVA: Two 5% below rated voltage, full capacity taps on primary winding.

.2 Transformers 15 kVA and Larger: NEMA ST20.

.8 Sound Levels: Maximum sound levels:

.1 1-25 kVA: 45 dB.

.2 26-150 kVA: 50 dB.

.3 151-300 kVA: 55 dB.

.4 301-500 kVA: 60 dB.

.9 Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

.10 Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

.11 Mounting:

.1 1-15 kVA: Suitable for wall mounting.

.2 16-75 kVA: Suitable for floor and wall mounting.

.3 Larger than 75 kVA: Suitable for floor mounting.

.12 Coil Conductors: Continuous windings with terminations brazed or welded.

.13 Enclosure: NEMA ST20, Type 3R ventilated. Provide lifting eyes or brackets.

.14 Isolate core and coil from enclosure using vibration-absorbing mounts.

.15 Nameplate: Include transformer connection data.

2.2 Source Quality Control

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Production test each unit according to NEMA ST20.

Part 3 Execution

3.1 Installation

.1 Install transformers to manufacturer's instructions.

.2 Set transformer plumb and level.

.3 Use flexible conduit, under the provisions of Section 26 05 33, 600mm (24”) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

.4 Mount wall-mounted transformers using integral flanges or accessory brackets provided by the manufacturer.

.5 Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

.6 Mount floor-mounted transformers on 100mm (4”) housekeeping pad.

.7 Provide grounding and bonding to Section 26 05 26.

.8 Provide minimum 150mm (6”) of clearance from walls and 100 mm (4”) of clearance from adjacent equipment for ventilation.

.9 Maintain shipping supports after transformer is installed and remove just before putting transformer into service.

.10 Loosen isolation pad retaining bolts until no compression is visible.

3.2 Adjusting

.1 Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Switchboards.

.2 Metering transformers.

.3 Accessories.

1.2 Related Sections

.1 Section 03 30 00 - Cast-in-place Concrete: Concrete for supporting foundations and pads.

.2 Section 26 05 26 - Grounding and Bonding.

.3 Section 26 24 01 - Utility Service Entrance.

.4 Section 26 25 00 - Feeder and Plug-In Busway.

.5 Section 26 18 16 - Fuses.

1.3 References

.1 ANSI C39.1-1981(R1992) - Requirements for Electrical Analog Indicating Instruments.

.2 NEMA C12.1-2008 - Code for Electricity Metering.

.3 IEEE C57.13-2008 - IEEE Standard Requirements for Instrument Transformers.

.4 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.5 CSA-C22.2 No. 5-09 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

.6 NEMA KS 1-2001 (R2006) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

.7 NEMA PB 2-2006 - Deadfront Distribution Switchboards.

.8 NEMA PB 2.1-2007 - General Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards Rated 600 V or Less.

.9 NEMA 260-1996 (R2004) - Safety Labels for Pad Mounted Switchgear and Transformers Sited in Public Areas.

.10 NETA ATS 2007 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

.11 CSA (Canadian Standards Association).

.12 ULC (Underwriters' Laboratories of Canada).

1.4 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: Provide electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of all equipment and components.

.3 Shop Drawings: Indicate front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral and ground; and switchboard instrument details.

1.5 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Test Reports: Indicate results of factory production tests.

.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.

1.6 Closeout Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

.3 Record Documentation: Record actual locations of switchboard in project record documents.

1.7 Maintenance Material Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Extra Stock Materials: Provide two (2) of each key.

1.8 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.9 Regulatory Requirements

.1 Products: Listed and classified by ULC, CSA and as suitable for the purpose specified and indicated.

1.10 Delivery, Storage, and Protection

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

.3 Handle to NEMA PB 2.1 and manufacturer's written instructions. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

Part 2 Products

2.1 Manufacturers

.1 Eaton

.2 Schneider

.3 Siemens

.4 GE

.5 Substitutions: Refer to Section 26 05 00.

2.2 Switchboards

.1 Description: NEMA PB 2 switchboard with electrical ratings and configurations as indicated and specified.

.2 Ratings:

.1 Voltage: As indicated

.2 Main Bus: Ampere rating as indicated

.3 Integrated Equipment Rating: As indicated

.3 Main Section Devices: Individually mounted and compartmented.

.4 Distribution Section Devices: Individually mounted and compartmented.

.5 Auxiliary Section Devices: Individually mounted and compartmented.

.6 Bus Material: Copper.

.7 Bus Connections: Bolted and, accessible from front for maintenance.

.8 Fully insulate load side bus bars. Do not reduce spacing of insulated bus.

.9 Ground Bus: Extend length of switchboard.

.10 Moulded Case Circuit Breakers: CAN/CSA-C22.2 No. 5, integral thermal and instantaneous magnetic trip in each pole.

.11 Include electronic trip unit where indicated:

.1 Adjustable continuous current setting.

.2 Adjustable short time pickup setting encompassing an I2t ramp function.

.3 Adjustable long time delay tLD and pickup setting Ir.

.4 Adjustable flat response short time delay and instantaneous trip setting.

.5 Adjustable ground fault pickup and flat response ground fault delay.

.12 Circuit Breaker Functions:

.1 Provide electronic trip with adjustable long time, short time and instantaneous settings, as well as adjustable arc flash reduction settings for all main service breakers.

.2 Provide electronic trip at the following locations:

.1 Breakers feeding:

.1 Fire pumps

.2 Elevators

.3 Generator emergency distributions

.2 Generator emergency distribution main breaker

.3 Additional breakers as indicated

.3 Provide ground fault protection at the following locations:

.1 All 347/600V breakers 1000A and larger

.2 All 120/208V breakers 2000A and larger

.3 Additional breakers as indicated

.13 Circuit breakers, ULC and CSA listed.

.14 Moulded Case Circuit Breakers with Current Limiters: CAN/CSA-C22.2 No. 5, moulded case circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

.15 Solid-State Moulded Case Circuit Breakers: CAN/CSA-C22.2 No. 5, with electronic sensing, timing and tripping circuits for adjustable current settings.

.16 Ground fault trip ground fault sensing integral with circuit breaker.

.1 Instantaneous trip.

.2 Adjustable short time trip.

.3 Stationary mounting.

.17 Line and Load Terminations: Accessible from the front and the rear of the switchboard, suitable for the conductor materials and sizes indicated.

.18 Ground Fault Sensor: Ground return type.

.19 Metering Transformer Compartment: For Utility Company's use; compartment size, bus spacing and drilling, door, and locking and sealing requirements.

.20 Pull Section: Size as indicated or width, depth and height to match switchboard. Arrange as indicated.

.21 Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Provide continuous current rating as indicated.

.22 Pull Box: Removable top and sides, same construction as switchboard.

.23 Enclosure: Type 1 provided with a sprinkler drip hood.

.1 Align sections at front and rear.

.2 Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

.24 Mimic Bus: Show bussing, connections and devices in single line form on the front panels of the switchboard using colour, factory painting and, fastened flat against the panel face with screws or rivets.

2.3 Digital Multi-Function Meters

.1 The power meter to applied in 600V three-phase, four-wire systems in WYE mode.

.2 The power meter shall be capable of being applied without modification at nominal frequencies of 60Hz.

.3 The power meter unit and display shall be mounted in the pre-made cut-out without tools.

.4 The power meter display shall be backlit dot-matrix LCD for easy viewing, display shall also be anti-glare and scratch resistant with a minimum of 128x128 pixels.

.5 All setup parameters required by the power meter shall be stored in nonvolatile memory and retained in the event of a control power interruption. Cumulative quantities for real, reactive and apparent energies shall be stored in non-volatile memory. The power meter shall provide the user the ability to reset the cumulative energy quantities from the display of the unit or via communications.

.6 The power meter shall have a real time clock with battery back-up with at least 1 year ride through time without external power.

.7 The current and voltage signals shall be digitally sampled at a rate high enough to provide true rms accuracy to the 31st harmonic (fundamental of 60 Hz). The power meter shall provide continuous sampling at a minimum of up to 64 samples/cycle, simultaneously on all voltage and current channels in the meter.

.8 0-10 amps with 5 amps nominal input from CT secondary.

.9 Residual current shall be calculated by vectorial summation of the phase currents.

.10 A fourth CT input shall be available to measure neutral or ground current.

.11 Operating temperature range: meter: -25 to 70 °C, display -20 to 70 °C.

.12 The power meter device shall comply with ANSI C12.20 Class 0.5 and IEC 61557-12 Class 0.5 for revenue meters. Accuracy for Active energy of the power meter shall be class 0.5S as per IEC 62053-22. Accuracy for reactive energy of the power meter shall be class 2 as per IEC 62053-23 (reactive energy). No annual calibration shall be required to maintain this accuracy.

.13 The power meter shall provide for onboard data logging. Each power meter shall be able to log data, alarms and events, and waveforms (if applicable). Logged information to be stored in each Power Meter include the following: Data logs, Min/Max log files of selected parameter values, Alarm logs for each user defined alarm or event and Waveform log. The meters shall offer the following on-board nonvolatile memory. The power meter shall have onboard memory sufficient to log 14 values every 15 minutes for 90 days.

.14 Real-time readings

- .1 Current (Per-phase, 3-Phase Avg, % Unbalanced)
- .2 Neutral and Ground (4CTs)
- .3 Voltage (L–L Per-phase, L-L 3-Phase Avg, L–N Per-Phase, 3-Phase Avg, % Unbalanced)
- .4 Real Power (Per-phase, 3-Phase Total)
- .5 Reactive Power (Per-phase, 3-Phase Total)
- .6 Apparent Power (Per-phase, 3-Phase Total)
- .7 Power Factor (True/Displacement)(Per-phase, 3-Phase Total)
- .8 Frequency
- .9 THD, thd, TDD (Current and Voltage), Neutral & ground current THD
- .10 Individual harmonics up to the order of 15th
- .11 Temperature (Internal Ambient)
- .12 K-Factor (Per-Phase)

.13 Crest Factor (Per-Phase)

.15 Energy Readings

.1 Accumulated Energy (Real kWh, Reactive kVARh, Apparent kVAh) (Signed/Absolute)

.16 Demand Readings

.1 Demand Current Calculations (Per-Phase, 3-Phase Avg, Neutral)-Present and Peak

.17 Demand Calculations (3-Phase Total):

.1 Real Power

.2 Reactive Power

.3 Apparent Power

.18 All power demand calculations shall use any one of the following calculation methods, selectable by the user:

.1 Thermal demand using a sliding window technique.

.2 Block interval, with optional sub-intervals. Block methods available are Sliding, Fixed and Rolling.

.3 Demand can be calculated using a Synchronization signal:

.4 Demand can be synchronized to an input pulse from an external source.

.5 Demand can be synchronized to a communication signal.

.6 Demand can be synchronized to the clock in the power meter

.19 Power Analysis Values

.1 THD, thd – Voltage, Current (3-Phase, Per-phase, Neutral & Ground current)

.2 Power Factor (Per-phase, 3-Phase)

.3 Displacement Power Factor (Per-phase, 3-Phase)

.4 Fundamental Voltage, Magnitude and Angle (Per-phase)

.5 Fundamental Currents, Magnitude and Angle (Per-phase)

.6 Fundamental Real Power (Per-phase, 3-Phase)

.7 Fundamental Reactive Power (Per-phase)

.8 Harmonic Power (Per-phase, 3-Phase)

.9 Phase Rotation

.10 Unbalance (Current and Voltage)

.11 Harmonic Magnitudes & Angles (Per-phase)

.12 Total Demand distortion factor (TDD)

2.4 Metering Transformers

.1 Coordinate CT & PT requirements with Supply Utility.

2.5 Accessories

.1 Circuit Breaker Lifting Device: Carriage and track on top of each switchboard with lifting device to serve draw-out circuit breakers in switchboard.

2.6 Source Quality Control

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Shop inspect and test switchboard according to NEMA PB 2.

Part 3 Execution

3.1 Examination

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Verify that field measurements are as indicated on Shop Drawings and as instructed by the manufacturer.

3.2 Preparation

.1 Provide concrete housekeeping pad to Section 03 30 00.

3.3 Installation

.1 Install switchboard in locations shown on Drawings, according to CSA-C22.1.

.2 Tighten accessible bus connections and mechanical fasteners after placing switchboard.

.3 Install fuses in each switch.

3.4 Adjusting

.1 Adjust all operating mechanisms for free mechanical movement.

.2 Tighten bolted bus connections to manufacturer's written instructions.

.3 Adjust circuit breaker trip and time delay settings to values as indicated.

3.5 Cleaning

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Touch up scratched or marred surfaces to match original finish.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Distribution panelboards.

.2 Branch circuit panelboards.

.3 Load centres.

1.2 Related Sections

.1 Section 26 05 26 - Grounding and Bonding.

.2 Section 26 05 53 - Electrical Identification.

.3 Section 26 18 16 - Fuses.

1.3 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CSA-C22.2 No. 29-15 - Panelboards and Enclosed Panelboards.

.3 CSA C22.2 No. 94.1-15 Enclosures for Electrical Equipment, Non-Environmental Considerations

.4 CSA C22.2 No. 94.2-15 Enclosures for Electrical Equipment, Environmental Considerations

.5 NEMA ICS 2-2000 (R2005) - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.

.6 NEMA KS 1-2001 (R2006) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

.7 NETA ATS 2007 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

.8 CSA (Canadian Standards Association).

.9 ULC (Underwriters' Laboratories of Canada).

1.4 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.5 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Installation Data: 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.

1.6 Closeout Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

.3 Record Documentation: Record actual locations of panelboards and record actual circuiting arrangements in project record documents.

1.7 Maintenance Material Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Extra Stock Materials: Provide two (2) of each panelboard key.

1.8 Quality Assurance

.1 Products of This Section: Manufactured to ISO 14000 and ISO 9000 certification requirements.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.9 Regulatory Requirements

.1 Products: Listed and classified by CSA and as suitable for the purpose specified and indicated.

Part 2 Products

2.1 Distribution Panelboards

.1 Manufacturers:

.1 Eaton

.2 Schneider Electric

.3 Siemens

.4 Substitutions: Refer to Section 26 05 00.

.2 Description: CSA-C22.2 No.29, circuit breaker type.

.3 Panelboard Bus: Copper and ratings as indicated. Provide copper ground bus in each panelboard.

.4 Minimum integrated short circuit rating: 18,000 amperes rms symmetrical for 250 volt panelboards; 22,000 amperes rms symmetrical for 600 volt panelboards or as indicated.

.5 Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate Class R fuses.

.6 Moulded Case Circuit Breakers: CSA-C22.2 No. 5, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers ULC listed as Type HACR for air conditioning equipment branch circuits.

.7 Circuit Breaker Functions:

.1 Provide electronic trip LSI adjustable functions at the following locations:

.1 Breakers feeding:

.1 Fire pumps

.2 Elevators

.3 Generator emergency distributions

.2 Generator emergency distribution main breaker

.3 Additional breakers as indicated

.2 Provide ground fault protection at the following locations:

.1 All 347/600V breakers 1000A and larger

.2 All 120/208V breakers 2000A and larger

.3 Additional breakers as indicated

.8 Circuit Breaker Accessories:

.1 Trip units and auxiliary switches as indicated.

.9 Enclosure: CSA C22.2 No. 94.1:

.1 Surface mounted: Type 2.

.2 Recessed mounted: Type 2.

.3 Exterior use: Type 4 or as indicated.

.10 Cabinet Front: Surface type, fastened with hinge and latch and concealed trim clamps, hinged door with flush lock, metal directory frame and finished in manufacturer's standard gray enamel.

2.2 Branch Circuit Panelboards

.1 Manufacturers:

.1 Eaton

.2 Schneider

.3 Siemens

.4 Substitutions: Refer to Section 26 05 00.

.2 Description: CSA-C22.2 No.29, circuit breaker type, lighting and appliance branch circuit panelboard.

.3 Panelboard Bus: Copper and ratings as indicated. Provide copper ground bus in each panelboard.

.4 Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 250 volt panelboards; 18,000 amperes rms symmetrical for 600 volt panelboards or as indicated.

.5 Moulded Case Circuit Breakers: CSA-C22.2 No. 5, plug-on and 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 unless indicated.

.6 Current Limiting Moulded Case Circuit Breakers: CSA-C22.2 No. 5, 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 Circuit Breaker Functions:

.1 Provide electronic trip LSI adjustable functions at the following locations:

.1 Breakers feeding:

.1 Fire pumps

.2 Elevators

.3 Generator emergency distributions

.2 Generator emergency distribution main breaker

.3 Additional breakers as indicated

.2 Provide ground fault protection at the following locations:

.1 All 347/600V breakers 1000A and larger

.2 All 120/208V breakers 2000A and larger

.3 Additional breakers as indicated

.8 Enclosure: CSA C22.2 No. 94.1:

.1 Surface mounted: Type 2.

.2 Recessed mounted: Type 2.

.3 Exterior use: Type 4 or as indicated.

.9 Cabinet Box: 153mm (6 inches) deep, 508mm (20 inches) wide.

.10 Cabinet Front: Surface and Flush cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

2.3 Surge Protective Devices (SPDs):

.1 SPDs shall be close-coupled to panelboard equipment for the protection of AC electrical circuits and equipment from the effects of lightning induced currents, substation switching transients, and internally generated transients resulting from inductive and/or capacitive load switching and other electronic equipment.

.2 The surge suppression system shall be comprised of Types 1, 2, & 3 SPDs that are listed and labeled for their intended installation. System design shall be in accordance with the latest edition of the IEEE C62 standards.

.3 Characteristics:

.1 Surge Rating (Imax) shall be no less than:

.1 Service Entrance: 200kA

.2 Distribution Panel: 100kA

.3 End Use Equipment: 50kA

.2 Nominal Discharge Current Rating (In) shall be no less than:

.1 Type 1 & 2 devices - 20 kA

.2 Type 3 devices - 3 kA

.3 Short Circuit-Current Rating (SCCR) shall be no less than 200 kA.

.4 Maximum Continuous Operating Voltage (MCOV):

.1 No less than 15% of normal system operating voltage.

.2 No more than 25% of normal system operating voltage.

.5 Minimum Voltage Protection Rating (VPR)

.1 120/208V - 700 Volts L-N, 1200 Volts L-L

.2 347/600V - 1200 Volts L-N, 2000 Volts L-L

.6 Noise Filtering

.4 Provide SPDs as indicated on the electrical single line diagram.

2.4 Monitoring System

.1 Provide network and software to collect all voltage, current, power, and energy data for all monitored loads.

.2 Provide IP network connectivity with CAT6 cable for monitoring system.

.3 Coordinate with building automation sub-contractor to make energy usage data available to the building automation system for the following aggregate loads:

.1 Current Building HVAC load (kVA)

.2 Peak Building HVAC load (kVA)

.3 Building HVAC Energy (kWh)

.4 Current Building Interior Lighting load (kVA)

.5 Peak Building Interior Lighting load (kVA)

.6 Building Interior Lighting Energy (kWh)

.7 Current Building Exterior Lighting load (kVA)

.8 Peak Building Exterior Lighting load (kVA)

.9 Building Exterior Lighting Energy (kWh)

.4 Building automation system shall pole required data from registers of electrical monitoring system.

Part 3 Execution

3.1 Installation

.1 Install panelboards to CSA-C22.1 and to manufacturer's written instructions.

.2 Install panelboards plumb. Install recessed panelboards flush with wall finishes.

.3 Height: Refer to section 26 05 00.

.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 Provide spare conduits out of each recessed panelboard to an accessible location below floor and above ceiling where applicable. Minimum spare conduits: three (3) empty 35mm (1-1/4”) up and two (2) 35mm (1-1/4”) down. Identify each as spare.

.8 Ground and bond panelboard enclosure according to Section 26 05 26.

3.2 Field Quality Control

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Perform inspections and tests listed in NETA ATS Section 7.4 for switches, Section 7.5 for circuit breakers.

3.3 Adjusting

.1 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20% of each other.

.2 Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

Part 1 General

1.1 Summary

.1 Section includes EV charging equipment that provides Level 2 EV charging.

1.2 Definitions

.1 EV: Electric vehicle.

.2 EV Cable: The off-board cable containing the conductor(s) to connect the EV power controller to the EV that provides both power and communications during energy transfer.

.3 EV Capable: Parking spaces that include nearby termination of raceway (conduit) to a power source with sufficient electrical panel capacity designed for simultaneous charging of electric vehicles in all planned EV parking spaces. Electrical wiring need not be pulled through raceway (conduit) until charging station is installed.

.4 EV Charger or EV Charging Equipment: See "EVSE".

.5 EV Connector: A conductive device that, when electrically coupled to an EV inlet, establishes an electrical connection to the EV for the purpose of power transfer and information exchange. This device is part of the EV coupler.

.6 EV Coupler: A mating EV inlet and connector set.

.7 EV Inlet: The device in the vehicle into which the EV connector is inserted, and a conductive connection is made for the transfer of power and communication. This device is part of the EV coupler.

.8 EV Make Ready: Parking spaces that include nearby termination of raceway (conduit) and electrical wiring pulled to a power source with sufficient electrical panel capacity for simultaneous charging of electric vehicles in all EV parking spaces.

.9 EVSE: Electric Vehicle Supply Equipment. It includes the EV charging equipment and conductors, including the ungrounded, grounded, and equipment grounding conductors and EV cables, attachment plugs, and all other fittings, devices, power outlets, or apparatus installed specifically for transferring energy between the premise wiring and the EV.

1.3 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CSA (Canadian Standards Association).

.3 ULC (Underwriters' Laboratories of Canada).

1.4 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: For each type of product.

.1 Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for EV charging equipment.

.2 Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

.3 Shop Drawings: For EV charging equipment.

.1 Include plans, elevations, sections, and mounting attachment details.

.2 Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

.3 Detail fabrication and assembly of mounting assemblies for EV charging equipment.

.4 Include diagrams for power, signal, and control wiring.

.5 Include verification of wireless / cellular communications service at each location of EV charging equipment.

1.5 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Installation Data: Submit manufacturer's installation instructions.

1.6 Maintenance Material Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

1.7 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

.2 Comply with SAE J1772.

1.8 Regulatory Requirements

.1 Provide products listed and classified by CSA and as suitable for the purpose specified and indicated.

1.9 Field Conditions

.1 Wireless Survey: Complete wireless survey to determine if wireless provider signals meet or exceed manufacturer's recommended minimum values.

.2 Rate equipment for continuous operation under the following conditions unless otherwise indicated:

.1 Ambient Temperature: Not exceeding minus 30 to plus 50 deg C.

.2 Altitude: Not exceeding 2000 m.

.3 Rate Equipment for non-operation under the following conditions:

.1 Ambient Temperature: Not exceeding minus 40 to plus 60 deg C.

.2 Altitude: Not exceeding 2000 m.

.4 Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by City or others unless permitted under the following

conditions and then only after arranging to provide temporary electric service according to requirements indicated:

.1 Notify City no fewer than 2 days in advance of proposed interruption of electric service.

.2 Do not proceed with interruption of electric service without City's written permission.

1.10 Warranty

.1 Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of EV charging units that fail(s) in materials or workmanship within specified warranty period.

.1 Standard Warranty Period: One year from date of Substantial Completion.

Part 2 Products

2.1 Manufacturers:

.1 AddEnergie

.2 ChargePoint

.3 ClipperCreek

.4 Schneider

.5 Hubbell

.6 Substitutions: Refer to Section 26 05 00.

.7 Source Limitations: Obtain EV charging equipment from single manufacturer.

2.2 EV Charging Equipment Description

.1 EV Charging Equipment Mounting: pedestal mount.

.2 Enclosures: Rated for environmental conditions at installed location.

.1 Indoor Locations: NEMA 250, Type 3R.

.2 Outdoor Locations: NEMA 250, NEMA 4X.

.3 Aluminum and UV-resistant plastic.

.4 Paint and Anodized.

.5 Charging components protected by security screws.

.6 Charging connectors in locking holsters.

.7 Meter, modem, and CPU, tamper resistant.

.3 EV Cable and Connectors:

.1 SAE J1772 connector.

.2 One connector per charger. with locking holster

.3 5 m cable.

.4 Status Indicators:

.1 LEDs to indicate power, vehicle charging, charging complete, system status, faults, and service, as well as authorization.

.5 Display Screen:

.1 VGA-resolution, daylight-viewable LCD screen with UV protection. Daylight readable and fingerprint resistant.

.2 Displays power, charging, charging complete, remote control, system status, faults, payment and pricing details, and service.

.6 Networking:

.1 WAN Communications: Cellular GSM/GPRS and CDMA.

.2 LAN Communications: 2.4 GHz Wi-Fi 802.11b/g/n.

.3 Capable of remote configuration, diagnostics and reporting.

.4 Capable of remote software updates (future proof).

.7 Payment System:

.1 RFID (ISO 15693, ISO 14443), NFC, Contactless credit card reader.

.2 PCI (Payment Card Industry) compliant.

.3 Capable of remote control and authorization including mobile phone application or toll free phone number.

.8 Charging Network: Compatible with the ChargePoint EV charging network.

.1 Multiple units shall independently connect to charging network.

.2 Individual units shall be capable of indicating station status and availability providing or connecting user to customer support and remote control.

2.3 Performance Requirements

.1 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

.2 Surge Withstand: 6 kV at 3000 A.

.3 Integral GFCI.

.4 Auto-GFCI fault retry.

.5 Input Power:

.1 40 A, 208/240-V ac, 60 Hz, single phase per charger.

.2 Dual circuits do not need to be interlocked.

.1 EV Charging Levels:

.1 Single vehicle: AC Level 2 at up to 7.5 kW per vehicle.

.2 Multiple vehicles simultaneously charging at a site may be charged up to 7.5 kW per vehicle.

2.4 General Finish Requirements

.1 Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

.2 Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if

they are within the range of approved Samples and are assembled or installed to minimize contrast.

Part 3 Execution

3.1 Examination

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

.3 Examine roughing-in for EV charging equipment electrical conduit to verify actual locations of conduit connections before equipment installation.

.4 Examine walls, floors, and pavement for suitable conditions where EV charging equipment will be installed.

.5 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

.1 Concrete Base & Post Mounting:

.1 Install EV charging equipment on 24-inch (600-mm) nominal-diameter and 24-inch (600-mm) concrete base. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete."

.1 Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

.2 Install rigid steel post & anchor bolts to elevations required for proper attachment to supported equipment.

.3 Secure EV charging equipment to post according to manufacturer's written instructions.

.2 Wiring Method: Install cables in raceways and cable trays. Conceal raceway and cables except in unfinished spaces.

.1 Comply with requirements for underground raceways and enclosures specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems."

.3 Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

.4 Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

.5 Circuit Breakers: Comply with Section 26 28 16 "Enclosed Switches and Circuit Breakers."

.6 Secure covers to enclosure.

3.3 Connections

.1 Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

.2 Comply with grounding requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

.3 Comply with requirements for installation of conduit in Section 26 05 33 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.

.4 Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

3.4 Identification

.1 Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.5 Field Quality Control

.1 Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

.2 Perform tests and inspections with the assistance of a factory-authorized service representative.

.3 Tests and Inspections:

.1 For each unit of EV charging equipment, perform the following tests and inspections:

.1 Unit self-test.

.2 Operation test with load bank or EV.

.3 Network communications test.

.4 EV charging equipment will be considered defective if it does not pass tests and inspections.

.5 Prepare test and inspection reports.

3.6 Startup Service

.1 Engage a factory-authorized service representative to perform startup service.

.1 Complete installation and startup checks according to manufacturer's written instructions.

3.7 Ongoing Management Services

.1 Engage a station manufacturer that offers a service to manage the administration and policies of the electric vehicle charging stations on an ongoing basis.

3.8 Software Service Agreement

.1 Technical Support: Beginning at Substantial Completion, service agreement shall include software support for the duration of an active Network Service Plan.

.2 Upgrade Service: At Substantial Completion, remotely update software to latest version. Install and program software upgrades that become available while an active Network Service Plan is maintained. Upgrading software shall include operating system and new or revised licenses for using software.

3.9 Demonstration

.1 Utilize EV Station Management Services, or Train City's maintenance personnel to adjust, operate, and maintain EV charging equipment.

3.10 Cleaning

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Hinged cover enclosures.

.2 Cabinets.

.3 Terminal blocks.

.4 Accessories.

1.2 Related Sections

.1 Section 26 05 29 - Electrical Supporting Devices.

1.3 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CAN/CSA-C22.2 No. 94-M91 (R2006) - Special Purpose Enclosures.

.3 CSA-C22.2 No. 158-10 - Terminal Blocks.

.4 CSA (Canadian Standards Association).

.5 ULC (Underwriters' Laboratories of Canada).

1.4 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: Provide manufacturer's standard data for enclosures and cabinets.

1.5 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Installation Data: 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.

1.6 Maintenance Material Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Extra Stock Materials: Provide [two (2)] of each key.

1.7 Regulatory Requirements

.1 Conform to requirements of CSA-C22.1.

.2 Products: Listed and classified by CSA and as suitable for the purpose specified and indicated.

Part 2 Products

2.1 Hinged Cover Enclosures

.1 Construction: CAN/CSA-C22.2 No. 94.

.1 Surface Mounted Indoor: Type 1 16 gauge steel enclosure complete with sprinkler drip hood.

.2 Recessed Mounted Indoor: Type 1 16 gauge steel enclosure.

.3 Exterior Use: Type 4 14 gauge steel enclosure or as indicated.

.2 Covers: Surface or Flush cabinet front with continuous hinge,

.1 Indoor: Held closed by flush latch operable by key.

.2 Outdoor: Held closed by hasp and staple for padlock.

.3 Provide interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.

.4 Enclosure Finish: Manufacturer's standard grey enamel.

2.2 Cabinets

.1 Boxes: Galvanized steel with removable end walls.

.2 Box Size: 600mm (24 inches) wide x 150mm (6 inches) deep.

.3 Backboard: Provide 19mm (3/4 inch) thick plywood backboard for mounting terminal blocks. Paint matte white.

.4 Fronts: Steel, flush with concealed trim clamps and door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.

.5 Provide metal barriers to form separate compartments wiring of different systems and voltages.

.6 Provide accessory feet for free-standing equipment.

2.3 Terminal Blocks

.1 Terminal Blocks: CSA-C22.2 No. 158.

.2 Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

.3 Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

.4 Provide ground bus terminal block, with each connector bonded to enclosure.

2.4 Accessories

.1 Description: Plastic channel with hinged or snap-on cover.

Part 3 Execution

3.1 Installation

.1 Install components to CSA-C22.1 and to manufacturer's written instructions.

.2 Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner to Section 26 05 29.

.3 Install cabinet fronts plumb.

3.2 Cleaning

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Clean electrical parts to remove conductive and harmful materials.

.3 Remove dirt and debris from enclosure.

.4 Clean finishes and touch up damage.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Wall switches.

.2 Wall dimmers.

.3 Receptacles.

.4 Device plates and decorative box covers.

.5 Floor box service fittings.

.6 Poke-through service fittings.

.7 Access floor box.

1.2 Related Sections

.1 Section 26 05 39 - Underfloor Ducts.

.2 Section 26 05 34 - Boxes.

1.3 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CSA C22.2 No. 42-10 (R2015) - General Use Receptacles, Attachment Plugs, and Similar Wiring Devices

.3 CSA C22.2 No. 42.1-13 (R2017) - Cover Plates for Flush-Mounted Wiring Devices.

.4 CSA C22.2 No. 55-15 - Special use switches.

.5 CAN/CSA C22.2 No. 111-18 - General-Use Snap Switches.

.6 CSA C22.2 No. 184-15 - Solid-State Lighting Controls.

.7 CSA (Canadian Standards Association).

.8 ULC (Underwriters' Laboratories of Canada).

1.4 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.

1.5 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Installation Data: Submit manufacturer's installation instructions.

1.6 Maintenance Material Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Extra Stock Materials:

.1 Provide two of each style, size, and finish wall plate.

1.7 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

1.8 Regulatory Requirements

.1 Provide products listed and classified by CSA and as suitable for the purpose specified and indicated.

Part 2 Products

2.1 Wall Switches

.1 Manufacturers:

.1 Leviton
.2 Hubbell
.3 Cooper
.4 Legrand
.5 Substitutions: Refer to Section 26 05 00.

.2 General-use snap switch:

.1 Grade: Commercial Specification Grade CSA-C22.2 No. 111
.2 Style: Standard toggle
.3 Device Body: White nylon toggle.
.4 Ratings: Match branch circuit and load characteristics. Amperage rating shall be marked on body of switch.

.3 Body and Handle: White nylon toggle.

.4 Indicator Light: Separate pilot strap red colour with load on.

.5 Locator Pilot Light: Separate pilot strap red colour.

2.2 Wall Dimmers

.1 Manufacturers:

.1 Lutron
.2 Substitutions: Refer to Section 26 05 00

.2 Description: Wall dimmer complete with slide to off control and surge protection.

.3 Body and Handle: White with linear slide control.

.4 Voltage: 120 volts.

.5 Power Rating: Match load as required for circuits controlled.

.6 Products:

.1 Incandescent or Halogen: NT series
.2 Magnetic Low Voltage: NTLV series

.3 Electronic Low Voltage: NTELV series

.4 Fluorescent or LED 3-wire: NTF series

.5 Fluorescent 2-wire: NTFTU series

.6 Fluorescent or LED 0-10VDC: NTSTV-DV

2.3 Astronomic Wall Switch Timer

.1 Application: As indicated on the plans and schedules.

.2 Manufacturers:

.1 NSI Industries model SS721Z.

.2 Substitutions: Refer to Section 26 05 00

.3 Description: Seven (7) day astronomic in-wall time switch complete with manual on/off override.

.4 Scheduling: Ten (10) on and off pairs of set points available for individual programs on each day of the week. Minimum setting of one (1) minute per schedule.

.5 Operation Modes: Random, Manual, and Vacation modes.

.6 Power Backup: Supercapacitor complete with two (2) days backup.

.7 Device Body: Smooth white.

.8 Ratings:

.1 Resistive Loads: 16 amps

.2 Fluorescent Ballasts: 13 amps

.3 LED Drivers: 10 amps

.4 Motor Load: 1/2HP

.9 Operating Temperature: 0 degrees C. to 40 degrees C.

2.4 Receptacles

.1 Manufacturers:

.1 Leviton

.2 Hubbell

.3 Cooper

.4 Legrand

.5 Substitutions: Refer to Tender No. 543-2022B; Part B – Bidding Procedures.

.2 General-duty duplex convenience receptacle:

.1 Grade: Commercial Specification Grade. Nema WD-6 Compliant, CSA-C22.2 No.42.

.2 Style: Standard.

.3 Device Body: Smooth white nylon face and base.

.4 CSA Configuration: Type as specified and indicated.

.5 Tamper resistant as indicated or as per Electrical Code.

.3 GFCI Receptacle: Duplex receptacle with integral ground fault circuit interrupter to meet regulatory requirements complete with steady-on “Green-Power-On” and steady-on “Red-Power-Tripped Off” LED indicator lights.

.4 Exterior Use Receptacle: Extra Heavy Duty Industrial grade duplex receptacle with integral ground fault circuit interrupter to meet regulatory requirements complete with steady-on “Green-Power-On” and steady-on “Red-Power-Tripped Off” LED indicator lights complete with UV and corrosion resistant device body complete with CSA 5-20R configuration only.

.5 USB Charger Receptacle: General-duty tamper resistant decorator style duplex receptacle with dual USB type C chargers with smart chips optimized for USB power delivery meeting specification of USB-PD 3.0 and Quick Charge 4. Type C port shall be rated 6A @20V (auto sensing) at 60W for single port charging and 30W per port for dual port charging. Standard of acceptance Leviton T5636 for 5-15R and T5836 for 5-20R. Color white.

.6 Controlled Receptacle: General-duty dual-controlled duplex receptacle with integral relay, wireless RF communication, and manual override button. Control system shall be complete with wireless RF signal packs to control all receptacles in individual rooms as indicated on drawings. RF signal packs shall be integrated with room lighting control occupancy sensor to turn off controlled receptacle within 20 minutes of unoccupied state.

.7 Surge Protection Receptacle: General-duty duplex receptacle with integral surge protection device, power-on indicator light and damage-alert alarm with silencing screw. Surge suppression shall be 240 joules/15000A per mode. Device body shall be decorator style, smooth blue nylon face and base.

.8 Isolated Ground Receptacle: General-duty duplex receptacle with insulation barrier between green grounding screw and metal box mounting strap. Device body shall be smooth orange nylon face with “IG triangle”.

.9 Receptacle on Emergency Circuit: Heavy Duty Specification grade duplex receptacle with smooth red nylon face. CSA configuration as indicated. Type as indicated.

.10 Range Receptacle: CSA configuration 14-50R commercial specification grade complete with stainless steel faceplate.

.11 Dryer Receptacle: CSA configuration 14-30R commercial specification grade complete with stainless steel faceplate.

.12 Suitable for No. 10 AWG for back and side wiring.

.13 Break-off links for use as split receptacles.

.14 Double wipe contacts and riveted grounding contacts.

.15 Receptacles shall be of one manufacturer throughout the project.

2.5 Wall Plates

.1 Nylon Cover Plate: Impact resistant unbreakable nylon with reinforcing ribs. Style and color shall match wiring device. Combination or multi-gang covers as required or indicated. Jumbo or standard size as indicated or specified.

.2 Standard Stainless Steel Cover Plate: 430 type stainless steel cover plate complete with protective plastic film. Combination or multi-gang covers as required or indicated. Jumbo or standard size as indicated or specified.

.3 Metallic While-in-Use covers: Nema 3R rated, die-cast aluminum construction with powder coated “chip resistant” paint corrosion protection and plug/cord management, suitable for horizontal mounting on device box only, and padlock provision.

.4 Thermoplastic While-in-Use covers: Nema 3R rated, thermoplastic construction, suitable for horizontal mounting on device box only, and padlock provision.

.5 Weatherproof Cover Plate: Gasketed cast metal with gasketed double hinged device covers suitable for horizontal mounting on device box only. Provide single hinged device cover for GFI type receptacle only.

2.6 Intelligent Parking Lot Controller (IPLC) Receptacles

.1 Manufacturers:

.1 Vantera Incorporated: IPLC M210

.2 Substitutions: Refer to Section 26 05 00.

.2 Description: Assembly comprising of duplex receptacle complete weatherproof zinc die-cast housing complete with green and red LED indicator lights complete with CPU access port for custom programming.

.3 Programming Schedule: Each IPLC shall be factory pre-programmed:

.1 To suit Efficiency Manitoba requirements and

.2 To limit power use to 650W per 15A circuit and 975W per 20A circuit.

.4 Wiring Device: Utilize heavy duty, or industrial grade 5-15R or 5-20R duplex receptacles, single circuit or split-wired as indicated complete with weatherproof cover plate.

.5 Data-Mate Programmer: Hand-held device for transfer of data between IPLC receptacles and windows based computer complete with software package for custom reprogramming IPLC settings. Supply one (1) programmer only and turn over to City.

2.7 Accessories:

.1 Audible Device Vandal Guard: Clear vandal resistant, UV Stabilized polycarbonate shield and frame complete with integral 95db piezo horn and battery. Flush mounted or surface as indicated. Outdoor rated as required. Vandal guard shall be equal to STI Stopper II series.

.2 Device Vandal Guard: Clear vandal resistant, UV Stabilized polycarbonate shield and frame. Flush mounted or surface as indicated. Outdoor rated as required. Vandal guard shall be equal to STI Stopper II series.

Part 3 Execution

3.1 Examination

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Verify that outlet boxes are installed at proper height.

.3 Verify that wall openings are neatly cut and will be completely covered by wall plates.

.4 Verify that floor boxes are adjusted properly.

.5 Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

.6 Verify that openings in access floor are in proper locations.

3.2 Preparation

.1 Provide extension rings to bring outlet boxes flush with finished surface.

.2 Clean debris from outlet boxes.

3.3 Installation

.1 Install to CSA-C22.1 and to manufacturer's written instructions.

.2 Install devices plumb and level.

.3 Install switches with OFF position down.

.4 Provide neutral conductor in box for all line voltage lighting control devices.

.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 Use exterior use receptacles for exterior applications unless noted otherwise.

.9 Connect wiring device grounding terminal to branch circuit equipment grounding conductor and outlet box.

.10 Install locator pilot light for lighting controls located in crawlspace.

.11 Install indicator pilot light for all lighting controlled from a remote switch location. Switch and light shall be clearly labelled identifying the controlled lighting.

.12 Install decorative plates on switch, receptacle, and blank outlets in finished areas.

.13 Connect wiring devices by wrapping conductor around screw terminal.

.14 Use jumbo size plates for outlets installed in masonry walls.

.15 Stainless steel protective coverings shall be maintained until project completion and turn-over to City.

.16 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

.17 Install metallic While-In-Use covers on exterior receptacles.

.18 Use weatherproof covers for parking receptacles, and dust-tight applications only, or as indicated.

.19 Install protective rings on active flush cover service fittings.

3.4 Intelligent Parking Lot Controller (IPLC) Receptacles

.1 Install IPLC receptacle on Parking Lot Outlet Box. Refer to architectural details. Coordinate installation with GC.

.2 Provide lamacoid labelling on all IPLC receptacles indicating “Block Heaters Only. The use of in-car warmers is prohibited.”

3.5 Interface With Other Products

.1 Coordinate locations of outlet boxes provided under Section 26 05 34 to obtain mounting heights specified and as indicated on drawings.

.2 Coordinate installation of access floor boxes with access floor system.

.3 Coordinate the installation of wiring devices with underfloor duct service fittings provided under Section 26 05 39.

3.6 Field Quality Control

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Inspect each wiring device for defects.

.3 Operate each wall switch with circuit energized and verify proper operation.

.4 Verify that each receptacle device is energized.

.5 Test each receptacle device for proper polarity.

.6 Test each GFCI receptacle device for proper operation.

3.7 Adjusting

.1 Adjust devices and wall plates to be flush and level.

3.8 Cleaning

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Packaged engine generator set.

.2 Remote radiator.

.3 Heat exchanger.

.4 Exhaust silencer and fittings.

.5 Fuel fittings and day tank.

.6 Remote control panel.

.7 Battery and charger.

.8 Weatherproof enclosure.

1.2 Related Sections

.1 Section 23 05 48 - Vibration Isolation.

.2 Section 23 07 19 - Piping Insulation.

.3 Section 23 11 13 - Fuel Oil Piping.

.4 Section 23 21 00 - Hydronic Piping: Cooling water system and exhaust piping.

.5 Section 23 21 23 - HVAC Pumps.

.6 Section 23 31 00 - Duct Work.

.7 Section 26 36 00 - Enclosed Transfer Switch.

1.3 References

.1 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.2 CSA-C22.2 No. 100-04 (R2009) - Motors and Generators.

.3 CSA-Z32-09 - Electrical safety and essential electrical systems in health care facilities

.4 CSA-C22.2 No. 5-09 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

.5 CAN/CSA-C22.2 No. 94-M91 (R2006) - Special Purpose Enclosures.

.6 CSA-C282-09 - Emergency Electrical Power Supply for Buildings.

.7 NFPA 30 - Flammable and Combustible Liquids Code, 2008 Edition.

.8 NFPA 110 - Standard for Emergency and Standby Power Systems, 2010 Edition.

.9 CSA (Canadian Standards Association).

.10 ULC (Underwriters' Laboratories of Canada).

1.4 Administrative Requirements

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Pre-installation Meetings: Convene one week before starting work of this section.

1.5 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.1 Product Data:

.1 Provide manufacturer's printed product literature, specifications and data sheets for generating units and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Include following technical data:

.1 Engine: make, model, rating and performance curves.

.2 Starter motor, make model.

.3 Generator: make, model and rating complete with generator saturation curves, heat damage curves, reactive capability and special data.

.4 Voltage regulator: make, model, type.

.5 Governor: type, model.

.6 Battery: make, type, voltage, capacity.

.7 Charger: make, model, input and output rating.

.8 Submit general outline drawing of complete assembly showing engine, radiator and generator mounting, exhaust, recirculating and intake air louvre arrangement, exhaust gas silencer and pipe arrangement, locations of fuel and lubricating oil filters, fuel supply and return line connections, lubricating oil drain valve, radiator and coolant drain valves, air cleaner, engine instrument panel, starting motor, power and control junction boxes, engine and generator mounting feet. Indicate on drawings:

.1 Horizontal and vertical dimensions.

.2 Minimum door opening required for moving unit.

.3 Head room required for removal of piston and connecting rod.

.4 Weight of engine, generator, baseplate, radiator and exhaust silencer.

.9 Identify exact locations and details where necessary of interconnecting services to permit final engineering by Departmental Representative.

.10 Baseplate construction details and materials.

.11 Outline and layout of panels.

.12 Schematic and wiring diagrams of engine, generator, control panel complete with interconnecting wiring diagrams.

.13 Single line diagram showing all breakers, switches, metering and protective relays.

.14 Field wiring diagrams.

.15 Complete bill of materials, including manufacturer's name, catalogue numbers and capacity.

.3 Lubricating oil system: where oil pump not provided, submit certification to Departmental Representative ensuring oil pump is not required and will not detract from service life of engine.

.4 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

1.6 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Test Reports: Indicate results of performance testing.

.3 Installation Data: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

.4 Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

.5 Manufacturer's Field Reports: Indicate procedures and findings.

1.7 Closeout Submittals

.1 Provide maintenance data for diesel generating units for incorporation into manual specified in Section 01 78 10 – Closeout Submittals.

.2 Provide in English for incorporation into instruction manuals as follows:

.1 Complete set of reviewed shop drawings.

.2 Factory test data of engine, generator, exciter, control logic, metering and other pertinent test data.

.3 Maintenance and operation bulletins for:

.1 Engine and Accessories.

.2 Generator.

.3 Voltage Regulator and Accessories.

.4 Exciter.

.5 Permanent magnet generator if installed.

.6 Battery charger.

.7 Speed Governor.

.8 Starting Motor.

.9 Batteries.

.10 Ventilating Equipment.

.11 Timers, Relays, Meters.

.12 Power Circuit Breakers.

.13 Controller, Contactors.

.14 Other Accessories.

.4 Submit original brochures; photocopies are not acceptable.

.1 Include technically relevant data.

.5 Complete sequence of system operation.

.6 Complete bill of materials including nameplate data of equipment and accessories.

.3 Forward, two weeks prior to factory tests, one copy of instruction manual for each unit of different ratings to Contract Administrator.

.4 Forward, within two weeks after factory tests, one copy of instruction manuals, with updated drawings, for each unit of different ratings, to Contract Administrator.

1.8 Tools

.1 Provide complete set of tools required for proper care, adjustment and maintenance of equipment supplied.

.2 Where metric size nuts and bolts are used, provide one set of sockets complete with ratchet handle and set of combination wrenches, to fit sizes used.

1.9 Extra Stock Materials

.1 Provide maintenance materials in accordance with Section 01 78 10 – Closeout Submittals.

.1 Extra Material/Spare Parts: provide the following:

.1 One spare control circuit breaker per rating.

.2 Ten spare indicating light bulbs per rating.

.3 One spare control relay and socket per rating and contact arrangement.

.4 One spare contactor operating coil.

.5 Six fuel filter elements for each type of fuel filter/water separator.

.6 Six lubricating oil filter elements.

.7 Three air cleaner elements.

1.10 Quality Assurance

.1 Provide Products listed and classified by ULC/CSA or testing firm acceptable to authority having jurisdiction and as suitable for purpose specified and indicated.

.2 Perform Work to Ontario Electrical Safety Code, latest edition.

.3 Conform to CSA B139 Series 15, CSA C282-09.

.4 Maintain one copy of document on site.

.5 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

.6 Supplier Qualifications: Authorized and distributor of specified manufacturer with minimum three years documented experience.

1.11 Delivery, Storage, And Protection

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Product Requirements with manufacturer’s written instructions.

.2 Delivery and Acceptance Requirements:

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Prepare, crate and protect equipment against shipping and storage damage.

.3 Provide minimum 12.5 mm plywood outer covering single vapour barrier inside.

.4 Mount unit and panel on shipping skids with plank floor.

.5 Each package to have shipping weight, address, dimensions and brief description of contents stencilled on at least two sides.

.1 Staple on outside packing list contained in waterproof envelope.

.2 Place copy of packing list inside.

.3 Mail additional copies to consignee.

.3 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials in accordance with Section 01 61 00 – Product Requirements.

Part 2 Products

2.1 System Description

.1 Provide automatic, unattended, emergency power supply system consisting of:

.1 Liquid cooled low voltage diesel electric generating unit with control panel.

.2 Accessories and equipment specified in this specification.

.2 Provide design, fabrication, testing, transportation, demonstration and equipment warranty.

2.2 Design Criteria

.1 Description: CAN/CSA-C282, engine generator system to provide source of power for Level 1 and 2 and applications

.2 Design equipment to meet following requirements:

.1 Total load: 200kW.

.2 Voltage: 600 V.

.3 Frequency: 60 Hz.

.4 3 Phase/4 Wire.

.5 Power factor: 0.8.

.6 Load harmonic content: 15% THD.

.7 Maximum rotational speed: 1800 rpm.

.8 Interrupting capacity: 1 MVA.

.9 Performance: automatic.

.10 Ambient temperature: 40 degree C.

.11 Relative humidity: 60%.

.3 Design unit capable of starting, attaining settled voltage and frequency limits and accepting 80% rated load with voltage and frequency settling to specified steady state bands, within 15 seconds for any temperature between 0 degree C to 40 degrees C.

.4 Use engine manufacturer's standard, published continuous (prime) horsepower rating in assessing engine capacity and derate this rating for specified conditions and engine driven accessories in accordance with ISO 3046-1.

.5 Description of generating set operation:

.1 Automatic starting on abnormal or loss of normal voltage via control signal from transfer switches.

.2 When emergency supply has reached settled voltage and frequency preset limits (adjustable) transfer switch will transfer load to emergency supply.

.3 Continue to supply load until hydro supply returns or set is shut down manually or under failure conditions.

.4 On hydro restoration, monitored by the transfer switch, for time period in excess of three minutes (adjustable), transfer switch will transfer load to hydro supply.

.5 Adjustable time delay relay to allow engine to run unloaded to cool down and subsequently to shut down, ready for next cycle.

.6 Equip engine with key switch with following positions: auto-off-crank-start, key removable in auto position only.

.7 Automatic shut down on:

.1 Overcranking.

.2 Overspeed.

.3 High engine temperature.

.4 Low lubricating oil pressure.

.5 Over and under frequency.

.6 Emergency breaker failure.

.7 Electrical fault lock-out on short circuit and generator over and under voltage.

2.3 Assembly

.1 Provide items as follows plus other items necessary to make unit complete:

.1 Diesel engine.

.2 Diesel engine accessories.

.3 Baseplate and drip pan.

.4 Vibration isolators.

.5 Governor.

.6 Engine exhaust system.

.7 Engine cooling system.

.8 Engine ventilating system.

.9 Starting motors.

.10 Batteries and rack.

.11 Battery charger.

.12 Generator and exciter.

.13 Voltage regulator and accessories.

.14 Control panel.

.15 Circuit Breaker.

.16 Spares and accessories.

2.4 Mounting

.1 Connect engine flywheel housing rigidly to generator stator housing with SAE adapter.

.1 Mount unit on common, heavy duty fabricated steel baseplate.

.2 Obtain approval for design and materials of baseplate from engine manufacturer.

.2 Baseplate: rigid material to maintain alignment of engine-generator shafts and frames under shipping, installation and service conditions.

.3 Install machine engine-generator feet and baseplate sole plates parallel and true.

.1 Shims: steel type, installed under generator feet.

.4 Provide spring type isolators as follows:

.1 Isolators: cast iron housings, complete with levelling bolts, adjustable oil proof snubbers and minimum 6 mm sound pads.

.2 Isolation efficiency 95% minimum.

.5 Determine quantity and location of isolators.

.1 Locate each isolator to carry equal proportion of weight and that pressure exerted on floor by each isolator does not exceed 345 kPa.

.6 Ship isolators loose for installation at project site.

2.5 Diesel Engine

.1 Full diesel, heavy duty, cold start, liquid cooled, vertical in-line or vee, and current manufacture of a type and size that has been service as a prime mover for electric power generation for not less than two years.

.1 Turbocharged engine is acceptable providing brake mean effective pressure (BMEP) at rated output is <275 psi.

.2 Mechanically driven superchargers not acceptable.

.2 Engine: minimum of four (4) cylinders.

.3 Engine with auxiliary starting aids (i.e., glow plug assist start) not acceptable.

.4 Equip engine air intakes with dry type heavy duty air cleaners located close to inlet manifold.

.1 Cleaner element: directly replaceable with elements of Canadian manufacture.

.5 Provide engine wiring in liquid-tight conduit and fittings with insulated bushings.

.1 Use stranded, minimum No.14 AWG, TEW 105 degree C and coloured coded wires .

.2 Terminate wiring with coded, insulated terminals flanged fork type. Terminal blocks heavy duty, screw type.

.3 Wire markers of slip on oil proof type.

.4 Maximum of two wires per terminal block.

.6 Provide high quality lubricating oil pressure gauge, lubricating oil temperature gauge, tachometer, coolant temperature gauge thermocouple, exhaust pyrometer and other standard gauges and instruments.

.1 Calibrate and scale gauges and instrument in both metric and imperial units and symbols.

.2 Mount oil temperature sensors on engine full flow pressure line.

.3 Hoses or tubing for gauges: high pressure reinforced type.

.7 Mount unit accessories, including gauges, instruments, and protective sensors, to isolate or dampen vibrations.

.8 Dynamically balance complete engine-flywheel generator arrangement after assembly.

.1 Torsional or other vibration tolerance within 10% above or below rated speed of unit, when operating unloaded or connected to any load within its rating.

.2 Cyclic irregularity: 1/250 maximum.

.9 Provide engine flywheel with graduated marking around its periphery to facilitate fuel injection and valve timing.

.10 Provide removable wet type cylinder liners.

.1 Furnish cylinder head with removable valve seat insert and guides.

.11 Provide personnel safety guards for exposed moving parts and exhaust manifolds.

.1 Provide platform for servicing upper part of engine where applicable.

.12 Engine control panel complete with:

.1 Lubricating oil pressure gauge.

.2 Lubricating oil temperature gauge.

.3 Coolant temperature gauge.

.4 Low coolant level gauge.

.5 Engine switch auto-off-crank-start selector switch and crank pushbutton.

.6 D.C. main power supply circuit breaker.

.7 Terminal blocks for connection to D.C. power supply, engine monitoring and shutdown device.

.8 Provide low oil pressure, high coolant temperature, low coolant level and overspeed protection to shut down engine on manual operation.

2.6 Cooling and Ventilation System

.1 Provide complete cooling and ventilating system for unit.

.2 Thermostatically control system and maintain coolant, ethylene glycol, within engine manufacturer's tolerances, with unit operating at rated load under specified conditions. Cooling system engine mounted radiator type.

.1 Design and supply complete ventilating system where engine mounted radiator is required.

.1 Radiator cooling fan to be pusher type, minimum two belt drive with belt adjuster.

.2 Fan, pulley and belt with removable protective cage.

.2 Provide multi-fan system suitable for indoor installation complete with electrical controls and breaker type combination starters.

.1 Starters mounted in control panel.

.2 Motor of splash proof enclosure.

.3 Provide braided corrugated flexible lines for pipe terminations at radiator and engine, isolating valves, fittings and pipe for installation of radiators approximately 9m from front of engine.

.3 Provide drain valves for draining coolant from engine block and radiator.

.1 Drain coolant conveniently into large container through flexible extensions.

.2 Dripping valves or leaking connections will not be permitted.

.4 Ventilation system: complete with canvas connections, mounting hardware, modulating damper motors, dampers, inlet and outlet hoods, bird/insect/screen, air filters, manual potentiometer, damper linkages, low voltage transformer, thermostat, fan motor.

.1 Provide positive seal, zero heat loss louvers.

.5 Ventilating system operation as follows:

.1 Air inlet and outlet damper closed when engine not running.

.2 On engine start, air inlet damper to open.

.3 Inlet damper minimum opening to be set by manual potentiometer.

.4 Thermostat to modulate inlet and outlet dampers to maintain set room temperature.

.5 Fan to start when inlet louvres 90% open (adjustable).

2.7 Lubrication System

.1 Provide full pressure lubricating system complete with filters and oil cooler.

.2 Oil pump: engine driven gear type complete with strainer.

.3 Equip filters with automatic by-pass valve and full flow filter elements conveniently located for servicing and directly replaceable with elements of Canadian manufacture.

.1 Cooler to have sufficient capacity to maintain oil temperature within engine manufacturer's tolerances with unit operating at rated load under conditions specified.

.4 Equip engine oil sump with oil drain pipe, gate valve and pipe cap.

.1 Permit complete drainage in a convenient manner.

.5 Metallic oil hoses: steel reinforced rubber type with crimped or swaged end fittings.

2.8 Fuel System

.1 Provide complete fuel system including fuel lift pump and filters in accordance with CSA-B139 Series 15 and TSSA FS-219-16 Code Adoption Document.

.1 Filter elements to be directly replaceable with elements of Canadian manufacture.

.2 Day Tank: 380 L (100 gal) unit with dual integral pumps and level control. Include flexible fuel line connections, fuel gauge, check valve, high fuel level alarm contact, and indicating light. Operate pump with motor rated 120 volts AC. Conform to NFPA 30.

2.9 Exhaust System

.1 Provide complete exhaust system including heavy duty industrial type silencer with condensate drain, plug and flanged couplings; stainless steel, corrugated expansion joints, length to suit, to absorb both vertical and horizontal expansion; flanges, bolts, gaskets, adjustable hangers and pipe and pipe-thimble to permit projection of pipe 1.0 m beyond wall.

.1 Exhaust tail pipe end at 45 degree angle and terminate in Insulate interior exhaust piping and silencer. All exhaust terminations to be vertical per TSSA.

.2 Arrange exhaust system to suit openings.

.1 Where schedule of dimensions does not indicate location of opening, arrange exhaust run best suited to engine.

.3 Provide exhaust pyrometers located on common exhaust manifold or two pyrometers on separate manifolds.

.1 Pyrometer range to include temperature at 110% load.

2.10 Jacket Coolant Heater

.1 Provide engine jacket coolant heaters complete with 20 degree C to 60 degree C adjustable immersion type thermostat.

.1 Size heaters to maintain coolant at 40 degree C in an ambient temperature of 0 degree C.

.2 Obtain circulation of heated coolant on thermosiphon principle.

.1 However, if this does not provide sufficient circulation to avoid hot spots in system, provide electrical motor driven circulating pump to operate automatically when heater is energized.

.2 Motor: 120 V single phase splash-proof type complete with breaker type combination starter.

.3 Starter mounted in control panel.

2.11 Speed Governor

.1 Provide full electronic governor with speed changer and dry type actuator.

.1 Governing system: in accordance with ISO 3046-4.

.2 Governor with following features:

.1 Ten turn locking type manual speed adjustment.

.2 Speed regulation, steady state, no-load to full load and vice versa: +/- 0.25%.

.3 Transient peak, no-load to full-load and vice versa +/-10%.

.4 Recovery time to steady state condition on application of 80% load from no load not to exceed 3 seconds.

.5 Frequency: externally adjustable from zero to 5% while engine is running.

.6 Class A accuracy.

2.12 Starting System

.1 Provide complete starting system including cranking starting motors, batteries, battery stand, heavy-duty battery cables and battery charger.

.2 Provide positive engaging type cranking motors.

.1 Cranking motor and flywheel ring gear arrangements which may permit tooth to tooth abutment not acceptable.

.3 Provide lead acid battery with sufficient capacity in ambient room temperature of 0 degree C to crank unit at engine manufacturer's recommended cranking starting speed for period of 3 minutes.

.1 Voltage measured at starting motor terminals at end of 3 minutes cranking, with cranking current flowing, not less than 1.75 V per cell.

.2 Size battery to suit engine and battery manufacturer's published data.

.3 Batteries: Heavy duty, diesel starting type lead-acid storage batteries, 225 ampere-hours minimum capacity. Match battery voltage to starting system. Include necessary cables and clamps.

.4 Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.

.5 Battery termination: bolt-on or study type.

.6 Protect terminals and exposed electrical connections from accidental short circuit by falling conductive objects on battery.

.4 Provide battery rack integral to generator set frame, and within outer frame rails.

.5 Provide battery charger with 120 volt AC input and output equal to 1.20 of ampere-hour capacity of battery based on 8 hour rate.

.1 Output voltage ripple: 3% or less.

.2 Provide AC input circuit breaker and 24 hours terminating equalizer timer with approximately 4 m of connecting cord and permanent connectors for connecting to battery terminals.

.3 Provide 5 spare fuses inside charger panel.

.4 Charger: CSA approved.

.5 A battery charger integrated with the generator control panel is also acceptable.

.6 Provide necessary heavy duty, maintenance-free battery cables and connectors.

.1 Select cable wire size on the basis of allowing not more than 5% voltage drop at time of peak load.

.2 Cable length sufficient to allow battery location on either side of engine.

.7 Fit turbocharged engines with one spring actuated, two stage accumulator per turbocharger to automatically provide pre-start and post run lubrication to turbochargers.

2.13 Generator

.1 Provide generator, drip proof, single bearing and close coupled to engine with SAE housing: to NEMA MG 1.

.1 Generator: full amortisseur winding, direct connected brushless exciter with easily removable bolt-on diodes with surge protection.

.2 Maximum deviation of open circuit terminal voltage waveform not to exceed 5%.

.3 Provide permanent magnet generator (PMG) for generator short circuit sustaining capability not less than 2.4 times rated current.

.4 Generator winding insulation: Class H; winding temperature rise not to exceed 105 degree C as measured by resistance in ambient temperature of 40 degree C.

.5 Identify generator windings with metal tags.

.1 Bring windings to insulated terminals in metal junction box mounted on side or top of generator.

.2 Size junction box to permit mounting of engine and generator low voltage controls and wiring terminals blocks.

.3 Provide barrier in junction box to separate low and high voltage wiring.

.6 Provide voltage regulation system complete with auto/manual control module.

.1 Voltage regulator: capable of withstanding continuous vibration, 15 G shock and temperature up to 50 degree C while maintaining accuracy to plus/minus 1%.

.7 Steady-state voltage regulation not to exceed 0.25%.

.1 Transient voltage regulation, when full load is applied or removed, not to exceed 10% when measured by oscilloscope or high speed strip chart recorder with recovery time to steady-state less than 3 seconds.

.8 Design equipment to minimize radio frequency interference (RFI) under operating conditions.

.1 Balanced telephone influence factor (TIF) to: NEMA MG 1.

.9 Enclosure: CSA-C22.2 No. 100, open drip proof.

2.14 Panel – General

.1 Panel: Unit mounted, dead front, metal-enclosed steel construction.

.2 Design and construct panel to withstand strains, jars, vibrations and other conditions incident to shipping, storage, installation and service.

.3 Panel CSA certified. Mount a nameplate bearing CSA monogram in a prominent position on panel.

.4 Identify instruments and controls with lamacoid or metal engraved nameplates fastened by rivets or screws for permanent identification.

.1 Identify door mounted items with nameplates.

.2 Attach nameplates to removable items such as relays and wireway covers.

.5 Provide panel with bolted rear covers.

.6 Factory wire panel completely. Use stranded, minimum No.14AWG, TEW 105 degree C and coloured for control wiring. Use No.10AWG for CT secondary connections:

.1 Blue - DC control.

.2 Red - AC control.

.3 Black - PT secondary connections.

.4 Orange - CT secondary connections.

.5 Green - non-current carrying ground.

.6 White - current carrying ground.

.7 Yellow - interlocks.

.8 Brown - generator excitation system.

.7 Code wiring at each wire end with permanent, non-aging slip on markers.

.1 Support and run wiring neatly.

.2 Protect wiring from mechanical damage by grommets and shields.

.8 Code terminal blocks, clamp type, serrated for positive grip and of tough, non-brittle, unbreakable nylon, size 3,453/0 or equivalent.

.1 For current transformer secondary circuits, provide terminals blocks of dual connector type.

.2 Provide test block for current transformer secondary connections.

.9 Provide door detent mechanism to maintain hinged door at open position.

.10 Supply loose 2 sets of wiring markers for each external wiring connection.

.1 Place markers in plastic bag and secured inside panel.

.11 Use wiring duct for interconnection within panel.

.12 Direct inter-panel connection not permitted, use terminal blocks.

2.15 Control Panel

.1 Provide control panel for controlling engine generator unit.

.2 Provide hinged front door and internal sub-panel.

.3 Provide instrumentation, switching and control as listed in bill of material.

.1 Electrical connection of components shown in solid lines on drawing.

.4 Panel dimensions and layout as indicated.

.5 Mount terminal blocks on common mounting strips for interconnection wiring between the following:

.1 Sub-panel and panel door.

.2 Sub-panel and external wiring from diesel generator unit circuits.

.3 Sub-panel and external indicating circuits.

.4 Sub-panel and secondary circuits of power sub-cubicle.

.5 Sub-panel and external wiring from power transfer panel.

.6 Provide 1 cm x 4 cm horizontal copper ground bus for whole length of enclosure, and two ground lugs; one at each end.

.1 Lug: capable of accepting grounding conductor of range from No. 8 to No. 2/0 AWG.

.7 Terminal blocks: CSA approved, clamp type, serrated for positive grip and of tough, non-brittle unbreakable nylon material; maximum two wires per terminal block.

.1 Use factory made terminal block jumpers wherever necessary.

.8 Provide circuit breakers for equipment protection: use fuses where breakers are not applicable.

.9 Provide top and bottom entry for power and control cables. Provide removable bottom plate.

.10 Factory installed unit mounted Type 1 120/208/1P/3W/125A main lug only branch circuit panel complete with circuit breakers supplying engine coolant heater, battery charger, battery heater. Engine coolant heater, battery charger shall all be factory pre-wired back to load center.

2.16 Engine Generator Controller

.1 Provide microprocessor controller complete with control and power modules for sensing, timing, logic and instrumentation to control diesel generator set.

.2 Controller to include following features:

.1 Five position function selection switch - Reset, Off, Auto, Test No. Load, Test Full Load.

.2 Inverse time-voltage sensors for monitoring normal and emergency voltage and frequency.

.3 Controls necessary to provide system operation.

.4 Annunciator lights for following:

.1 Overcrank.

.2 Low Oil Pressure.

.3 High Coolant Temperature.

.4 Low Coolant Level.

.5 Overspeed.

.6 Frequency Limit.

.7 Voltage Limit.

.8 Contactor Failure.

.9 Fire Alarm.

.3 Function selection to operate as follows:

.1 Reset: to reset the engine-generator set after it has been shut down on protective device.

.2 Off: the engine-generator set is shut off.

.3 Auto: provides automatic operation of engine generator set and transfer system.

.4 Test No. Load: exercises engine generator set without load. In event normal power fails during this mode, transfer system will operate to connect load to set.

.5 Test Full Load: simulates normal power failure and runs engine generator set under load. If emergency power fails under this mode, transfer system to operate to re-store normal power to load.

.4 Provide sufficiently sized capacitors on power input terminals to controller to maintain supply voltage, especially on D.C. power input during engine start.

.5 Controller to include following time delays and adjustments.

.1 Crank delay preset at 3-20 sec.

.2 Restart preset at 15 sec.

.3 Bypass preset at 10 sec.

.4 Anticipated fail preset at minimum time setting.

.5 Engine start preset at 2 sec.

.6 EM - normal preset at 20 sec.

.7 Cool down preset at 5 min.

.6 Equip controller with cycle crank provision to crank engine three time with adjustable rest delay of 3-30 seconds preset at 5 seconds.

.7 Provide controller with following features:

.1 Front panel programming and display using keypad and to allow changing of parameters, operating configuration, status, and values.

.2 Security access code to prevent unauthorized changes.

.3 Self diagnostics, continually operating in the background, to ensure proper operation of microprocessor.

.4 Non-volatile memory to store operating logic, configuration and set points upon total loss of power.

.5 Sufficient internal power to maintain control outputs and operating sequence upon loss of DC supply from working battery.

.6 Isolation of inputs and outputs to ensure correct operation and no damage in event of transient voltages.

.7 With modem, initialized by controller. Provide necessary hardware, software and configuration for controller as well as necessary software for central remote monitoring and control station. Provide Communications between controller and central station through switched telephone lines.

.8 Operation counter for number of diesel starts (non-resettable).

.9 Operating temperature 0-50 degree C.

.10 Equip controller with communications system and uninterruptible power supply for central remote monitoring and control.

2.17 Enclosure

.1 Compact footprint, weatherproof low profile design. Easy access to all major generator and engine control components for servicing. Full house, enclosed exhaust silence ensures safety and protects against rust.

.2 Cambered roof to prevent water accumulation.

.3 Rodent barriers on inlet and outlet.

.4 Wind rated to 100mph.

.5 Recessed, lockable doors.

.6 Emergency stop button.

.7 Level 2 sound attenuation.

2.18 Circuit Breaker

.1 CAN/CSA-C22.2 No. 5, moulded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole, sized to CEC requirements. Include battery-voltage operated shunt trip, connected to open circuit breaker on engine failure. Unit mount in generator connection box.

2.19 Signs

.1 Provide at front top of each panel and on each generator junction box, lamacoid or metal engraved identification nameplate.

.1 Provide nameplates with letter and number identification designation to be given at time of acceptance tests.

.2 Provide and attach to unit in prominent location, bilingual warning sign as indicated.

.3 Where metric tools are required to service engine-generator unit, provide bilingual warning sign.

2.20 Finishes

.1 In accordance with manufacturer's recommendations for surface conditions.

.2 Clean, finish and paint equipment with smooth and durable finish.

.3 Provide one half pint can of grey gloss paint for touch up.

2.21 Quality Of Work

.1 Manufacture and construct equipment free from blemishes, defects, burrs and sharp edges; accuracy of dimensions and marking of parts and assemblies; thoroughness of welding, brazing, painting and wiring, alignment of parts and tightness of assembly screws and bolts.

2.22 Quality Control

.1 General: before acceptance, assemble and set up the unit, complete with specified equipment, for tests at the supplier's plant in accordance with manufacturer certifications.

.1 Provide suitable test area with adjustable loading facilities.

.2 Ensure that engine has run in sufficiently prior to load test, test forms completed, system debugged and recorders connected.

.2 Product examination: complete mechanical and electrical examination to determine compliance with specification and drawings with respect to materials, workmanship, dimensions and marking.

.3 Non-operational tests and checks: perform following test and checks before starting the unit:

.1 Shaft alignment, end float, angular and parallel.

.2 Cold resistance of generator windings.

.3 Belt tensioning.

.4 Equipment grounds.
.5 Electrical wiring.
.6 All grease lubricating points.
.7 Personnel safety guards.
.8 Air cleaner.
.9 Coolant.
.10 Lubricating oil type and level.
.11 Type of fuel.
.12 Vibration isolator adjustment.
.13 Temperature and pressure sensors.
.14 Engine exhaust system.
.15 Tools.
.16 Spares.

.4 Operation test and check: on completion of non-operational tests and checks, start unit cold. Provide multi-channel recorder and record following:

.1 Time for unit to start and reach settled voltage and frequency.
.2 Time from initiation of start to full load application, with voltage and frequency settled.
.3 Voltage and frequency transient and steady state limits for full load to no load, 3/4 load to no load, load to no load, 1/4 load to no load and vice versa. Measure machine vibration levels under the same load conditions, in accordance with manufacturer certification.
.4 Record battery voltage drop during cranking.

.5 Protection and control demonstration: on completion of operation test and check, demonstrate following:

.1 Overheat protection.
.2 Low oil pressure protection.
.3 Cranking cut out.
.4 Overcrank protection (3 tries).
.5 Overspeed protection.
.6 Under and over frequency.
.7 Under and over voltage.
.8 Electrical fault protection:
.1 Failure to close breaker.
.2 Failure to build up voltage.
.3 Generator short circuit and overcurrent.
.9 All control functions.

.6 Load tests: load test the unit for 4 hours at full rated load in ambient room temperature of 40 degree C. Take following data at start of load test and every one hour interval thereafter:

.1 Frequency.
.2 Voltage.
.3 Current.

.4 Kilowatts.

.5 Generator winding temperature.

.6 Generator frame temperature.

.7 Engine coolant temperature.

.8 Oil temperature and pressure.

.9 Manifold pressure.

.10 Ambient room temperature.

.11 Generator cooling air outlet temperature.

.12 Exciter field current and voltage.

.13 Vibration displacement.

.14 Ambient air temperature inside panel with doors closed.

.7 Miscellaneous: provide accurate means for determining fuel and lubricating oil consumption.

.1 Provide strip chart recorders for monitoring frequency, voltage and load.

.2 Provide recorder with ability to select speeds to allow accurate measurement of voltage, frequency and time during tests.

.3 Calibrate recorder by the recorder manufacturer (or designated representative) within three months of factory testing.

.8 Interpretation of ambient room temperature: consider ambient room temperature as that temperature, which is lowest temperature registered out of a group of three thermometers when placed in engine room as follows:

.1 One thermometer located on each side of engine block, approximately two-thirds of length of block back from front (radiator) end of block, 900 mm out from block and at height equal to height of block.

.2 Locate third thermometer over end of exciter on unit centre line, approximately 150 mm above top of exciter.

.3 Take thermometer showing lowest temperature to give true ambient air temperature.

.4 Adjust temperature to maintain this thermometer at 40 degree C during heat test.

.9 Voltage and frequency regulation tests: on completion of load tests take hot resistance reading of generator windings.

.1 Subject the unit to hot voltage and frequency regulation tests for full load to no load, 3/4 load to no load, load to no load, 1/4 load to no load and vice versa.

.10 Panel performance and functions: check sequence of operation under service conditions.

.1 Make provision for supplying and connecting required levels of voltage for primary circuits.

.2 Test overcurrent relays by impressing current in secondary circuits.

.11 Additional tests: perform tests, consistent with contract, which Departmental Representative may require to satisfy adequacy and satisfactory operation of the unit.

.12 Test data, charts and manufacturers' test forms be complete with diagrams and description of test results, deficiencies and corrective action.

.1 Ensure test data sheets signed by supplier.

2.23 Accessories

.1 Remote Generator Emergency Stop Switch: Nema 4X surface mounted non-metallic enclosure complete with red push (stop) pull (reset) button.

.2 Walk-in Enclosure: Pre-fabricated, skid-mounted unit with engine generator, motorized air intake and exhaust louvres, controls, space heaters, and lighting fixtures. Provide 1.0m (3ft) access aisle around engine-generator, with at least two doors for personnel access. Provide 2.25m (7ft) clear height. Construct unit from insulated sheet metal panels to provide sound and thermal insulation.

Part 3 Execution

3.1 Examination

.1 Verification of Conditions:

.1 Verify that substrate conditions, which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of liquid cooled diesel electric generating units.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 Installation

.1 Install liquid cooled Diesel electric generating units to CAN3-Z299.3 and in accordance with manufacturer's written instructions.

3.3 Field Quality Control

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Provide full load test utilizing portable test bank, if required, for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown and return to normal.

.3 Record in 20 minute intervals during four hour test:

.1 Kilowatts.

.2 Amperes.

.3 Voltage.

.4 Coolant temperature.

.5 Room temperature.

.6 Frequency.

.7 Oil pressure.

.4 Test alarm and shutdown circuits by simulating conditions.

3.4 Manufacturer's Field Services

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Monitor and report installation procedures and unacceptable conditions.

3.5 Interconnections

.1 Interconnect with fire alarm system to provide notification of generator:

.1 Generator common trouble

.2 Generator running

.3 Generator low fuel

.2 Interconnect with DDC to provide notification of generator:

.1 Generator common supervisory

.2 Generator running

.3 Generator low fuel

3.6 Adjusting

.1 Adjust generator output voltage and engine speed.

3.7 Cleaning

.1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 19 – Construction Waste Management and Disposal.

.3 Clean engine and generator surfaces. Replace oil and fuel filters.

3.8 Maintenance – Clearances

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer and CSA-C282.

3.9 Warranty

.1 Provide five (5) year 1500 hour comprehensive extended warranty for standby generators. Warranty shall cover all parts, labour, and travel costs.

3.10 Closeout Activities

.1 Demonstration:

.1 As directed by Contract Administrator and in accordance with Section 01 79 00 – Demonstration and Training carry out demonstrations of complete interruptible power unit.

.2 Provide familiarization training of operating and maintenance staff.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

.4 Provide fuel required for performing site test and top-up after acceptance test completion.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Automatic transfer switch.

.2 Automatic transfer switch and bypass/isolation switch.

1.2 RELATED SECTIONS

.1 Section 03 30 00 - Cast-in-place Concrete: Housekeeping pads.

.2 Section 26 05 53 - Electrical Identification: Engraved nameplates.

.3 Section 26 32 13 - Packaged Engine Generators: Testing requirements.

1.3 REFERENCES

.1 CSA-C22.2 No. 5-09 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

.2 CAN/CSA-C22.2 No. 94-M91 (R2006) - Special Purpose Enclosures.

.3 CSA-C22.1-21 - Canadian Electrical Code, Part I (25th Edition), Safety Standard for Electrical Installations.

.4 CSA-C22.2 No. 178.1-07 - Requirements for Transfer Switches.

.5 CSA (Canadian Standards Association).

.6 ULC (Underwriters' Laboratories of Canada).

1.4 SUBMITTALS FOR REVIEW

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: Provide catalogue sheets showing voltage, switch size, ratings and size of switching and over-current protective devices, operating logic, short circuit ratings, dimensions, and enclosure details.

1.5 SUBMITTALS FOR INFORMATION

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Installation Data: 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.

1.6 CLOSEOUT SUBMITTALS

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Operation Data: Include instructions for operating equipment. Include instructions for operating equipment under emergency conditions when engine generator is running.

.3 Maintenance Data: Include routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.7 CLOSEOUT SUBMITTALS

.1 Maintenance Contracts: Provide service and maintenance of transfer switch for one (1) year from Date of Substantial Completion.

1.8 MAINTENANCE MATERIAL SUBMITTALS

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Tools: Provide two (2) of each special tool required for maintenance.

1.9 QUALITY ASSURANCE

.1 Products of This Section: Manufactured to ISO 14000 and ISO 9000 certification requirements.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years experience, with service facilities within 160 km of Project.

.3 Supplier Qualifications: Authorized distributor of specified manufacturer with minimum three (3) years experience.

1.10 REGULATORY REQUIREMENTS

.1 Provide products listed and classified by testing firm acceptable to authority having jurisdiction ULC/CSA and as suitable for purpose specified and indicated.

1.11 DELIVERY, STORAGE, AND PROTECTION

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

.3 Handle to manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure and finish.

Part 2 Products

2.1 MANUFACTURERS

.1 ASCO

.2 Substitutions: Refer to Section 26 05 00.

2.2 AUTOMATIC TRANSFER SWITCH

.1 Description: CSA-C22.2 No. 178, automatic transfer switch

.2 Configuration: Electrically operated, mechanically held transfer switch.

2.3 AUTOMATIC TRANSFER AND BYPASS/ISOLATION SWITCH

.1 Description: CSA-C22.2 No. 178, automatic transfer switch with manual bypass switch.

.2 Configuration: Draw-out type electrically-operated, mechanically-held transfer switch with manually-operated CONNECTED, TEST, AND DISCONNECTED draw-out positions, and with mechanically-operated, mechanically-held transfer switch connected to bypass automatic switch in both NORMAL and EMERGENCY positions.

.3 Bypass Switch Ratings: Match automatic transfer switch for electrical ratings.

2.4 SERVICE CONDITIONS

.1 Temperature: 35C degrees

.2 Altitude: 1000m (3,300 ft).

2.5 RATINGS

.1 Voltage: 600 volts, three phase, four-wire, 60 Hz.

.2 Switched Poles: Refer to electrical single line diagram.

.3 Load Inrush Rating: Combination load.

.4 Continuous Rating: Refer to electrical single line diagram.

.5 Interrupting Capacity: 100% of continuous rating.

.6 Withstand Current Rating: 35,000 rms symmetrical amperes, when used with moulded case circuit breaker.

2.6 PRODUCT OPTIONS AND FEATURES

.1 Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, SWITCH POSITION, ALTERNATE SOURCE BYPASS, NORMAL BYPASS and.

.2 Test Switch: Mount in cover of enclosure to simulate failure of normal source.

.3 Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.

.4 Transfer Switch Auxiliary Contacts: One (1) normally open; one (1) normally closed.

.5 Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 85% or frequency varies more than 3% from rated nominal value.

.6 Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85% or frequency varies more than 3% from rated nominal value.

.7 In-Phase Monitor: Inhibit transfer until source and load are within 1 electrical degrees.

.8 Switched Neutral: Non-Overlapping.

2.7 AUTOMATIC SEQUENCE OF OPERATION

.1 Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.

.2 Time Delay To Start Alternate Source Engine Generator: 0 to 60 seconds, adjustable.

.3 Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.

.4 Time Delay Before Transfer to Alternate Power Source: 0 to 60 seconds, adjustable.

.5 Initiate Re-transfer Load to Normal Source: Upon permission by normal source monitor.

.6 Time Delay Before Transfer to Normal Power: 0 to 60 seconds, adjustable; bypass time delay in event of alternate source failure.

.7 Time Delay Before Engine Shut Down: 0 to 15 minutes, adjustable, of unloaded operation.

.8 Engine Exerciser: Start engine every thirty (30) days; run for thirty (30) minutes before shutting down. Bypass exerciser control if normal source fails during exercising period.

.9 Alternate System Exerciser: Transfer load to alternate source during engine exercising period.

2.8 ENCLOSURE

.1 Enclosure: CAN/CSA-C22.2 No. 94, Indoor and, Type 1.

.2 Finish: Manufacturer's standard Grey enamel.

Part 3 Execution

3.1 EXAMINATION

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Verify that field measurements are as indicated on shop drawings.

.3 Verify that surface is suitable for transfer switch installation.

3.2 PREPARATION

.1 Provide housekeeping pads to requirements of Section 03 30 00.

3.3 INSTALLATION

.1 Install transfer switches to manufacturer's written instructions.

.2 Provide engraved plastic nameplates to requirements of Section 26 05 53.

3.4 MANUFACTURER'S FIELD SERVICES

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Monitor and report installation procedures, unacceptable conditions.

.3 Program default sequence of operation steps:

.1 Step 1 - Standby Transfer Switch - Within 7 seconds of loss of power (5 seconds after generator voltage is stable).

3.5 INTERCONNECTIONS

.1 Interconnect with fire alarm system to provide notification of transfer switch:

.1 Transfer switch connected to normal source (NORMAL POWER)

.2 Transfer switch connected to emergency source (EMERGENCY POWER)

.3 Transfer switch not in automatic mode.

3.6 CLOSEOUT ACTIVITIES

.1 Demonstration: Demonstrate operation of transfer switch in bypass, normal, and emergency modes.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Luminaires.

.2 Emergency lighting inverter.

.3 Exit signs.

.4 LED luminaires and drivers.

.5 Lamps.

.6 Luminaire accessories.

1.2 Related Sections

.1 Section 23 82 00 - Terminal Heat Transfer Units: Air distribution accessories for air handling luminaires.

1.3 References

.1 ANSI/NEMA C78.379-2006 - American National Standard for Electric Lamps - Classification of the Beam Patterns of Reflector Lamps.

.2 CSA-C22.1-18 - Canadian Electrical Code, Part I (24th Edition), Safety Standard for Electrical Installations.

.3 CSA-C22.2 No. 9.0-96 (R2006) - General Requirements for Luminaires.

.4 CSA-C22.2 No. 250.0-08 - Luminaires.

.5 CSA-C22.2 No. 141-15 - Emergency lighting equipment.

.6 NEMA WD 6-2002 (R2008) - Wiring Devices - Dimensional Requirements.

.7 CSA (Canadian Standards Association).

.8 ULC (Underwriters' Laboratories of Canada).

1.4 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Shop Drawings:

.1 Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

.1 Interior –

.1 0.3m by 0.3m grid

.2 Entire project area.

.3 Separate Calculation Zones for each room.

.2 Exterior –

.1 1m by 1m grid.

.2 Entire project site inclusive of 3m past the property line.

.3 Data to include:

.1 Fixture info:

.1 Make & model
.2 Description
.3 Lamp info
.4 Lumens
.5 Lumen Multiplier
.6 Light Loss Factor
.7 Wattage
.8 Efficiency
.9 Distribution
.10 Quantities

.2 Calculation Zones
.1 Average
.2 Max
.3 Min
.4 Max/Min
.5 Avg/Min
.6 Reflectances used
.7 Lighting Power Density (W/sqm)

.2 Product Data: Provide dimensions, ratings, and performance data.

1.5 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Installation Data: Submit data indicating 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.

1.6 Closeout Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Operation and Maintenance Data: Submit manufacturer's operation and maintenance instructions for each product.

1.7 Maintenance Material Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Extra Stock Materials:

.1 Provide two (2) of each plastic lens type.
.2 Provide ten (10) replacement lamps for each lamp type.
.3 Provide two (2) of each ballast type.

1.8 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

.2 Conform to requirements of CSA C22.1, and to the Efficiency Manitoba Commercial Lighting Program.

.3 Products: Listed and classified by CSA, and as suitable for the purpose specified and indicated.

Part 2 Products

2.1 Luminaires

.1 Manufacturers:

.1 Refer to Luminaire Schedule on drawings.

.2 Substitutions: Refer to Section 26 05 00 Common Work Results for Electrical.

.1 All requests for substitutions shall be complete with photometric layouts indicating proposed luminaire performance in a 1' by 1' grid.

2.2 Emergency Lighting Inverter

.1 Description: Stand-alone pure sine wave output inverter unit equipment designed to operate designated LED fixtures on emergency power and their full nominal lumen rating.

.2 Battery: 12 volt, valve regulated lead acid type, with minimum 1/2 hour capacity at full load.

.3 Inverter:

.1 120VAC +/- 3%

.2 60Hz +/- 1%

.3 Transfer Time <1s.

.4 Load Power Factor: 0.9 leading to 0.9 lagging.

.5 AC lockout

.6 Short circuit and brownout protection.

.4 Housing: Factory white powder coat paint finish steel cabinet.

.5 Indicators: Lamps to indicate AC ON and RECHARGING.

.6 TEST Switch: Transfers unit from external power supply to integral battery supply.

.7 Auto-test self-diagnostic

.8 Electrical Connection: Hard wired

.9 Input Voltage: 120V.

.10 Manufacturers:

.1 Refer to Emergency Battery Bank Schedule on drawings.

.2 Substitutions: Refer to Section 26 05 00

2.3 Exit Signs

.1 Housing: Extruded aluminum

.2 Face: Green Pictogram face with white chevrons.

.3 Directional Arrows: Universal type for field adjustment

.4 Mounting: Universal, for field selection and as indicated

.5 Lamps: LED

.6 Input Voltage: Universal 120-347VAC, 6-24VDC.

.7 Manufacturers:

.1 Refer to Emergency Lighting Schedule on drawings.

.2 Substitutions: Refer to Section 26 05 00

2.4 Led Luminaires and Drivers

.1 All Luminaires

.1 Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.

.2 Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.

.3 LED's shall be Restriction of Hazardous Substances Directive (RoHS) compliant.

.4 LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours.

.5 LED luminaires shall deliver a minimum of 60 lumens per watt.

.1 LED's shall be "Bin No. 1" quality.

.6 Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.

.7 The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.

.8 LED color temperatures: CRI 85, 2700K as noted +/- 145K.

.9 LED color temperatures: CRI 85, 4000K as noted +/- 275K.

.10 LED color temperatures: CRI 85, 5000K as noted +/-283K.

.11 Luminaires shall have internal thermal protection.

.12 Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.

.13 Color spatial uniformity shall be within .004 of CIE 1976 diagram.

.14 Color maintenance over rated life shall be within .007 of CIE 1976.

.15 Indoor luminaires shall have a minimum CRI of 85.

.16 Luminaire manufacturers shall adhere to device manufacturer guidelines, certification programs, and test procedures for thermal management

.17 LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours.

.18 Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.

.2 Power Supplies and Drivers

.1 Efficiency Manitoba approved.

.2 Power Factor: 0.90 or higher

.3 Maximum driver case temperature not to exceed driver manufacturer recommended in-situ operation.

.4 Output operating frequency: 60Hz.

.5 Interference: EMI and RFI compliant with FCC 47 CFR Part 15.

.6 Total Harmonic Distortion Rating: 20% Maximum.

.7 Meet electrical and thermal conditions as described in LM-80 Section 5.0.

.8 Primary Current: Confirm primary current with Drawings.

.9 Secondary Current: Confirm secondary current specified by individual luminaire manufacturers.

.10 Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified control components.

.11 Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.

.3 Controller and Control System

.1 System electronics driver / controller to use coordinated communication protocols: DMX512, 0-10V, DALI, or proprietary as required.

.2 The Contractor shall ensure that external control equipment is compatible with LED control requirements

.3 Provide connector types and wiring as appropriate for un-interrupted communication between devices, considering distance maximums, field obstructions, and accessibility. Ensure that connection points are optically isolated for system noise reduction.

.4 Compatibility: Certified by manufacturer for use with individually specified luminaire and individually specified power supplies and/or drivers

.5 Luminaires used for emergency lighting connected to emergency lighting inverter to be controlled by relay type control that senses loss of normal power and controls the fixture to operate at 100%, locking out all other control until normal power is restored.

2.5 Lamps

.1 Fluorescent Lamp Manufacturers:

.1 Philips

.2 Standard

.3 Osram Sylvania

.4 GE

.5 Substitutions: Refer to Section 26 05 00.

.2 Lamp Types: As specified for luminaire. Less than 1.7mg of mercury. Refer to Section 26 05 00 for substitutions and product options.

2.6 Accessories

.1 Description: Standard down light reflector shall be semi-specular unless noted otherwise.

.2 Joiner Fittings: As specified for linear lighting systems, or as required for end to end continuous row mounting as indicated on drawings. Fittings to match style and finish of luminaire specified.

.3 End Caps: As specified for linear lighting systems, or as required for end of row or stand-alone luminaire installations as indicated on drawings. End caps to match style and finish of luminaire specified.

.4 Power Cord: As required for suspended lighting systems where wiring is exposed between fixture canopy and fixture lamp assembly. Power cord shall match finish of lighting fixture. Provide 0-10V combination cable as required for dimming purposes. Length of cable shall be suitable for minimum suspension length of 4'-0" from ceiling finish. Confirm final lengths with installation requirements.

.5 Wireguard: As specified for luminaire, or as indicated on the drawings.

.1 Gauge: Minimum 8 gauge unless noted otherwise.

.2 Color: Custom color to be confirmed by architect at time of shop drawing review.

2.7 Source Quality Control

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Certify fluorescent ballast design and construction by Certified Ballast Manufacturers, Inc.

Part 3 Execution

3.1 Installation

.1 Support luminaires larger than 600 x 1200mm (24 x 48 inch) size independent of ceiling framing.

.2 Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

.3 Install surface mounted luminaires, emergency lighting, and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

.4 Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling grid members using bolts, screws, or suitable clips.

.5 Install recessed luminaires to permit removal from below.

.6 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

.7 Install clips to secure recessed grid-supported luminaires in place.

.8 Install wall mounted luminaires, emergency lighting units, and exit signs at height as indicated.

.9 Install end to end, or continuous rows of luminaires with appropriate joiner fittings to match the luminaire manufacturer and finish.

.10 Install linear lighting with appropriate end caps where practicable.

.11 Lighting installed in corridors shall be oriented to maximize light distribution along the corridor rather than across it.

.12 Install accessories provided with each luminaire.

.13 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

.14 Daisy chaining of lighting fixtures using AC90 not permitted.

.15 Bond products and metal accessories to branch circuit equipment grounding conductor.

.16 Install specified lamps in each luminaire, emergency lighting unit and exit sign.

3.2 Interface With Other Products

.1 Interface with air handling accessories provided and installed under Section 23 37 00.

3.3 Field Quality Control

.1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 Adjusting

.1 Aim and adjust luminaires as directed.

.2 Position exit sign directional arrows as indicated.

.3 Allow for warranty visit 6 months after installation to incorporate user feedback on lighting control operations. Make adjustments as required.

3.5 Cleaning

.1 Refer to 26 05 00 Common Work Results for Electrical.

.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.

3.6 Closeout Activities

.1 Demonstration: Demonstrate luminaire operation for minimum of one (1) hours.

3.7 Protection of Finished Work

.1 Refer to 26 05 00 Common Work Results for Electrical.

3.8 Schedules

.1 As indicated on drawings.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Luminaires and accessories.

.2 Poles.

1.2 Related Sections

.1 Section 03 30 00 - Cast-in-place Concrete: Foundations for poles.

1.3 References

.1 C22.2 NO. 250.0-18 - Luminaires.

.2 C22.2 No. 9.0-96 (R2016) - General Requirements for Luminaires.

.3 CAN/CSA-A14-07 (R2017) - Concrete Poles.

.4 C22.2 No. 206-17 - Lighting Poles.

.5 CAN/CSA-C239-02 (R2016) - Performance Standard for Dusk-to-Dawn Luminaires.

.6 CAN/CSA-E60598-2-3-98 (R2017) - Luminaires - Part 2: Particular Requirements - Section 3: Luminaires for Road and Street Lighting.

.7 IES RP-33-14 - Lighting for Exterior Environments

.8 IES RP8-14 - Roadway Lighting.

.9 IES RP20-14 - Lighting for Parking Facilities.

.10 CSA (Canadian Standards Association).

.11 ULC (Underwriters' Laboratories of Canada).

1.4 Administrative Requirements

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Coordination:

.1 Coordinate with other work having a direct bearing on work of this section.

.2 Provide bolt templates and pole mounting accessories to installer of pole foundations.

1.5 Submittals for Review

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Product Data: Provide dimensions, ratings, and performance data.

.3 Shop Drawings: Indicate dimensions and components for each luminaire which is not a standard Product of the manufacturer.

1.6 Submittals for Information

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Test Reports: Indicate measured illumination levels.

.3 Installation Data: 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.

1.7 Closeout Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Maintenance Data: Submit maintenance data for each luminaire.

1.8 Maintenance Material Submittals

.1 Refer to 26 05 00 Common Work Results for Electrical.

1.9 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.10 Regulatory Requirements

.1 Products: Listed and classified by CSA and as suitable for the purpose specified and indicated.

1.11 Delivery, Storage, and Protection

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Store and handle lighting poles to CAN/CSA-A14 and CSA-C22.2 No. 206.

Part 2 Products

2.1 Luminaires and Accessories

.1 Manufacturers:

.1 Refer to Luminaire Schedule on drawings.

.2 Substitutions: Refer to Section 26 05 00 Common Work Results for Electrical.

.1 All requests for substitutions shall be complete with photometric layouts indicating proposed luminaire performance in a 1’ by 1’ grid.

2.2 Poles

.1 Manufacturers:

.1 Hapco

.2 Substitutions: Refer to Section 26 05 00.

.2 Material and Finish: Aluminum with anodized finish.

.3 Section Shape and Dimensions: Tapered round.

.4 Height: 600 mm (20 ft) or as indicated.

.5 Base: Nonbreakaway.

.6 Accessories: Anchor bolts and cast reinforced handhole (75mm x 125mm (3”x5”)).

.7 Loading Capacity Ratings:

.1 Luminaire Weight: 45kg (100lbs).

.2 Luminaire and Bracket Effective Projected Area: 0.7 sq m (8 sq ft)

.3 Steady Wind: Minimum 150 kph (90mph).

.8 Warranty: Lifetime warranty for defects in material, workmanship and to be free from corrosion.

Part 3 Execution

3.1 Installation

.1 Provide concrete bases for lighting poles at locations indicated, to Section 03 30 00.

.2 Install poles plumb. Provide shims and double nuts to adjust plumb. Grout around each base.

.3 Install lamps in each luminaire.

.4 Bond metal poles, metal accessories and luminaires to branch circuit equipment grounding conductor.

3.2 Field Quality Control

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Operate each luminaire after installation and connection. Inspect for improper connections and operation.

3.3 Adjusting

.1 Aim and adjust luminaires to provide illumination levels and distribution as directed and indicated on Drawings.

3.4 Cleaning

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Clean electrical parts to remove conductive and deleterious materials.

.3 Remove dirt and debris from enclosure.

.4 Clean photometric control surfaces as recommended by manufacturer.

.5 Clean finishes and touch up damage.

3.5 Protection of Finished Work

.1 Refer to 26 05 00 Common Work Results for Electrical.

.2 Re-lamp luminaires where lamps have failed at Substantial Completion.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Heating cable.

.2 Heating cable mat.

.3 Temperature controllers for heating cable and mat.

1.2 Related Sections

.1 Section 03 30 00 - Cast-in-place Concrete.

1.3 Performance Requirements

.1 Pipe Trace Heating: Freeze protection with outside temperature at -40 degreesC (-40 degrees F).

.2 Snow Melting Installations: 500W/sq m (45W/sq ft) minimum, in protected areas.

1.4 Administrative Requirements

.1 Section 01 31 00: Project management and coordination procedures.

.2 Coordination:

.1 Coordinate with other work having a direct bearing on work of this section.

.2 Coordinate installation of heating cable with installation of gutters.

.3 Pre-installation Meetings: Convene before starting work of this section.

.1 Require attendance of parties directly affecting the work of this Section.

.2 Review sequencing of installation, protection from damage of finished installation, location of expansion and control joints in concrete and building, and methods used for covering installations with insulation and concrete.

1.5 Submittals for Review

.1 Section 01 33 00: Submission procedures.

.2 Product Data: Provide data for heating cable, mat and control components.

.3 Shop Drawings: Indicate mat and heating cable layout, locations of terminations, thermostats, and branch circuit connections.

1.6 Submittals for Information

.1 Section 01 33 00: Submission procedures.

.2 Installation Data: Manufacturer's special installation requirements.

1.7 Closeout Submittals

.1 Section 01 78 10: Submission procedures.

.2 Record Documentation: Accurately record actual locations of temperature sensors, heating cable, mat, thermostats, and branch circuit connections.

.3 Operation and Maintenance Data:

.1 Include description of operating controls.

.2 Include repair methods and parts list of components.

1.8 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

Part 2 Products

2.1 Manufacturers

.1 Manufacturers:

.1 Pentair; Product: GM.

.2 Substitutions: Refer to Tender No. 543-2022B; Part B – Bidding Procedures.

2.2 Heating Cable

.1 Heating Cable: Self-limiting, parallel resistance heating cable.

.2 Rating: 120 and 208V, (39 W/lin m (12W/lin ft).

2.3 Heating Cable Mat

.1 Description: Heating cable assembled into pre-spaced unit.

.2 Heating Cable: Mineral-insulated, copper-sheathed, series resistance heating cable.

.3 Ratings: 208V

.4 Non-heating Leads: 3m (10ft) length.

.5 Unit Size: 900mm (36 inch) width.

2.4 Accessories

.1 Thermostat: Gutter De-Icing Controller complete with built-in 30mA GFCI protection.

.1 Product: ETI GF Pro, manufactured by Pentair.

Part 3 Execution

3.1 Examination

.1 Section 01 70 00: Verify existing conditions before starting work.

.2 Verify that ceiling framing, piping and concrete form work is ready to receive work.

.3 Verify field measurements are as shown on Shop Drawings.

.4 Verify that required utilities are available, in proper location, and ready for use.

.5 Beginning of installation means installer accepts conditions.

3.2 Installation

.1 Install to manufacturer's written instructions.

.2 Bending Radius: Six times cable diameter, minimum.

.3 Avoid pinching and making sharp bends in cable.

.4 Prevent damage by sharp rocks, metal, or other objects during installation.

.5 Do not install heating cable and mat across expansion or construction joints.

.6 Do not cross heating cable over itself.

.7 Cable Spacing in Concrete: 75mm (3 inch) centres, minimum; 225mm (9 inch) centres, maximum.

.8 Depth in Concrete: 50mm (2 inches) below finished surface.

.9 Installation on Roof and in Ceiling: Do not begin until roofing work is complete. Route and fasten cable to manufacturer's written instructions. Select and install cable based on maximum safe temperature for materials used.

.10 Provide 30mA trip GFCI breaker(s) for all circuits feeding heating cables and mats.

3.3 Field Quality Control

.1 Section 01 45 00: Field inspection and Testing.

.2 Test continuity of heating cable.

.3 Perform continuity and insulation resistance test on completed cable installation. For cables embedded in concrete, perform tests immediately before and after concrete placement.

.4 Measure voltage and current at each unit.

.5 Submit written test report showing values measured on each test for each cable.

3.4 Closeout Activities

.1 Demonstration: Demonstrate operation of heating cable controls.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Electric unit heaters.

.2 Electric cabinet heaters.

.3 Electric baseboard heaters.

.4 Thermostats and accessories.

1.2 References

.1 NEMA DC 3-2008 - Residential Controls - Electric Wall-Mounted Room Thermostats.

1.3 Submittals for Review

.1 Section 01 33 00: Submission procedures.

.2 Product Data: Provide unit size, finish, and performance data.

1.4 Submittals for Information

.1 Section 01 33 00: Submission procedures.

.2 Installation Data: Manufacturer's special installation requirements.

1.5 Closeout Submittals

.1 Section 01 78 10: Submission procedures.

.2 Operation and Maintenance Data:

.1 Include instructions for safe operating procedures.

.2 Include instructions for replacement parts and troubleshooting diagnostics.

.3 Include recommended cleaning methods, cleaning materials, and waxes for interior parts and exterior finishes.

Part 2 Products

2.1 Manufacturers

.1 Manufacturers:

.1 Ouellet

.2 Chromalox

.3 Stelpro

.4 Q-Mark

.5 Substitutions: Refer to Tender No. 543-2022B; Part B – Bidding Procedures.

2.2 Electric Horizontal Discharge Unit Heaters

.1 Description: Electric unit heater for suspended mounting, with fan forced air distribution over electric resistance heating coils and horizontal discharge.

.2 Input Voltage: Refer to Schedule.

.3 Output Rating: Refer to Schedule.

.4 Heating Element: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centred in tubes and embedded in refractory material.

.5 Input Fuses: Provide integral fuses for units rated more than 48 amperes full load.

.6 Provide line voltage disconnect switch for each input circuit.

.7 Fabrication: Fabricate cabinet of heavy welded steel.

.8 Provide hinged and latched panel for electrical connection and control compartment.

.9 Provide internal shroud around heating elements to assure uniform air flow and delivery temperature across heater face.

.10 Provide suitable fan blade protection using wire guard.

.11 Cabinet Finish: Use corrosion-resisting primer and finish with baked enamel, colour beige.

.12 Contactor: Provide contactor control for unit.

.13 Thermostat: Provide remote low voltage thermostat to control contactor.

.14 Provide low voltage control transformer.

.15 Operating Stages: One.

.16 Provide terminal blocks for power and control wiring connections.

.17 Louvre: Provide discharge louvre with individually adjustable blades.

2.3 Electric Downflow Discharge Unit Heaters

.1 Description: Electric unit heater for suspended mounting, with fan forced air distribution over electric resistance heating coils and vertical discharge.

.2 Input Voltage: Refer to Schedule.

.3 Output Rating: Refer to Schedule.

.4 Heating Element: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centred in tubes and embedded in refractory material.

.5 Input Fuses: Provide integral fuses for units rated more than forty-eight (48) amperes full load.

.6 Provide line voltage disconnect switch for each input circuit.

.7 Fabrication: Fabricate cabinet of heavy welded steel.

.8 Provide hinged and latched panel for electrical connection and control compartment.

.9 Cabinet Finish: Use corrosion-resisting primer and finish with baked enamel.

.10 Contactor: Provide contactor control for unit.

.11 Thermostat: Refer to Schedule.

.12 Provide low voltage control transformer.

.13 Operating Stages: One.

.14 Provide terminal blocks for power and control wiring connections.

.15 Diffuser: Louvre type, adjustable from 0 degrees to 45 degrees (0 to 50 grads).

2.4 Electric Cabinet Heaters

.1 Description: Surface wall or ceiling mounted and Recessed cabinet heater with fan forced air distributed over resistance heating element.

.2 Input Voltage: Refer to Schedule.

.3 Output Rating: Refer to Schedule.

.4 Heating Element: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centred in tubes and embedded in refractory material.

.5 Provide line voltage disconnect switch integral with thermostat to directly control heater element.

.6 Fabrication: Fabricate cabinet of heavy welded steel.

.7 Grille: Fabricate from extruded aluminum

.8 Provide captive-screw held panel for electrical connection and control compartment.

.9 Cabinet Finish: Use corrosion-resisting primer and finish with baked enamel.

.10 Grill Finish: Use corrosion-resisting primer and finish with baked enamel.

.11 Provide terminal blocks for power and control wiring connections.

2.5 Electric Baseboard Heaters

Description: Wall mounted electric convector heater with resistance heating element.

.1 Input Voltage: Refer to Schedule.

.2 Output Rating: Refer to Schedule.

.3 Heating Element: Enclosed copper tube, aluminum finned element of coiled nickel-chrome wire embedded in refractory material.

.4 Element Hangers: Ball bearing cradle type.

.5 Provide line voltage disconnect switch integral with thermostat to directly control heater element.

.6 Fabrication: Fabricate cabinet of extruded aluminum.

.7 Grille: Fabricate from extruded aluminum.

.8 Provide captive-screw held panel for electrical connection and control compartment.

.9 Cabinet Finish: Use corrosion-resisting primer and finish with anodized enamel.

.10 Grille Finish: Use corrosion-resisting primer and finish with anodized enamel, colour beige.

.11 Provide terminal blocks for power and control wiring connections.

2.6 Accessories

.1 Room Thermostat: heating only single line break line voltage thermostat with control point reset.

Part 3 Execution

3.1 Examination

.1 Section 01 70 00: Verify existing conditions before starting work.

.2 Verify that field measurements are as instructed by manufacturer and shown on Drawings.

.3 Verify that field conditions are acceptable and are ready to receive work.

.4 Verify that required utilities are available, in proper location, and ready for use.

.5 Beginning of installation means installer accepts existing conditions.

3.2 Installation

.1 Install to manufacturer's written instructions.

.2 Locate each unit in position indicated.

.3 Install unit with sufficient clearance from adjacent construction, piping, ductwork, and other obstructions to allow access for service and maintenance.

.4 Support unit heaters and ceiling mounted cabinet heaters from structure. Install manufacturer supplied vibration isolation as required.

3.3 Field Quality Control

.1 Section 01 45 00: Field adjusting and testing.

.2 Verify operation of each electric heating unit by measuring input voltage and current simultaneously for period of ten minutes of continuous operation.

3.4 Closeout Activities

.1 Demonstration: Demonstrate location of circuit breakers and switches serving electric heating branch circuits, and location and setting procedures for thermostats and other heating controls.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 26 05 26 – Grounding and Bonding.

1.2 References

.1 American National Standards Institute

.1 ANSI/TIA-607-D-2019, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

.2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)

.1 TIA/EIA-606-2002, Administration Standard for the Commercial Telecommunications Infrastructure.

1.3 System Description

.1 Telecommunications grounding and bonding system consist of grounding busbars, bonding backbones, and other bonding conductors.

.2 Provides ground reference for telecommunications systems within building and bonding to it of telecommunications rooms.

.3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to telecommunications grounding and bonding system.

Part 2 Products

2.1 Telecommunications Main Grounding Busbar (TMGB)

.1 Predrilled copper busbar, electrotin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI J-STD-607-A.

.2 Dimensions 0.5”(6 mm) thick, 4”(100 mm) wide, 24”(600 mm) long to: TIA-607.

2.2 Bonding Conductor for Telecommunications

.1 3/0 AWG copper conductor, green marked to: TIA-607.

2.3 Warning Labels

.1 Non-metallic warning labels in English to: TIA-607.

.2 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

Part 3 Execution

3.1 Telecommunications Main Grounding Busbar (TMGB)

.1 Install TMGB in entrance room on insulated supports “2” (50mm) high at location close to electrical power panel if one is installed in same room.

.2 Install 3/0 AWG copper bonding conductor from TMGB to alternating current equipment ground (ACEG) of serving electrical power panel (panelboard).

3.2 Bonding Conductors General

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

3.3 Bonding Conductor for Telecommunications

.1 Install bonding conductor for telecommunications from TMGB to service equipment (power) ground.

.2 Use approved 2 hole compression lugs lugsfor connection to TMGB.

3.4 Bonding To TMGB

.1 Bond metallic raceways in telecommunications entrance room to TMGB using #3AWG copper conductor.

.2 For cables within telecommunications entrance room having shield or metallic member, bond shield or metallic member to TMGB using #6 AWG copper conductor.

.3 Bond all equipment racks and cabinets located in telecommunications entrance room to TMGB using #3 AWG copper conductor.

3.5 Labelling

.1 Apply warning labels to telecommunications bonding and grounding conductors.

.2 Apply additional administrative labels to: TIA/EIA-606.

END OF SECTION

Part 1 General

1.1 Action and Informational Submittals

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for communication raceway systems and include product characteristics, performance criteria, physical size, finish and limitations.

1.2 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect communication raceway systems from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 Products

2.1 System Description

.1 Empty telecommunications raceways system consists of outlet boxes, cover plates, terminal and distribution cabinets, conduits, pull boxes, sleeves and caps, fish wires, service poles, service fittings, concrete encased ducts.

.2 Overhead distribution system.

2.2 Material

.1 Conduits: EMT type, in accordance with Section 26 05 33 - Conduits.

Conduit Fill Chart (0 Bends*)							
Size		Category Cables			Coaxial	Fiber Multimode	
inch	mm	Cat5e	Cat6	Cat6A	RG6	12 strands OM3	12 strands OM4
1/2	16	3	2	1	2	2	2
3/4	21	5	4	3	3	4	4
1	27	9	7	5	6	7	7
1-1/4	35	15	13	8	9	13	12
1-1/2	41	21	18	12	14	18	17
2	53	35	30	20	23	30	29

2-1/2	63	50	42	28	33	42	41
3	78	77	65	44	51	65	63
3-1/2	91	105	89	60	70	89	86
4	103	135	114	77	90	114	110

*Conduit fill shall be de-rated by 15% per bend between pull boxes.

.2 Underground cable ducts: PVC type.

.3

Cable Tray Fill Chart							
Size		Category Cables			Coaxial	Fiber Multimode	
inch	mm	Cat5e	Cat6	Cat6A	RG6	12 strands OM3	12 strands OM4
2"D x 2"W	56mm x 50mm	56	47	32	37	48	46
2"D x 4"W	56mm x 100mm	113	95	65	75	96	92
2"D x 6"W	56mm x 150mm	170	143	97	113	145	139
2"D x 8"W	56mm x 200mm	227	191	130	151	193	185
2"D x 12"W	56mm x 300mm	341	287	195	227	290	278
4"D x 12"W	102mm x 300mm	682	574	390	454	580	556
6"D x 12"W	152mm x 300mm	1023	861	585	681	870	834

.4 Overhead distribution system: in accordance with J-hooks.

J Hook Fill Chart							
Size		Category Cables			Coaxial	Fiber Multimode	
inch	mm	Cat5e	Cat6	Cat6A	RG6	12 strands OM3	12 strands OM4
1	27	20	15	10	13	16	16
1-5/16	33	50	40	25	27	35	34
2	53	90	60	35	48	61	59
3	78	200	150	80	113	144	138
4	103	330	220	140	189	241	231

.5 Junction boxes, cabinets: In accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

.6 Outlet boxes: In accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.

.7 Fish wire: polypropylene type.

Part 3 Execution

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for communication raceway systems installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

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

3.2 Installation

.1 Install empty raceway system, including overhead distribution system, fish wire, terminal cabinets, outlet boxes, floor boxes, pull boxes, cover plates, conduit, sleeves and caps, cable tray, service poles, miscellaneous and positioning material to constitute complete system.

.2 Size raceway system to accommodate all cable drops as shown, refer to Fill Chart for minimum sizing requirements unless size is otherwise indicated on drawings.

.3 Maintain the following clearances from all electrical equipment as follows:

.1 Transformers above 5kVA – 1000mm

.2 347/600V power – 1000mm

.3 120V power – 50mm

.4 208/240V power – 300mm

.5 Motors – 1000mm

.6 120V fluorescent lighting – 300mm

.7 347V fluorescent lighting – 1000mm

3.3 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.3 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 19 – Construction Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by pathways for communications systems installation.

END OF SECTION

Part 1 General

1.1 References

.1 Canadian Standards Association (CSA International)

.1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).

.2 CSA-C22.2 No. 232-[M1988(R2004), Optical Fiber Cables.

.2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)

.1 TIA/EIA-568-C.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.

.2 TIA/EIA-568-C.2-(2001), Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted-Pair Cabling Components.

.3 TIA/EIA-568-C.3-(2000), Optical Fiber Cabling Components Standard.

.4 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.

.5 TIA TSB-140-2004, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.

.6 TIA-598-C-(2005), Optical Fiber Cable Color Coding.

1.2 Definitions

.1 Refer to TIA/EIA-598-C, Annex A for definitions of terms: optical-fiber interconnect, distribution, and breakout cables.

1.3 System Description

.1 Structured telecommunications wiring system consist of unshielded-twisted-pair and optical fiber cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.

.2 Installed in physical star configuration with separate horizontal and backbone sub-systems.

.1 Horizontal cables link work areas to telecommunications room[s] located on same floor.

.2 Telecommunications rooms linked to main terminal/equipment room (MT/ER) by backbone cables.

.3 MT/ER also linked to Entrance Room by backbone cables.

1.4 Action and Informational Submittals

.1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 As-built Records and Drawings: in accordance with Section 01 78 10 – Closeout Submittals.

1.5 Delivery, Storage and Handling

.1 Waste Management and Disposal: separate waste materials for reuse or recycling in accordance with Section 01 74 19 - Construction Waste Management and Disposal.

Part 2 Products

2.1 Four-Pair 100 Ω Balanced Twisted Pair Cable

.1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT6 or MPP or CMP to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA/EIA-568-C.

.1 Cabling must be packaged on reel inside of the box, complete with a Brake Box braking system to prevent kinking of the cable during installation. Breaking system to have two resistance mechanisms on both sides of the reel, each of which has three resistance settings to allow for back-tension, over-spin control and preventing tangling.

.2 Cabling reel to also include Quick Count cable product that provides footage marking on the cable jacket counting down from 1,000 feet.

.3 Colour Coded as follows:

.1 Data Outlets – Blue
.2 Wireless Access Points – Green
.3 Video or CCTV – Red
.4 Phone or Voice Outlets – Yellow
.5 Access Control Systems – Purple
.6 Paging and Intercom – Black
.7 Lighting Controls – White

2.2 Work Area UTP 4-Pair Modular Jack

.1 Eight-position modular jack ("RJ-45"), type T568A Category 6 to: TIA/EIA-568- C:

.1 In self-contained surface-mount box, 2 jacks per box.
.2 Mounted in compatible single gang faceplate, flush entry, 4 jack positions per faceplate.

2.3 Termination and Cross-Connection Hardware for UTP

.1 IDC Terminal strips, 25 pair, for terminating multi pair 100 Ω balanced twisted pair cables and supporting cross-connections using jumper wires or compatible plug-ended patch cords: Category 6 to: TIA/EIA-568-C.

.2 Mount or block for housing 12 IDC terminal strips, mounted on wall.

.1 Distribution rings or channels capable of externally mating with the above mount for managing cross-connection wires.

.3 Patch panel, 2 rack units high, 48 ports:

.1 Each port equipped with factory installed "RJ-45" jacks, type T568A Category 6 to: TIA/EIA-568-C.

.2 Horizontal cable-management unit for every 48 ports.

2.4 UTP Cross-Connect Wire

.1 Category 6, 4 pairs to: TIA/EIA-568-C.

2.5 UTP Patch Cords

.1 3 metres long, with factory-installed male plug at one end to mate with "RJ-45" jack and with factory-installed male plug at other end to mate with "RJ-45" jack Category 6, 4 pairs to: TIA/EIA-568-C.

.2 Colour Coded as follows:

.1 Data Outlets – Blue

.2 Wireless Access Points – Green

.3 Video or CCTV – Red

.4 Telephone or Voice Outlets – Yellow

.5 Access Control Systems – Purple

.6 Paging and Intercom – Black

.7 Lighting Controls – White

2.6 UTP Equipment Cable

.1 4 pair "pigtail", 3 metres long, with factory-installed male plug on one end to mate with "RJ-45" jack and other end equipped with factory-installed male plug to mate with "RJ-45" jack: Category 6 to: TIA/EIA-568-C.

2.7 UTP Work Area Cords

.1 3 metres long, each end equipped with "RJ-45" plug Category 6 to: TIA/EIA-568-C.

Part 3 Execution

3.1 Installation Of Termination and Cross-Connect Hardware

.1 Install termination and cross-connect hardware in rack as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606-A.

3.2 Installation of Horizontal Distribution Cables

.1 Install horizontal cables as indicated in "J" hooks from telecommunication rooms to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606-A.

.2 Support horizontal cables at intervals not exceeding 2 metres.

.1 Where raceways are used to distribute cables to each zone, provide supplementary "J" hooks to support cables at intervals not exceeding 2 metres.

.3 Terminate horizontal cables in telecommunications room and at individual work-area jacks

.1 Identify and label as indicated to: TIA/EIA-606-A.

.4 Coil spare cables and store in ceiling space in zone.

.5 Harness slack cable in cabinets, racks, and wall-mounted termination and cross-connection hardware.

3.3 Installation of Backbone Cables

.1 Install backbone cables from each telecommunications room to main terminal/equipment room (MT/ER) as indicated and according to manufacturers' instructions.

.1 Identify and label as indicated to: TIA/EIA-606-A.

.2 Install backbone cables from MT/ER to carrier demarcation point in [Entrance Room] as indicated and according to manufacturer's instructions.

.1 Identify and label as indicated to: TIA/EIA-606-A.

3.4 Installation of Equipment Cables

.1 Install equipment cables from equipment patch panel as indicated.

.1 Identify and label as indicated to: TIA/EIA-606-A.

3.5 Implement Cross-Connections

.1 Implement cross-connections using patch cords as specified.

3.6 Field Quality Control

.1 Test horizontal UTP cables as specified below and correct deficiencies provide record of results as hard copy, electronic record on CD.

.1 Perform tests for Permanent Link on installed cables, including spares:

.1 Category 6 using certified level III tester to: TIA/EIA-568-C.

.2 Perform the following tests: wire map, length, insertion loss, NEXT loss, ELFEXT, PSELFEXT, ACR, PSACR, propagation delay, delay skew, return loss.

.2 Perform tests for Channel on 20% of cross-connected data horizontal cabling installed from each telecommunications room, including shortest and longest drops from each telecommunications room: should more than 5% of tested cables fail, test remaining cross-connected data cables.

.1 Category 6 using certified level III tester to: TIA/EIA-568-C.

.2 Perform the following tests: wire map, length, insertion loss, NEXT loss, ELFEXT, PSELFEXT, ACR, PSACR, propagation delay, delay skew, return loss.

.2 Test backbone Category 3 voice cables as specified below and correct deficiencies: provide record of results as hard copy, electronic record on CD.

.1 Perform Wire Map tests on multi-pair Category 3 cables to: TIA/EIA-568-B.1.

.2 Provide loop resistance measurements in ohms and dB at 1KHz, 8KHz, and 256 KHz.

.3 Test multi-pair Category 3 cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors.

.3 Test Optical-fiber strands for attenuation to: TIA/EIA-568-C and correct deficiencies: provide record of results as hard copy, and electronic record on CD.

.1 Test backbone links in both directions. Backbone links:

.1 Test multi-mode fiber at both applicable wavelengths (850nm and 1300nm).

.2 Maximum attenuation: Cable attenuation + Connector loss + Splice loss.

.1 Multi-mode-fiber attenuation coefficients:

.1 3.5 db/km @ 850nm; and

.2 1.5 db km @ 1300nm

.2 Maximum connector insertion loss: 0.75 db per pair and maximum splice insertion loss: 0.3 db.

.4 Perform additional Tier 2 tests using optical time domain reflectometer (OTDR) on backbone fiber pairs.

.1 Correct deficiencies.

.2 Provide record of results as described in SUBMITTALS.

.5 Provide record of results as electronic record on CD to: TIA/TSB-140.

.6 Provide record of results as [hard copy] [electronic record on CD to: TIA/TSB-140.

3.7 Contractor Certification

.1 The cabling system shall be installed by a contractor or sub-contractor certified by the cable manufacturer.

3.8 Warranty

.1 The installation Contractor shall support the installed system for a period of two years from the date of acceptance by the City.

.2 Contractor shall be responsible for obtaining all documentation necessary to achieve manufacturer's warranty

.3 The manufacturer shall provide a minimum 20 year warranty for the complete cabling system.

.4 The manufacturer's warranty shall be provided directly to the City and shall be independent of the installation contractor.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Access control panel.

.2 Proximity Readers

.3 Door Controllers

.4 Power Supplies

.5 Request to Exit Motion Detectors

.6 Software Management

.7 Wiring

.8 Hardware and Software Integration with Door Hardware

1.2 Codes and Standards

.1 Work shall be performed in accordance with the applicable National, Provincial and local codes or standards current at the commencement of installation. The following list summarizes applicable standards:

.1 UL 294, UL 1076, ULC

.2 CE

.3 FCC-Part 15, Part 68

.4 NFPA70, NEC

.5 IEEE, RS170 variable standard

.6 IEEE, NTSC (colour camera broadcast)

.2 Where more than one code or regulation is applicable, the more stringent shall apply.

.3 Cable installation, identification and termination shall be performed in accordance with the manufacturer's technical installation guidance, in addition to the applicable codes above.

.4 In the absence of the manufacturer's recommendations on conductor application, the contractor shall ensure that the cable selected meets all technical requirements of the equipment to be installed.

1.3 Related Sections

.1 Section 08 71 00 - Door Hardware - General.

.2 Section 08 36 27 - Folding Bay Doors.

.3 Section 26 05 19 - Building Wire and Cable.

1.4 System Description

.1 Access Control System: Control access through building as follows:

.1 Provide access control at all controlled door points complete with door controllers, proximity readers, interconnection to door hardware, request to exit motion sensors, and power supplies.

.2 Provide access control on all doors as noted on drawings. Readers shall allow access through controlled doors for registered users.

.3 Provide software for user control of system complete with hardware for programming of proximity cards.

.4 Provide all hardware and software for a complete solution.

.5 System shall integrate with door hardware systems. Refer to Division 08 specifications.

.6 System shall integrate with folding bay doors. Refer to Division 08 Specifications.

.7 Zones:

.1 Main building

.2 Evidence D121

.3 Investigator's Office D114.

.8 Users & Groups:

.1 Minimum 1000 users.

.2 Minimum 100 user groups.

.3 The building manager shall have the capability to assign individual users to multiple access control schemes in each zone.

.2 The system shall require one master control file server station and be able to support a minimum of 20 additional concurrent (logged on) control locations, badging stations, or workstations, utilizing LAN/WAN network software and hardware.

.3 The system shall be expandable in modular increments to total capacity. The software shall not require installation of any modules or any other upgrading to achieve above stated capacities. Additional communication server licenses shall be made available to expand the system capacity as needed. Upgrading a user license or the number of communication servers shall not require any additional software.

1.5 Submittals for Review

.1 Section 01 33 00: Submission procedures.

.2 Product Data: Provide electrical characteristics and connection requirements.

.3 Shop Drawings: Indicate system wiring diagram showing each device and wiring connection required.

1.6 Submittals for Information

.1 Section 01 33 00: Submission procedures.

.2 Test Reports: Indicate satisfactory completion of required tests and inspections.

.3 Installation Data: Manufacturer's special installation requirements.

.1 Indicate application conditions and limitations of use stipulated by Product testing agency.

.2 Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.7 Closeout Submittals

.1 Section 01 78 10: Submission procedures.

.2 Maintenance Contracts: Provide service and maintenance of intrusion detection system for one (1) year from Date of Substantial Completion.

.3 Operation Data: Operating instructions.

.4 Maintenance Data: Maintenance and repair procedures.

.5 Record Documentation: Record actual locations of initiating devices, signaling appliances, and end-of-line devices.

1.8 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years experience and with service facilities within 160km (100 miles) of Project.

1.9 Regulatory Requirements

.1 Products Requiring Electrical Connection: Listed and classified by ULC as suitable for the purpose specified and indicated.

Part 2 Products

2.1 Manufacturers

.1 Mercury

.2 Altronix

.3 Substitutions: Refer to Tender No. 543-2022B; Part B – Bidding Procedures.

2.2 Alarm & Access Control Panel

.1 Control Panel: Modular construction with surface wall-mounted enclosure with adequate power supply to serve control panel modules, alarm signaling devices, remote detectors, relays, and card readers. Include battery-operated emergency power supply with capacity for operating system in standby mode for twenty-four hours.

.1 Products:

.1 Mercury LP1502

.2 Mercury MR52

.2 Cabinets

.1 Altronix Trove 2M2

.2 Altronix Trove 1M1

.3 Altronix T2MK38D

.4 Altronix T2MK78D

.5 Altronix T2M7XK3D

.2 BASIC SYSTEM CAPABILITIES

.1 The following functional capabilities are considered essential for the system described in this specification. The capabilities are to be considered standard, without the need for add-on software or hardware.

.2 General

.1 All databases will have the ability to ADD, DELETE, REPORT, VIEW or EDIT information.

.2 Provide storage of all system transactions in a retrievable file.

.3 Log all events by time and date.

.4 Provide capability to store all or selected system transaction to a disk file.

.5 Provide ability for CITY to make system configuration changes such as, but not limited to door open time, door contact shunt time, point and reader names, when and where a cardholder is valid, and the ability to add or modify card databases at any time.

.6 Support “Global Anti-passback”, allowing cardholder to enter/exit any such defined card reader on the same intelligent control panel.

.7 Anti-passback modes shall include hard (no forgiveness), soft (allows access but generates an alarm event) and timed for all readers on the intelligent controller, on specified reader or card for a definable period of time up to 32,000 seconds.

.8 Duress feature where when a PIN is used in conjunction with a card read the numbers of digits are selected at the keypad where the PIN number is a value of one different from the normal PIN.

.9 Two cardholder rule, where two valid, non-identical “cards” must be used within a 20 second period of time to grant access.

.10 Ability to display when a cardholder who uses the reader has accessed (opened) the door or if the card was used but the door was not opened.

.11 Latch mode operation where the first card read unlocks the door and the second causes it to lock the door.

.12 Provide mode of system operation that stores system commands that were not accepted by the hardware.

.13 Provide mode of system operation that requires the operator to enter a response to an event when Acknowledging it from the alarm view window.

.14 Provide mode system operation that allows acknowledged alarms to be automatically cleared.

.15 Provide mode of system operation where un-acknowledged events will cause the computer to continuously emit a pulsating beep until all un-acknowledged alarms are acknowledged. A momentary silence feature shall allow the beeping to cease for up to 60 seconds. The silence feature shall also provide a visual count down to when the beeping will begin again.

.16 Provide mode of system operation where when an acknowledged, but not cleared event will be reissued requiring acknowledgement when the event changes to an alarm or trouble state.

.17 Provide mode of system operation that does not allow the operator to clear an alarm prior to it being restored to normal.

.18 Provide ability for manual operator control of system output relays. The manual functions shall include the ability to energize, de-energize, return to time zones, or pulse the output relay. The pulse time shall be a programmable setting.

.19 Provide ability for manual operator control of system doors. The manual functions shall include the ability to Lock, Un-Lock, Disable, Card only, Card-Pin only, Pin only, Exit only and Site Code only.

.20 Provide ability to automatically display stored “video image” of cardholder, and switch real-time camera from CCTV or digital video server to card reader location for specific card usage.

.21 The cardholder “video image” pop-up shall be activated based on a priority level set to the cardholder or reader. Information in the pop-up shall include, but not be limited to the cardholder’s primary image a live video pop-up showing the person who initiated the pop-up, entrance name, time, date, cardholder name, and status. User shall be able to display up to 40 note fields. The size of the pop-ups shall be adjustable by the operator.

.22 Support multiple card reader technology including:

.23 Proximity

- .1 Wiegand effect
- .2 Biometrics
- .3 Magnetic stripe
- .4 Bar Code
- .5 Keypad
- .6 Card/Keypad (PIN)
- .7 High-speed long range Vehicle ID
- .8 Smart Card

.24 Provide a means for scheduled automatic backups of any or all database system files. A means to restore these files from a simple menu shall exist.

.25 Provide the ability to address up to 225 serial communication ports per communication server, where each port can be configured for either hardwired or dial-up. When configured for dial-up, an y one port can support multiple dial-up locations.

.26 Communication from the access control communication server to the remote intelligent control panels shall be selectable. Communication options shall be RS-232 directly to the intelligent control, via RS-485 converter, dial-up, leased line from a defined communication port or by LAN/WAN using an IP address for direct connection to the intelligent controller via network interface card. When using IP addressing it shall be un-acceptable to use a communication port converter device on the communication port converter device on the communication server side of the transmission. A minimum of 225 such IP connections shall be allowed per communication server.

.27 All commands and updates to the panels shall be verified and shall automatically retry if communications have failed.

.28 Provide a system scheduler that shall automatically:

.1 Call remote locations to retrieve history transactions and update panel information, including time and date.

.2 Activate or deactivate cards locally or at remote dial-up sites.

.3 Initiate a pre-programmed command event/action.

.4 Synchronized system to intelligent controller time.

.5 Frequency shall be defined as Never, Now, Once, Hourly, Daily, Weekly, Once per 2 weeks, and Monthly.

.3 Provide drop boxes for all system-required information that the user has previously entered.

.4 A host grant mode of operation shall exist that requires the host computer to grant accesses to “valid” cards. An alternate host grant mode shall allow the card access information to be downloaded along with unlocking the door for “valid” cards.

.1 Card Database

.1 Cardholder information shall include unique card number up to 15 digits and optional Personal Identification Number.

.2 Allow multiple cards per cardholder.

.3 Provide 40 user definable fields.

.4 Provide special card options that include, but are not limited to:

.1 Time zone reference, which defines valid time.

.2 Visitor use, which provides a specified activation date and expiration date (spanning years).

.3 Trigger control value, which can initiate a predefined procedure at the intelligent control independent from any control function from the system computer.

.5 Provide a card “Trace” function. The trace function shall allow normal access control, but will provide a tracking alarm at the system monitor.

.6 Provide ability to store digital images of cardholder or other digital images such as property of family members. Up to 99 such images shall be associated with the cardholder.

.7 Provide ability to store a written signature of the cardholder or other signatures such as family members. Up to 99 such signatures shall be associated with the cardholder.

.8 Provide the ability to prioritize specific card usage from 1 to 99 with separate priority options shall included but not be limited to Anti-passback, Trace, PIN Violation, Normal, Not Found, Expired, Host Grant, Site Code and Time Zone card activities or violations.

.9 Allow the user the ability to assign an operator message per card Event State and that a procedure for the intelligent control shall perform per Event State.

.10 Upon editing card information, the updated information shall be sent automatically to the appropriate access control panel, when hardwired, with no other user intervention. If the port is dial-up, the entry will be stored on disk and shall be updated when connection is made to the remote loop. If the scheduler is used, then card updates shall be sent based on scheduling.

.11 In a traditional (Wiegand) 5 digit card database, the numbers 0 and 65,535 shall not be valid card numbers as some devices transmit these numbers on an improper read.

.12 In a 15-digit card database, the number 0 shall not be a valid card number as some devices transmit this number on an improper read.

.13 A card shall have the ability to be allowed to access one or selected accounts up to all available accounts.

.2 Access Levels

.1 Provide the ability to define specific times of access.

.2 Provide the ability to define specific readers for access.

.3 Provide a template of a defined access level detail, where changes can be made to the template and saved as a new access level detail.

.4 Provide an access control tree structure that allows groupings of entrances. User shall have the ability to group program all entrances on the branch or make specific changes to individual entrances.

.5 Panel

.1 Provide ability to program Action messages and assign an alarm event priority. A specific action message may be displayed for each alarm, system alarm (communication, ground fault, power, panel reset, low voltage, panel tamper), card, or reader usage state. States shall include but not be limited to: Incorrect Password, Panel Configuration Error, Panel Remote Dial-up Failed, Panel Remote Dial-up Successful, Poll Response Alarm, Poll Response Normal, Primary Power Failure, Primary Power Normal, Tamper Switch Alarm, Tamper Switch Normal, Unsupported Panel Version, Anti-Passback Violation, Anti-Passback Violation Door Not Used, Anti-Passback Violation Door Used, Card Not Found, Door Normal, Door Alarm, Door Trouble, Door Ajar, Door locked, Door Unlocked, Duress Request Denied, Duress Request Door Not Used, Duress Request Door Used, Forced Open, Free Egress Door Not Used, Free Egress Door not Verified, Free Egress Door Used, Host Grant Card Downloaded, Host Grant Door Unlocked, Invalid Format, Invalid Format Reverse Read, Invalid Pin, Invalid Site Code, Invalid Time Zone, Issue Code, Never Allowed at this Door, No Second Card Presented, Site Code Verified Door Not Used, Site Code Verified Door Used Trace Card, Valid Card Door Not Used, Valid Card Door Used.

.2 Provide ability to program descriptions, shunt times, and momentary shunt times for all system alarm points.

.3 Provide ability to program descriptions, pulse times, and energize times for all system output relays used for door control and other auxiliary functions.

.4 Provide ability to program descriptions for all system card readers.

.5 Monitor both supervised and non-supervised alarm points with the ability to select by point which point shall be supervised and define if the point is a normally closed or normally open point contact.

.6 Provide ability to interlock any alarm point condition to an output relay.

.7 Provide ability to interlock any alarm point condition to another alarm point.

.8 Provide ability to interlock any alarm point to switch a camera to a system monitor.

.9 Provide ability to program alarms and associate incoming alarms with related outputs.

.10 Provide a programmable “delay” setting up to 255 seconds for all system alarm points. The system shall not report the alarm condition until the delay setting has expired.

.11 Allow for up to 8 different site codes to be used in the system.

.12 Support up to 16 readers per Intelligent Control Module.

.6 Reports

.1 Provide reporting capability for printing of selected system transactions from the disk files by specific time and date selection, range from time and date to time and date, or from start time to end time each day of the selected date range.

.2 Provide feature to generate a history report for an alarm point(s) state. An alarm point state shall be defined as Normal, Alarm, Trouble, or Ajar.

.3 Provide feature to generate a history report of system alarms. A system alarm state shall be defined by panel and include any of the following information: communication, ground fault, power, panel reset, low voltage, panel tamper, and loop communication.

.4 Provide feature to generate a history report for a card(s) state. A card state shall be defined as Normal, Trace, Not Found, Anti-passback Violation, PIN Violation, Time Zone Violation, Site Code Violation, or Expired card. Additional search criteria shall include cardholders that meet up to at least 3-note field restriction and filter the report with defined reader location(s).

.5 Provide feature to generate a history report for system operator(s) activities. The report shall include time, date, and operator name the device associated with the action the type of action performed by the operator. Activities shall include but not limited to:

.1 acknowledge and clear transactions, camera control, door mode, door and relay control such as unlock, lock; door and input control such as shunt, unshunt; login, logout, panelization, panel buffer and panel unbuffer.

.2 Provide complete database reporting of all data programmed into the system data files.

.6 Tracking/Muster Report

.1 A tracking feature shall allow the system operator to identify an area and the person(s) in that area.

.2 Areas shall be defined by readers representing an IN or OUT read status.

.3 An area defined as an exit shall remove the person from the tracking area.

.4 A Muster area shall be defined by a reader(s) used to “muster: individuals in the event of an emergency.

.5 Reports can be generated for the defined muster or tracking area.

.6 Reports can be generated for all muster or tracking areas in the system.

.7 Tracking areas can include “nested” areas. Nesting allows for various reports from a large area to smaller areas within the large area.

.8 A Tracking and Muster area screen shall be continually updated with the most recent card activity, therefore minimizing the time required generating a report.

.9 A history priming feature shall load history activities for the defined amount of hours when the software is started. This priming feature shall be implemented in the event that the system computer is offline when a muster call is initiated, therefore allowing the implementation of the tracking and muster features of the software. The history priming time shall be operator selectable in 1-hour increments up to 99 hours.

.7 Time Zones

.1 Time zone definitions shall include Starting time, Ending time, Days of the week, and Holiday override.

.2 Time shall be definable in either AM/PM or 24-hour (military) time.

.3 Minimum time zones that can be assigned to a panel shall be 63.

.4 Maximum time zones that can be defined in a system shall be unlimited.

.8 Floor Plan Graphic

.1 Provide the ability to import floor plan graphics stored in a WMF format.

.2 Provide the ability to associate all ADV’s to floor plan graphics allowing the user to control and monitor the system.

.3 Provide the ability to link floor plan graphics together in a hierarchy fashion.

.4 Allow multiple floor plan views to be displayed simultaneously.

2.3 Proximity Reader

.1 Products:

.1 Mullion Mount – HID Signo 20NKS-T0-000000

.2 Single Gang Mount – HID Signo 40NKS-T0-000000

.2 Substitutions:

.1 Mullion Mount – HID Signo 20NKS-T2-000000

.2 Single Gang Mount – HID Signo 40NKS-T2-000000

.3 Mullion Mount – HID RP15 – 910PTNNEK00000

.4 Single Gang Mount – HID RP30 – 920TNNEK00000Signo 40NKS-T0-000000

.5

.3 Supplied by Division 28.

.4 Installed and wired by Division 28

2.4 Proximity Card

.1 Provide three hundred (300) compatible proximity cards.

2.5 Proximity Card Programmer

.1 PC

2.6 Electric Strikes

.1 Products:

.1 Exterior Door – Von Duprin 6 Series

.2 Exterior Door RIM – HES 9600 or HES 9400 as required for low profile applications.

.3 Interior Door – HES 5400 Series Strike

.2 Supplied by Division 28.

.3 Installed and wired by Division 28

2.7 Power Supply

.1 Products:

.1 Altronix eFlow 6N8X – 24VDC, 8 Output.

.2 Altronix eFlow 104N16 – 24VDC, 16 Output.

.2 Substitutions:

.1 Altronix Pre-wired Trove Cabinet, T2M7XK3D only.

.3 Provide dedicated 120VAC 15A/1P circuit c/w lockable disconnect switch within 1m (3') of cabinet.

.4 Power supply wiring to be 18/4 AWG or 18/2 Stranded AWG.

2.8 Request to Exit Detector

.1 Manufacturer: T.Rex

.2 Infrared adjustable detector mounted on wall above door wired to system to detect door-forced-open events.

Part 3 Execution

3.1 Installation

.1 Install to manufacturer's written instructions.

.2 Use 16 AWG minimum size conductors for detection and signal circuit conductors. Install wiring in conduit. Multi-conductor access control cabling to be Honeywell Profusion 3195 FT6 rated or approved equal.

.3 Make conduit and wiring connections to door hardware devices provided under Section 08 71 00.

.4 Label outputs and connected wiring to clearly identify device and location.

.5 Mount access control cabinets no higher than (5’ 10”) to the top of the cabinet.

.6 Install cabinets free and clear of obstructions or impairments to accessing or servicing.

.7 Refer to Client Access Control riser for typical equipment layout.

3.2 System Programming

.1 Database: The contractor shall assist the City in setting up the system database requirements and formats. Forms to be utilized in collecting and entering all data shall be included. Examples of the sequence of completion for all related forms shall be provided. the City shall be responsible for the actual data collection and entry to ensure a complete understanding of the system and its contents.

.2 Programming: The contractor shall initially configure the system in accordance with the design shown in the drawings. All the access control requirements, alarm point definitions, camera/monitor, alarm point call up and in/out relationships, individual component descriptions, and any other programmable parameters required shall be as shown in the appropriate drawings and schedules. The City shall perform any additional programming with the assistance of the contractor.

3.3 Training

.1 The contractor shall supply personnel to create a cadre of key City employees in the operation and maintenance of the installed system. A training program shall be designed to provide a comprehensive understanding and basic level of competence with the system. It shall be sufficiently detailed to allow City personnel to operate the system independent of any outside assistance.

.2 The training plan shall include detailed session outlines and related reference materials. The City personnel shall be able to utilize these materials in the subsequent training of their co-workers.

.3 Training time shall not be less than a total of sixteen (16) hours, and shall consist of:

.1 Two periods: four (4) hours during a 8:00 AM to 4:00 PM period, four (4) hours during a 4:00 PM to 12:00 AM period. Specific schedules shall be established at the convenience of the City.

.2 Four (4) hours of system training shall be provided to City supervisory personnel so that they are familiar with the system operation.

.3 Four (4) hours of system maintenance familiarization training shall be provided to City telecommunications personnel.

.4 The specified training schedule shall be co-ordinated with the City and will follow the training outline submitted by the contractor as part of the submittal process.

3.4 System Testing

.1 System Testing: The contractor shall demonstrate the functionality of the system upon completion of installation, and shall document the result of all tests and provide these results to the City.

3.5 Manufacturer's Field Services

.1 Section 01 75 16 – Start-Up Procedures.

.2 Include services of technician to supervise installation, adjustments, final connections, system testing, and City training.

3.6 Demonstration

.1 Section 01 79 00: Systems demonstrations.

.2 Demonstrate normal and abnormal modes of operation, and required responses to each.

.3 Training: Provide two (2) hours of training to City personnel. Provide sign-off sheet from City personnel to confirm acceptance of training.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Network Video recorder.

.2 Cameras.

.3 Software.

1.2 REFERENCES

.1 Underwriters Laboratories of Canada (ULC)

.1 ULC-S317-1996, Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.

1.3 Related Sections

.1 Section 28 13 28 - Security Access Components.

.2 Section 28 16 00 - Intrusion Detection.

1.4 System Description

.1 Description: Provide network video recorder (NVR) system, video cameras, and video communications between points of surveillance as scheduled and indicated on Drawings.

1.5 Action and Informational Submittals

.1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for video surveillance equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit:

.1 Functional description of equipment.

.2 Technical data sheets of all devices.

.3 Device location plans and cable lists.

.4 Video camera surveillance chart.

.5 Video interconnection detail drawings.

.6 Camera mounting details specific to location.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Manitoba, Canada.

.2 Submit shop drawings to indicate project layout, camera locations, point-to-point diagrams, cable schematics, risers, mounting details and identification labeling scheme

.3 Submit zone layout drawings indicating number and location of zones and areas covered.

.4 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit 1 sample of each camera selected complete with housing, brackets and mounting hardware.

.4 Camera will be returned for incorporation into work as appropriate.

.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.1 Submit UL Product safety Certificates.

.2 Submit verification Certificate that service company is "UL List alarm service company".

.3 Submit verification Certificate that monitoring facility is "UL Listed central station".

.4 Submit verification Certificate that video surveillance system is "Certified alarm system".

.6 Test and Evaluation Reports:

.1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.7 Manufacturer's Instructions: submit manufacturer's installation instructions.

.8 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 Closeout Submittals

.1 Operation and Maintenance Data: submit maintenance data for incorporation into manual specified in Section 01 78 10 – Closeout Submittals. Include following:

.1 System configuration and equipment physical layout.

.2 Functional description of equipment.

.3 Manufacturer's Instructions for operation, adjustment and cleaning.

.4 Illustrations and diagrams to supplement procedures.

1.7 Quality Assurance

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years experience.

.2 Supplier: Authorized distributor of manufacturer with minimum five (5) years' experience.

.3 Installer Qualifications: Contractor shall have been in business for a minimum of five (5) years and have successfully completed one or more projects of scope 50% of the magnitude specified by these documents. Authorized installer of specified manufacturer with service facilities within 160km (100 miles) of the project.

1.8 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect video surveillance materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.9 Warranty

.1 For materials the 12 month warranty period prescribed in subsection GC 32.1 of General Conditions is extended to 60 months.

.2 Extended warranty period must include warranty meeting specified performance requirements, for specified time period.

.3 Manufacturer's Warranty: submit, for Contract Administrator's acceptance, manufacturer's standard warranty document executed by authorized company official.

Part 2 Products

2.1 Design Criteria

.1 Support: camera functions such as pan/tilt and zoom fully supported by Closed Circuit Television (CCTV) system.

.1 Provide operator with ability to control all camera functions.

.2 Alarm point monitoring: system capable, upon alarm recognition, of switching CCTV cameras associated with alarm point.

.3 Switching:

.1 Provision to switch any camera in system to any monitor in system manually or automatically.

.2 Provision to switch system video recorders to selective monitor outputs in system.

.4 Control: provision for any camera equipped with pan, tilt, and/or motorized zoom lens:

.1 Manually control pan, tilt and lens functions.

.2 Set pan and tilt home position.

.3 Set and clear movement limits of pan and tilt mechanism.

.4 Adjust motorized zoom lens.

.5 Enter and edit CCTV programs and save them for future use.

.6 Provide ability to display stored 'video image' of cardholder, and switch real-time camera to card reader location for specific card usage.

.7 Overall control of CCTV provided through software control, which provides complete integration of security components.

.8 Environment: design video components and systems to operate with specified requirements under following ambient temperatures:

.1 Indoor installations:

.1 Temperature: 0 degrees C to 30 degrees C.

.2 Humidity: 10 to 90%.

.2 Outdoor installations:

.1 Temperature: -50 degrees C to 60 degrees C.

.2 Humidity: 10 to 100%.

.9 Manufacturers:

.1 Hanwha.

.2 Substitutions: Refer to Tender No. 543-2022B; Part B – Bidding Procedures.

2.2 Network Video Recorder

.1 Digital Video Recorder: 32 channel digital video recorder c/w PoE, rack mounted.

.2 Products:

.1 XRN-3210RB2

.2 XRN-3210B2

.3 XRN-3210B4

.3 Features

.1 Scheduled backup to NAS

.2 Display: Web 3 users minimum

.3 Compression: H.264/H.265

.4 Bandwidth: 180Mbps

.5 Event Trigger: Alarm, Video loss, Camera event (Sensor, Video analytics), Tampering, Enter/Exit, Passing, Face detection, Audio Detection, Defocus.

.6 Event Action: E-mail, PTZ preset, Alarm out, Buzzer, Monitor out

.7 Digital storage for 30days of continuous recording in 5MP, variable bitrate, and motion activated recording.

.1 Hard drives shall be designed and rated for continuous read-write application.

.8 Remote connection through LAN unity Remote PC Client Application.

2.3 Cameras

.1 C1 - General purpose interior 180/360deg fisheye panoramic video camera with smoked dome housing:

.1 Products:

.1 QNF-9010 12MP Fisheye Panoramic Camera.

.2 C2 - General purpose interior/exterior vandal resistant video camera with smoked dome housing:

.1 Products:

.1 QNV-6082R/R1 2MP Dome Camera.

.2 QNV-8080R 5MP Dome Camera.

.3 C3 – Wet area general purpose indoor/outdoor flat eye camera.

.1 Products:

.1 QNE-8011R 5MP flat eye camera.

.2 QNE-8021R 5MP flat eye camera.

2.4 Cabinets

.1 Products:

.1 Hammond HLP6U31BK.

.2 Tripp-Lite SRWF6U.

2.5 Decoder

.1 Products:

.1 Hanwha SPD-151 48 Channel Decoder.

2.6 Software:

.1 The web viewer shall provide a monitoring screen which displays live camera video and simultaneously provides same-screen access to the following functions:

.1 Live view window size

.2 Resolution setting

.3 Image (snapshot) capture

.4 Manual recording to SD or NAS

.5 Audio/microphone control

.6 Access Playback and Setup menus

.2 The web viewer shall provide a playback screen which provides access to the following functions:

.1 Search date and time range

.2 Search event type

.3 Play an event video

.4 Set resolution

.5 Play audio if present

.6 Generate a backup copy of saved video data

.3 The web viewer shall provide a setup screen which provides access to the following configuration settings and functions in the camera:

.1 Digital video profile to include compression type, maximum or target bit rate, frame rate, multicast parameters, crop encoding area

.2 User profile to include password, access level, authentication

.3 Date and time

.4 Network settings and IP version

.1 DDNS

.2 SSL, including certificate management
.3 802.1x authentication
.4 Quality of Service settings
.5 SNMP to include version selection and settings
.6 Auto configuration

.5 Video setup to include flip and mirror mode, hallway view mode, video type, privacy zone

.6 Audio setup to include source, audio codec type, gain, and bit rate

.7 Camera settings to include image preset, sensor frame capture, dynamic range, white balance, back light, exposure, day/night operation, on-screen display, IR illumination, sharpness, contrast, color level, lens distortion correction.

.8 Event detection setup to include notification parameters, recording rules, time schedule, tamper protection, motion detection, event triggers

.9 System function to include reboot, upgrade, check system and event logs, application (SDK) management

.10 View profile information

.4 Minimum client hardware requirement:

.1 Processor: Intel Core i3, AMD Ryzen 3
.2 Ram: 4GB
.3 OS: Windows 7, 8, 10, Mac OS X 10.8
.4 Display: 1920 x 1080 (32bit)
.5 Web browsers: Internet Explorer, Edge, Firefox, Chrome, Safari

.5 Licensing requirement: included with hardware package.

Part 3 Execution

3.1 Examination

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for video surveillance installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 Installation

.1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheet.

.2 Install cable, boxes, mounting hardware, brackets, video cameras and system components in accordance with manufacturer's written installation instructions.

.3 Install components secure, properly aligned and in locations shown on reviewed shop drawings.

.4 Connect cameras to cabling in accordance with installation instructions.

.5 Install ULC labels where required.

.6 Mount all surface mount devices to a device box, junction box or back box. Conduit entry into camera is not permitted. Conduit back box must be installed.

.7 All flush mounted devices must be installed in a manufacturer's dlush mount enclosure/mount.

.8 Do not mount dome cameras vertically on walls. Vertical wall installation shall include a pendant style mount.

.9 Provide patch panels as required for terminations inside cabinets. Patch panels to be minimum 24 ports.

.10 All communications wiring shall be CAT6 FT6 rated cabling.

.11 Refer to Client Network surveillance riser for typical equipment layout.

3.3 Network Setting

.1 Coordinate network plan with City.

.2 Where IP (Network) type cameras are installed, coordinate network addresses and camera settings with City. Contractor is responsible for configuring camera.

.3 Provide documentation horizontal cabling identifying on which Patch Panel port each camera cable is terminated (e.g. Camera X = port Y).

3.4 Interface With Other Products

.1 Interface installation of closed-circuit television system with security access and intrusion detection systems.

3.5 Field Quality Control

.1 Manufacturer's Field Services:

.1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

.2 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits to review Work at stages listed:

.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

3.6 System Startup

.1 Perform verification inspections and test in the presence of Departmental Representative.

.1 Provide all necessary tools, ladders and equipment.

.2 Ensure appropriate subcontractors , and manufacturer's representatives are present for verification.

.2 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:

.1 Sturdiness of equipment fastening.

.2 Non-existence of installation related damages.

.3 Compliance of device locations with reviewed shop drawings.

.4 Compatibility of equipment installation with physical environment.

.5 Inclusion of all accessories.

.6 Device and cabling identification.

.7 Application and location of ULC approval decals.

.3 Technical verification: purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:

.1 Measurements of tension and power.

.2 Connecting joints and equipment fastening.

.3 Measurements of signals (dB, lux, baud rate, etc).

.4 Compliance with manufacturer's specification, product literature and installation instructions.

.4 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:

.1 Operation of each device individually and within its environment.

.2 Operation of each device in relation with programmable schedule and or/specific functions.

.3 Operation control of camera lens, pan, tilt and zoom.

.4 Switching of camera to any monitor.

.5 Switching of system video recorder to selective monitor.

.6 Set dwell times.

.7 Demonstrate:

.1 Sequence viewing of cameras on each monitor.

.2 Bypass capability.

.3 Display of stored image to cardholder.

3.7 Adjusting

.1 Adjust manual lens irises to meet lighting conditions.

.2 Adjust lens angle and zoom to meet City’s requirements. Review all camera views with City and acquire written signoff.

3.8 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 00 50 - General Instructions.

.1 Clean camera housing, system components and lens, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

.3 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 19 – Construction Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by video surveillance installation.

3.10 Closeout Activities

.1 Demonstration:

.1 Demonstrate system operation and provide two (2) hours of instruction with manufacturer's training personnel.

.2 Conduct walking tour of Project and briefly describe function, operation, and maintenance of each component.

.3 Provide written signoff from City to confirm accepted camera views.

END OF SECTION

Part 1 General

1.1 Section Includes

.1 Fire alarm control panels.

.2 Fire alarm initiating and signaling devices.

.3 Auxiliary fire alarm equipment and wiring.

.4 Modifications to existing system.

1.2 Related Sections

.1 Section 08 71 00 - Door Hardware - General: Door closers, electric locks, electric releases.

.2 Section 08 36 13 - Sectional Doors.

.3 Section 21 12 00 - Standpipe and Fire Hose.

.4 Section 21 13 00 - Sprinklers.

.5 Section 26 05 00 - Common Work Results for Electrical

.6 Section 26 05 19 - Building Wire and Cable.

1.3 References

.1 The latest version of the following including all amendments:

.1 CAN/ULC S524 - Standard for the Installation of Fire Alarm Systems.

.2 CAN/ULC S525 - Audible Signal Devices for Fire Alarm Systems, Including Accessories.

.3 CAN/ULC S526 - Visible Signal Devices for Fire Alarm Systems.

.4 CAN/ULC S527 - Control Units for Fire Alarm Systems

.5 CAN/ULC S528 - Manual Pull Stations for Fire Alarm Systems.

.6 CAN/ULC S529 - Smoke Detectors for Fire Alarm Systems.

.7 CAN/ULC S530 - Heat Actuated Fire Detectors for Fire Alarm Systems.

.8 CAN/ULC S536 - Inspection and Testing of Fire Alarm Systems.

.9 CAN/ULC-S537 - Standard for Verification of Fire Alarm Systems.

.10 CAN/ULC S541 - Speakers for Fire Alarm Systems, Including Accessories.

.11 ULC ORD-C386-1990 - Flame Detectors.

1.4 System Description

.1 Fire Alarm System: Fully supervised, manual and automatic, single stage addressable fire alarm system.

.2 The fire alarm system shall carry out fire alarm and protection functions consisting of receiving alarm signals, initiating alarm and trouble sequences, continuous supervision of fire alarm components and wiring, actuation of annunciators and auxiliary functions and signals to remote monitoring agency.

.3 Fire alarm system shall be modular in design complete with 15% spare capacity to allow for future system expansion

.4 The fire alarm system shall include, but not be limited to the following:

.1 Control panel
.2 Trouble signal devices
.3 Power supplies and booster facilities
.4 Manual alarm stations
.5 Automatic alarm initiating devices
.6 Audible and visual signal devices
.7 End-of-line devices
.8 Annunciators
.9 Ancillary devices
.10 Input and output modules
.11 Isolator modules

1.5 Submittals for Review

.1 Section 01 33 00: Submission procedures.

.2 Product Data: Provide electrical characteristics and connection requirements.

.3 Shop Drawings:

.1 Provide control panel and annunciator layout
.2 Provide system wiring diagram showing each device and wiring connection required.
.1 Wiring diagram shall be specific to the project and shall meet manufacturers recommendations and required building codes and standards.

1.6 Submittals for Information

.1 Section 01 33 00: Submission procedures.

.2 Test Reports: Indicate satisfactory completion of required tests and inspections.

.3 Installation Data: Manufacturer's special installation requirements.

.1 Indicate application conditions and limitations of use stipulated by Product testing agency.
.2 Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products.

1.7 Closeout Submittals

.1 Section 01 78 10: Submission procedures.

.2 Maintenance Contracts: Provide service and maintenance of fire alarm system for one (1) year from Date of Substantial Completion.

.3 Operation Data: Operating instructions.

.4 Maintenance Data: Maintenance and repair procedures.

.5 Record Documentation: Record actual locations of initiating devices, signaling appliances, and end-of-line devices. Include zone number and device number for each device installed. Include circuit number for signalling appliances.

.6 Test reports from CAN/ULC S536 and CAN/ULC-S537 verification testing.

1.8 Maintenance Material Submittals

.1 Section 01 78 10: Maintenance and extra material requirements.

.2 Extra Stock Materials:

.1 Provide six (6) keys of each type.

.2 Provide three (3) of the following devices:

.1 Addressable manual station

.2 Addressable heat detector

.3 Ceiling mounted smoke detector

.4 Ceiling mounted combination smoke detector and fixed temperature heat detector

.5 Ceiling mounted ionization smoke detector

.6 Wall mounted combination horn/strobe, standard cd rating

.3 Provide one (1) duct mounted photoelectric smoke detector.

.4 Provide two (2) addressable multi-criteria fire/CO detector

1.9 Quality Assurance

.1 Design and install fire alarm system to CAN/ULC S524.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum fifteen (15) years documented experience and with service facilities within 160 km (100 miles) of Project.

1.10 Regulatory Requirements

.1 Products Requiring Electrical Connection: Listed and classified by ULC and as suitable for the purpose specified and indicated.

Part 2 Products

2.1 Manufacturers

.1 The fire alarm system as described here-in is based on the Notifier NFS Series fire alarm system. Approved equals are: Simplex Grinnell, Mircom, and Siemens.

.2 Substitutions: Refer to Tender No. 543-2022B; Part B – Bidding Procedures.

2.2 Fire Alarm and Smoke Detection Control Panel

.1 Control Panel: CAN/ULC S527, modular construction with flush or surface wall-mounted enclosure.

.2 Power supply: Adequate to serve control panel modules, door holders, relays, remote detectors, smoke dampers, remote annunciators, and alarm signaling devices. The control unit shall be connected to a supervised, dedicated 120V/15A dedicated circuit complete with a lockable circuit breaker and red

lamacoid using white lettering showing “FIRE ALARM PANEL” affixed adjacent the circuit breaker. Utilize circuit as indicated. Painted circuit breakers are not permitted.

.3 Emergency power supply: Include battery-operated emergency power supply with capacity for operating the entire system in standby mode for twenty-four (24) hours followed by alarm mode for thirty (30) minutes. The emergency power supply shall be supervised for low battery or depleted battery condition, or disconnection of the battery.

.4 System Supervision: Component or power supply failure places system in trouble mode.

.5 Initiating Device Circuits: Supervised zone module with alarm and trouble indication; occurrence of single ground or open condition places circuit in trouble mode, but does not disable that circuit from initiating an alarm.

.6 Indicating Appliance Circuits: Supervised signal module, sufficient for signal devices connected to system; occurrence of single ground or open condition places circuit in trouble mode but does not disable that circuit from signaling an alarm.

.7 Remote Station Signal Transmitter: Electrically supervised alarm communicator transmitter, capable of transmitting alarm and trouble signals to central station receiver. Typical transmitter arrangement to include ALARM, TROUBLE, SUPERVISORY, and CO DETECTION.

.8 Auxiliary Relays: Provide sufficient SPDT auxiliary relay contacts to provide accessory functions specified.

.9 Switches: Provide the following:

.1 Trouble Acknowledge

.2 Test Bell Drill

.3 Public/Common Alarm Silence

.4 Public/Common Visual Alarm Silence

.5 SYSTEM RESET

.10 System Trouble Sequence of Operation: System or circuit trouble places system in trouble mode, which causes the following system operations:

.1 Visual and audible trouble alarm indicated by zone at fire alarm control panel.

.2 Visual and audible trouble alarm indicated by zone at remote annunciator panel.

.3 Trouble signal transmitted to remote station.

.4 Manual acknowledge function at fire alarm control panel silences audible trouble alarm; visual alarm is displayed until initiating failure or circuit trouble is cleared.

.5 Trouble condition on any circuit in system shall not initiate alarm conditions.

.11 System Supervisory Sequence of Operation: Actuation of supervisory device places system in supervisory alarm mode, which causes the following system operations:

.1 Electronic latch will lock-in supervisory mode at fire alarm control panel.

.2 Visual and audible supervisory alarm indicated by zone at fire alarm control panel.

.3 Visual and audible supervisory alarm indicated by zone at remote annunciator panel.

.4 Supervisory signal transmitted to remote station.

.5 Manual acknowledge function at fire alarm control panel silences audible supervisory alarm; visual alarm is displayed until supervised device is cleared.

.6 Supervisory condition on any circuit in system shall not initiate alarm conditions.

.12 Single Stage Alarm Sequence of Operation: Actuation of initiating device places system in alarm mode, which causes the following system operations:

.1 Electronic latch will lock-in alarm mode at fire alarm control panel.

.2 Sound and display local fire alarm signaling devices with signal.

.3 Transmit signal to remote monitoring station equipment.

.4 Indicate location of alarm zone on fire alarm control panel and on remote annunciator panel.

.5 Transmit signals to building elevator control panel(s) to facilitate emergency operation of elevator. Signals shall include General Alarm, Activation of Elevator Lobby Smoke Detector, Activation of Elevator Hoistway Smoke Detector, Activation of Elevator Machine Room Smoke Detector. Recall all elevators to main floor or alternate floors.

.6 Transmit signal to building mechanical systems to initiate shutdown of fans and damper operation. Shut down all make up air units except in corridor servicing residential suites for the purpose of maintain corridor pressurization as per OBC 3.2.6.2.

.7 Transmit signal to release door hold-open devices.

.8 Cause all current troubles on system to be suppressed during course of alarm.

.13 Alarm Reset: System remains in alarm mode until manually reset with key-accessible reset function; system resets only if initiating circuits are out of alarm mode.

.14 Lamp Test: Manual lamp test function causes alarm indication at each zone at fire alarm control panel and at annunciator panel.

.15 Drill Sequence of Operation: Manual drill function causes alarm mode operation as described above.

.16 Zoning: As indicated.

.17 History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

.18 Recording of Events: The system shall be capable of recording all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout shall differentiate alarm signals from all other printed indications.

2.3 Manual Initiating Devices

.1 Single Stage Manual Station: Non-coded type, double action manual station with key-operated reset lock constructed of red-colored polycarbonate. The station shall be designed that after emergency operation they cannot be restored to normal without key.

.1 Addressable manual station shall be complete with loop polling LED (Green), and shall be equal to Notifier NBG-12LX.

.2 Non-Addressable manual station shall be equal to Notifier NBG-12. Non-Addressable stations shall be used in crawlspaces only, or as indicated. Connect to addressable zone module as indicated.

.3 Provide manufacturer's standard backbox for surface applications. Backbox finish to match station finish.

2.4 Automatic Initiating Devices

.1 Heat Detector: Combination rate-of-rise and fixed temperature, rated 57 degrees C (135 degrees F) and temperature rate of rise of 8.3 degrees C (15 degrees F).

.1 Addressable heat detector shall be complete with inter-changeable plug-in base and loop polling LED (Green), and shall be equal to Notifier FST-851A.

.2 Non-Addressable moisture-proof heat detector shall be equal to Mircom CR-135-MP. Non-Addressable, moisture-proof heat detectors shall be used in crawlspaces only, or as indicated. Connect to addressable zone module as indicated.

.2 Ceiling Mounted Smoke Detector: Addressable photoelectric type with adjustable sensitivity with inter-changeable plug-in base and loop polling LED (Green). LED shall provide (Red) visual indication of detector actuation. Provide auxiliary relay contact as indicated. Provide sounder bases as indicated. Smoke detector shall be equal to Notifier FSP-851A.

.3 Ceiling Mounted Combination Smoke Detector and Fixed Temperature Heat Detector: Addressable photoelectric type smoke detector with adjustable sensitivity with inter-changeable plug-in base and loop polling LED (Green). LED shall provide (Red) visual indication of detector actuation. Fixed temperature shall be rated 57 degrees C (135 degrees F). Provide auxiliary relay contact as indicated. Provide sounder bases as indicated. Smoke detector shall be equal to Notifier FSP-851TA.

.4 Duct Mounted Photoelectric Smoke Detector: Addressable photoelectric type with key-operated NORMAL-RESET-TEST switch, duct sampling tubes extending width of duct, and visual indication of detector actuation, in duct-mounted housing. Provide auxiliary relay contact as indicated. Housing shall be complete with tamper signal and shall be suitable to mount on square or rectangular duct. Provide addressable relay. Duct smoke detector shall be equal to Notifier DNR series.

.5 Multi-Criteria Fire/CO Detector: Addressable combination detector combines smoke, CO, light/flame, and heat sensing technology in one device with adjustable sensitivity settings, and loop polling LED (Green). LED shall provide (Red) visual indication of detector actuation. Unit shall be complete with separate CO detection signal, and built-in CO cell end-of-life warning and fault. CO cell

shall be listed for applications in life safety. Provide sounder base for local CO alarm only. Multi-Criteria Fire/CO Detector shall be equal to Notifier FCO-851(A).

.6 Stand-Alone CO Detector: Non-Addressable complete with an audible and visual alarm, test/silence switch, built-in CO cell end-of-life warning and alarm/trouble relay outputs connected to an addressable zone monitor module and supervised power supply from the battery-backed up fire alarm system. The detector shall be suitable for wall or ceiling mounting. CO detector shall be equal to System Sensor CO1224A.

2.5 Monitor Modules

.1 Fully addressable modules to facilitate the monitoring of auxiliary devices intended to be monitored for alarm, supervision and trouble conditions by the fire alarm system using normally open dry contacts.

2.6 Control Modules

.1 Fully addressable modules to facilitate the control of ancillary devices intended to be controlled by the fire alarm system using dry contacts.

2.7 Zone Modules

.1 Fully addressable modules to facilitate connecting conventional non-addressable devices to addressable circuits.

2.8 Fault-isolation Modules

.1 Fully addressable fault-isolation modules on an SLC style device loop to identify wire-to-wire short circuits and to suit CAN/ULC S524 and CAN/ULC S537.

2.9 Signaling Appliances

.1 Alarm Horns and Strobes: The signalling device shall be 2-wire, and shall operate at 24VDC. Horn sound rating shall be rated at a sound level of at least 95dB at 3m (10ft). Horn tones and volume shall be field adjustable by way of integral switch. Strobe candela (cd) rating shall be field adjustable by way of integral switch. Standard strobe cd shall be field adjustable from 15 – 115cd. High cd strobes shall be field adjustable from 135 – 185cd. Provide ceiling or wall mounted, standard or high cd, indoor or outdoor units as indicated. All devices shall be red in color. Alarm horns and strobes shall be equal to Notifier SpectrAlert Advance series.

.2 Interior Remote Annunciator: Provide semi-flush mounted, lockable supervised remote annunciator(s) complete with minimum eighty (80) character backlit LCD display. The annunciator(s) shall display all alarm, trouble and supervisory conditions in the system and will provide an audible indication of the alarm. The annunciator shall include control switches for Trouble Acknowledge, Test Bell Drill, Public/Common Alarm Silence, Public/Common Visual Alarm Silence, SMOKE DETECTOR ZONE BYPASS, SMOKE DUCT DETECTOR BYPASS. and SYSTEM RESET. Include LED's for ALARM, TROUBLE, SUPERVISORY, and CO DETECTION. All annunciator components shall be mounted in a common cabinet enclosure complete with lockable cover. Cabinet shall be modularly sized based on required zones and annunciator components.

2.10 Auxiliary Devices

.1 Door Release: Magnetic door holder with integral diodes to reduce buzzing. Coil voltage 24 VDC.

.2 Door Release: Door closer as specified in Section 08 71 00.

2.11 Remote Signal Power Supplies/Signal Circuit Boosters

.1 Solid state microprocessor based power supply complete with integral transient protection, connected to the local addressable initiating circuit.

.2 Signal circuits shall be supervised using integral addressable output modules.

.3 Power supply shall be 120 VAC input. Interface power supply with battery charger and batteries to provide uninterruptible transfer of power to standby source during primary power failure or loss. Batteries shall be sized to suit ULC requirements.

2.12 End-of-Line Devices

.1 End-of-line devices shall control supervisory current where required, and sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, initiating an alarm or trouble condition.

2.13 Fire Alarm Wire and Cable

.1 Fire Alarm Power Branch Circuits: Building wire as specified in Section 26 05 19.

.2 Initiating Device and Indicating Appliance Circuits:

.1 Description: Type FAS solid conductor, complete with red tinted interlocking armour as required

.2 Conductor: Copper unless otherwise noted.

.3 Insulation Voltage Rating: 300 volts.

.4 Insulation: Coded PVC insulation and with overall red PVC jacket in accordance with the Canadian Electrical Code, rated 105 degrees C. Use shielded cable as per manufacturer’s recommendations only.

.3 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.

.4 To audible signal circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

.5 To visual signal circuits: 12 AWG minimum, and in accordance with manufacturer's requirements.

.6 Wiring shall be as per manufacturer’s recommendations. All wiring shall be in conduit unless noted otherwise. All wiring shall be armoured securex unless noted otherwise.

2.14 Accessories

.1 Manual Station Vandal Guard: Clear vandal resistant, UV Stabilized polycarbonate shield and frame complete with integral 95db piezo horn and battery. Flush mounted or surface as indicated. Outdoor rated as required. Vandal guard shall be equal to STI Stopper II series.

.2 Wire Guard: ULC listed 9 gauge steel wire complete with corrosion resistant polyester coating and tamper resistant hardware where indicated. Wire guard to be suitably sized to accommodate device and/or equipment being protected.

Part 3 Execution

3.1 Installation

.1 Install products to manufacturer's written instructions and CAN/ULC S524, local and national codes, as indicated, and as recommended by the manufacturer.

.2 All initiating and signalling devices, control panels and remote annunciators shall be flush mounted unless indicated otherwise.

.3 Install devices at heights indicated in Section 26 05 00.

.4 Locate detectors minimum 0.45m (18”) from air discharge or return grille as measured from the edge of the detector, and not closer than 300 mm (12”) to lighting fixtures.

.5 Locate ceiling mounted detectors minimum 100mm (4”) from edge of ceiling where it meets the wall as measured from the edge of the detector.

.6 Detectors shall be located such that a clear space of 450mm is maintained between the detector and any obstructions except where ceiling mounted obstructions protrude less than 100 mm (4”) from the ceiling.

.7 In areas without finished ceilings, mount detectors at underside of deck above unless otherwise indicated.

.8 Mount end-of-line devices in separate box adjacent to last device in circuit.

.9 Mount outlet box for electric door holder to withstand 36 kg (80 lbs) pulling force.

.10 Make conduit and wiring connections to duct smoke detectors, sprinkler valve tamper and flow switches, fire suppression system control panels, door release devices, smoke control fans and equipment.

.11 Circuiting for fire alarm devices shall be as follows:

.1 Provide Class “A” addressable initiating/alarm circuits throughout unless indicated otherwise.

.2 Provide Class “B” audible/visual signal circuits for signal circuits throughout unless indicated otherwise.

.3 Provide Class “A” audible/visual signal circuits for residential dwelling unit signal circuits only.

.4 Circuits shall have a minimum 15% spare capacity for future system expansion.

.5 All SLC, signal and power riser wiring shall be supervised, including internal wiring between modules.

.12 Where wiring is required to be surface mounted within finished areas, wiring shall be installed in a single piece metal raceway unless noted otherwise. Color of raceway shall be white unless noted otherwise.

.13 Where devices are surface mounted in finished areas, provide a surface mounted metal raceway device box. Color of box shall match the device.

.14 Where initiating devices are located within an attic space, and crawlspace, non-addressable type devices shall be used, connected to an addressable zone module located outside the attic space and/or crawlspace in an accessible location. Associated EOL's and Modules shall be clearly labelled.

.15 Where attic spaces and crawlspaces are compartmentalized, each compartment shall be wired in such a manner that each compartment is on a separate fire alarm zone. Provide additional zone modules as required.

.16 Branch circuit breakers supplying fire alarm equipment shall be lockable in the "ON" position. A red lamacoid nameplate shall be affixed on the electrical panel adjacent the associated circuit breaker indicating "FIRE ALARM PANEL" or other approved wording.

.17 Programming of room names and numbers shall match City's name and numbering scheme.

3.2 Wiring Methods

.1 Concealed Dry Interior Locations: Use FAS wire in raceway for all main runs. Armoured Securex for individual device drops only.

.2 Exposed Dry Interior Locations: Use only FAS wire in raceway.

.3 Above Accessible Ceilings: Use FAS wire in raceway for all main runs. Armoured Securex for individual device drops only.

.4 Wet or Damp Interior Locations: Use only FAS wire in raceway.

.5 Exterior Locations: Use only FAS wire in raceway.

.6 Underground Installations: Use only FAS wire in raceway.

3.3 Interconnections

.1 Interconnect with all systems and devices as identified on the drawings.

.2 Interconnect with all high volume low speed fans as provided by mechanical to shut down on fire alarm signal.

.3 Interconnect with all electromagnetic locks to release on fire alarm signal. Provide a manual release/reset keyswitch adjacent the fire alarm panel.

.4 Interconnect with automatic door operators (ADO) on fire doors

.1 Where fire doors equipped with power-operators are installed in rated wall assembly partitions, wire and connect the power-operator fire alarm releasing device to the fire alarm system using an addressable relay control module. Power-operator shall release on ALARM event only.

.5 Interconnect with generator to provide notification of generator:

.1 Common warning

.6 Interconnect with transfer switch to provide notification of:

.1 Status.

3.4 Field Quality Control

.1 Section 01 45 00: Field inspection and testing.

.2 Test to CAN/ULC S536 and CAN/ULC-S537 and local inspection authority requirements.

.3 Include services to re-test system one (1) month prior to completion of warranty.

3.5 Manufacturer's Field Services

.1 Section 01 75 16 – Start-Up Procedures.

.2 Include services of certified technician to supervise installation, adjustments, final connections, and system testing.

3.6 Closeout Activities

.1 Demonstration: Demonstrate normal and abnormal modes of operation, and required responses to each.

END OF SECTION