

**SPECIFICATIONS FOR  
INTERIOR RENOVATION OF  
Administration Building- - É.s.p  
Renovation**



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de l'Est de l'Ontario



**Administration Building É.s.p Front End Documents:**

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**END OF SECTION**

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**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 02 81 01 – Hazardous Materials
- .2        Section 02 82 00.01 – Asbestos Abatement – Minimum Risk Precautions
- .3        Section 02 82 00.02 – Asbestos Abatement – Medium Risk Precautions
- .4        Section 13 28 2 – Lead Paint Abatement – Intermediate Precautions

**1.2                WORK COVERED BY CONTRACT DOCUMENTS**

- .1        Work of this Contract includes the renovation of the Administration Building É.s.p, located within the Kemptville College in Kemptville ON.
  - .1        Proposed Project Schedule: August 2021 to December 2021
  - .2        Contractor to coordinate with CEPEO Project Manager to determine project schedule/timeline and to provide adequate notice of Project Phase completion to give tenants sufficient time to relocate as to not disturb the construction schedule.
- .2        Work of this Contract comprises of demolition and construction as required to provide for an air conditioning upgrade at 830 Heritage Drive, Kemptville ON also known as the Administration Building.

**1.3                CONTINUATION OF OPERATIONS**

- .1        Work within the Administration Building É.s.p must not interfere with continued School operations as indicated on the drawings.

**1.4                WORK BY OTHERS**

- .1        Co-operate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.
- .2        Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of Work.

**1.5                WORK SEQUENCE**

- .1        Co-ordinate Progress Schedule and coordinate with Departmental Representative during construction. Refer to 1.2 Work Covered by Contract Documents for proposed project schedule.
- .2        Maintain fire access/control.

**1.6                CONTRACTOR USE OF PREMISES**

- .1        Co-ordinate use of premises under direction of Departmental Representative.
- .2        Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

- .3 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .4 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Departmental Representative.
- .5 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

#### **1.7 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING**

- .1 Protect surrounding private and public property from damage during the performance of the Work.
- .2 Protect building systems, services and equipment.
- .3 Provide temporary dust tight screens, partitions, covers, barricades and/or other protection as required.
- .4 Execute work with least possible interference or disturbance to occupants and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

#### **1.8 EXISTING SERVICES**

- .1 Notify Departmental Representative and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by governing authorities with minimum disturbance to tenant operations.
- .3 Provide alternative routes for pedestrian and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.
- .5 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.
- .7 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

#### **1.9 DOCUMENTS REQUIRED**

- .1 Maintain at job site, one copy each document as follows:
  - .1 Contract Drawings.
  - .2 Specifications.
  - .3 Addenda.
  - .4 Reviewed Shop Drawings.

- .5 List of Outstanding Shop Drawings.
- .6 Change Orders.
- .7 Other Modifications to Contract.
- .8 Field Test Reports.
- .9 Copy of Approved Work Schedule.
- .10 Health and Safety Plan and Other Safety Related Documents.
- .11 Other documents as specified.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not used.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Not Used.

**1.2                REFERENCES**

- .1        Not Used.

**1.3                ADMINISTRATIVE**

- .1        Submit to Consultant submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2        Do not proceed with Work affected by submittal until review is complete.
- .3        Reproductions of drawings prepared by professionals working on the project and submitted as drawings will be refused.
- .4        Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .5        The review of shop drawings by the Consultant is for sole purpose of ascertaining conformance with general concept.
- .6        Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- .7        Review submittals prior to submission to Consultant. 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. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .8        Co-ordinate each submittal with requirements of the Work and the Contract Documents.
- .9        Verify accuracy and completeness of submittals prior to submission.
- .10      Verify field measurements, field construction criteria, catalogue numbers and similar data and affected adjacent Work is co-ordinated.
- .11      Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .12      Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.
- .13      Make changes Consultant deems appropriate to contract documents and resubmit documents and samples as directed by Consultant.
- .14      When resubmitting documents or samples, notify Consultant in writing of revisions other than those requested.
- .15      Keep one reviewed copy of each submission on site.

#### **1.4 SHOP DRAWINGS AND PRODUCT DATA**

- .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 Submit original drawings prepared by Contractor, Subcontractor, Supplier or Distributor illustrating part of work concerned, manufacturing details, layout, installation details and assembly prescribed in associated sections, as well as related elements for the project.
- .3 Identify details using sheet numbers and contract drawing sketches.
- .4 Allow 10 days for Consultant's review of each submission. A copy will be returned to Contractor after verification.
- .5 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .6 Reissue drawings within five (5) days when rejected or identified for resubmittal.
- .7 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work

#### **1.5 PRODUCT DESCRIPTION**

- .1 The above documentation must meet the following requirements for approval:
  - .1 Products meets characteristics specified in contract documents;
  - .2 They must not contain information unrelated to the project;
  - .3 Basic information must be completed by additional project information;
  - .4 Must indicate required dimensions and clearances.

#### **1.6 SAMPLES**

- .1 Samples: materials, quality, finish and installation method.
- .2 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .3 Deliver samples prepaid to Consultant's business address site office.
- .4 Notify Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .5 Where colour, pattern or texture is criterion, submit full range of samples.
- .6 Adjustments made on samples by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .7 Make changes in samples which Consultant may require, consistent with Contract Documents.

- .8 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

## **1.7 MOCK-UPS**

- .1 Samples: work carried out on site using the prescribed materials and installation methods.
- .2 Produce mockups in areas deemed acceptable by Consultant.
- .3 Notify Consultant in writing when product mock-ups are submitted of discrepancies over contract requirements.
- .4 Submit entire range of sample when colour, pattern or texture is required.
- .5 Once verified and approved, mockups will serve as quality standard for the project.

## **1.8 SUBMISSION REQUIREMENTS**

- .1 Accompany submissions with transmittal letter containing:
  - .1 Date of initial submission and date of each subsequent submission if required..
  - .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.
- .2 Submissions include:
  - .1 Date and revision dates.
  - .2 Project title and number.
  - .3 Name and address of:
    - .1 Contractor;
    - .2 Subcontractor;
    - .3 Supplier;
    - .4 Manufacturer;
    - .5 Retailer, if applicable;
  - .4 Identification of product or material;
  - .5 Matching to adjacent work;
  - .6 Dimensions measured on site, clearly identified;
  - .7 Specification section number;
  - .8 Applicable standards, and number;
  - .9 Designation of each drawing, data sheet and test report;
  - .10 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
  - .11 Details of appropriate portions of Work as applicable:
    - .1 Materials and fabrication details;
    - .2 Layout, showing dimensions, including identified field dimensions, and clearances;

- .3 Setting or erection details;
  - .4 Characteristics such as power, speed or capacity;
  - .5 Performance characteristics;
  - .6 Standards;
  - .7 Operating weight;
  - .8 Wiring diagrams;
  - .9 Single line and schematic diagrams;
  - .10 Relationship to adjacent work.
- .3 Submit one electronic copy of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request. If no shop drawing is required due to use of standard manufactured product, submit one electronic copy of data sheets or of manufacturer's documentation as prescribed in technical sections of specification and required by Consultant.
- .4 Submit one electronic copy of test reports for requirements requested in specification Sections and as requested by Consultant.
- .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
  - .2 Testing must have been within 3 years of date of contract award for project.
- .5 Submit one electronic copy of certificates for requirements requested in specification Sections and as requested by Consultant.
- .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
  - .2 Certificates must be dated after award of project contract complete with project name.
- .6 Submit one electronic copy of manufacturer's instructions for requirements requested in specification Sections and as requested by Consultant.
- .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .7 Submit one electronic copy of inspection reports conducted on site by manufacturer, as prescribed in technical sections of specification and required by Consultant.
- .8 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .9 Submit one electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .10 Delete information not applicable to project.
- .11 Supplement standard information to provide details applicable to project.

- .12 Copy of certificates of professional accreditation and certificates of accreditation to environmental awareness course (HRAI card) of all refrigeration specialists and technicians involved.

**1.9 CERTIFICATES AND TRANSCRIPTS**

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.

**1.10 PROJECT RECORD DRAWINGS**

- .1 Record, as the Work progresses, work constructed differently than shown on Contract Documents. Record all changes in the Work caused by site conditions; by Owner, Consultant, Contractor, and Subcontractor originated changes; and by site instructions, supplementary instructions, field orders, change orders, addendums, correspondence, and direction of jurisdictional authorities. Accurately record location of concealed structure, and mechanical and electrical services, piping, valves, conduits, pull boxes, junction boxes and similar work not clearly in view, the position of which is required for maintenance, and alteration work.
- .2 Make records in a neat and legibly printed manner with a non-smudging medium.
- .3 Provide Consultant with accurate red-marked record drawings for their transfer to AutoCAD with application for Certificate of Substantial Performance. Final acceptance of the Work will be predicated on receipt and approval of record drawings.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Not used.

**1.2                REFERENCE STANDARDS**

- .1            Canadian Construction Documents Committee (CCDC)
  - .1            CCDC 2-2008, Stipulated Price Contract.
  - .2            Section 00810 – Supplementary General Conditions

**1.3                INSPECTION**

- .1            Allow Departmental Representative and Consultant access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2            Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
- .3            If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4            Departmental Representative will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

**1.4                INDEPENDENT INSPECTION AGENCIES**

- .1            Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Departmental Representative.
- .2            Provide equipment required for executing inspection and testing by appointed agencies.
- .3            Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4            If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and reinspection.

**1.5                ACCESS TO WORK**

- .1            Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2            Co-operate to provide reasonable facilities for such access.

## **1.6 PROCEDURES**

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

## **1.7 REJECTED WORK**

- .1 Refer to CCDC, GC 2.4.
- .2 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .3 Make good other Contractor's work damaged by such removals or replacements promptly.
- .4 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Departmental Representative.

## **1.8 REPORTS**

- .1 Submit one copy of inspection and test reports to Departmental Representative.
- .2 Provide copies to subcontractor of work being inspected or tested.

## **1.9 TESTS AND MIX DESIGNS**

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Departmental Representative and may be authorized as recoverable.

## **1.10 MOCK-UPS**

- .1 Prepare mock-ups for Work specifically requested in specifications. Include for Work of Sections required to provide mock-ups.
- .2 Locate mock-ups where directed by Consultant.
- .3 Prepare mock-ups for Departmental Representative and Consultant review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mock-ups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

- .5 If requested, Departmental Representative will assist in preparing schedule fixing dates for preparation.
- .6 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed and when.
- .7 Approved mock-ups will establish the minimum acceptable quality of workmanship and will serve as the standard by which subsequent work will be judged acceptable.
- .8 Resubmit mock-ups until approval is given by Consultant. Remove mock-ups that are designated as unsuitable.
- .9 Do not proceed with work until mock-up has been approved. Only work which matches approved mock-up in all respects will be acceptable for Project.

**1.11 MILL TESTS**

- .1 Submit mill test certificates as required of specification Sections.

**1.12 EQUIPMENT AND SYSTEMS**

- .1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems when specified in the specification sections.

**Part 2 Products**

**2.1 NOT USED**

- .1 Not Used.

**Part 3 Execution**

**3.1 NOT USED**

- .1 Not Used.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Not used.

**1.2                REFERENCES**

- .1            Canadian General Standards Board (CGSB)
  - .1            CAN/CGSB 1.189-2000, Exterior Alkyd Primer for Wood.
  - .2            CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
- .2            Canadian Standards Association (CSA International)
  - .1            CSA-A23.1-09/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete
  - .2            CSA-0121-08 (C2013), Douglas Fir Plywood.
  - .3            CAN/CSA-S269.2-87 (C2003), Access Scaffolding for Construction Purposes.
  - .4            CAN/CSA-Z321-F96 (C2006), Signs and Symbols for the Occupational Environment.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1            Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

**1.4                INSTALLATION AND REMOVAL**

- .1            Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, storage, moving path of workers and materials, avenues of ingress/egress to fenced area and details of fence installation.
- .2            Identify areas which have to be gravelled to prevent tracking of mud.
- .3            Indicate use of supplemental or other staging area.
- .4            Provide construction facilities in order to execute work expeditiously.
- .5            Remove from site all such work after use.

**1.5                TRAFFIC FLOW**

- .1            Provide and maintain fire route, access roads, sidewalks and crossings, ramps and construction runways as may be required for access to the work.
- .2            Maintain free access for Owner to service doors and other entrances at all times.
- .3            At conclusion of the work repair and make good damages to existing construction resulting from construction operations.
- .4            Maintain access routes in a clean and orderly condition to the Owner's acceptance. Make good damage due to construction activities.

**1.6 SITE STORAGE/LOADING**

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with weight or force that will endanger Work.

**1.7 CONSTRUCTION PARKING**

- .1 Parking will be permitted on site where indicated by Departmental Representative provided it does not disrupt performance of building's operations.
- .2 Parking outside of identified zone is prohibited.

**1.8 EQUIPMENT, TOOL AND MATERIALS STORAGE**

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

**1.9 CLEAN-UP**

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.
- .3 Store materials resulting from demolition activities that are salvageable.
- .4 Stack stored new or salvaged material not in construction facilities.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Not used.

**1.2                REFERENCES**

- .1            Canadian General Standards Board (CGSB)
  - .1            CGSB 1.59-97, Alkyd Exterior Gloss Enamel.
  - .2            CAN/CGSB 1.189-00, Exterior Alkyd Primer for Wood.
- .2            Canadian Standards Association (CSA International)
  - .1            CSA-O121-M1978(R2003), Douglas Fir Plywood.

**1.3                INSTALLATION AND REMOVAL**

- .1            Provide temporary controls in order to execute Work expeditiously.
- .2            Remove from site all such work after use.

**1.4                HOARDING**

- .1            Erect temporary site enclosure within corridors as indicated on the drawings, to allow normal school operations to proceed during the school year and to close access to all non-authorized people to areas during demolition and construction work.
- .2            Provide adequate signage indicating areas under construction that are closed access to all non-authorized people during demolition and construction work.
- .3            Hoarding to incorporate dust tight screen.

**1.5                GUARD RAILS AND BARRICADES**

- .1            Provide secure, rigid guard rails and barricades around open shafts, open edges of floors and roofs.
- .2            Provide as required by governing authorities

**1.6                WEATHER ENCLOSURES**

- .1            Provide weather tight closures to tops of shafts and other openings in floors and roofs.
- .2            Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3            Design enclosures to withstand wind pressure and snow loading.

**1.7                DUST TIGHT SCREENS**

- .1            Provide dust tight screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2            Maintain and relocate protection until such work is complete.

**1.8 ACCESS TO SITE**

- .1 Set up a safe zone in secured enclosure for storage of materials and waste containers.
- .2 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.
- .3 Submit a plan of the latter to Departmental Representative.
- .4 Once work over, restore Contractor's reserved area to match original condition, including avenues of ingress/egress.

**1.9 FIRE ROUTES**

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.

**1.10 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY**

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

**1.11 PROTECTION OF BUILDING FINISHES**

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Departmental Representative locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Not used.

**1.2                REFERENCES**

- .1            Not used.

**1.3                PROJECT CLEANLINESS**

- .1            Maintain Work in tidy condition, free from accumulation of waste products and debris, including other than that caused by Owner or other Contractors.
- .2            Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
- .3            Clear snow and ice from access to building, bank/pile snow in designated areas only remove from site.
- .4            Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5            Provide on-site containers for collection of waste materials and debris.
- .6            Provide and use marked separate bins for recycling.
- .7            Dispose of waste materials and debris off site.
- .8            Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .9            Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .10           Tight seal all openings of ducts at their installation until authorization to unseal from the Departmental Representative
- .11           Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .12           Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .13           Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

**1.4                FINAL CLEANING**

- .1            When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2            Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris other than including that caused by Owner or other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site, unless approved by Departmental Representative.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Leave roof clean of debris. Leave grounds and building free of debris spread by pedestrian traffic where applicable. Use a magnetic sweeper to sweep the grounds around the building for stray nails, screws and construction debris.
- .9 Remove dust, stains, marks and scratches detected on decorative surfaces, mechanical and electrical devices, furniture elements, walls, floors and ceilings.
- .10 Clean lighting reflectors, lenses, and other lighting surfaces.
- .11 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .12 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .13 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .14 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .15 Remove dirt and other disfiguration from exterior surfaces.
- .16 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .17 Sweep and wash clean paved areas.
- .18 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to building.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1    Section 01 35 29.06 – Health and Safety Requirements
- .2    Section 01 52 00 – Construction Facilities
- .3    Section 01 56 00 – Temporary Barriers and Enclosures
- .4    Section 01 74 11 – Cleaning
- .5    Section 02 81 01 – Hazardous Materials
- .6    Section 02 82 00.01 – Asbestos Abatement – Minimum Risk Precautions
- .7    Section 02 82 00.02 – Asbestos Abatement – Medium Risk Precautions
- .8    Section 13 28 2 – Lead Paint Abatement – Intermediate Precautions
- .9    Section 09 21 99 – Partitions for Minor Works
- .10   Section 09 51 13 – Acoustic Panel Ceilings
- .11   Section 09 91 23 – Interior Painting

**1.2                REFERENCE STANDARDS**

- .1    CSA International
  - .1    CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
- .2    National Research Council Canada (NRC)
  - .1    National Building Code of Canada 2015 (NBC).
  - .2    National Fire Code of Canada 2015 (NFC).
- .3    U.S. Environmental Protection Agency (EPA)/Office of Water
  - .1    EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with 01 33 00 - Submittal Procedures.

**1.4                SITE CONDITIONS**

- .1    Review the following specification sections, written by EXP Services Inc., relating to hazardous materials and take precautions to protect the environment.
  - .1    Section 02 81 01 Hazardous Materials
  - .2    Section 02 82 00.01 Asbestos Abatement – Minimum Risk Precautions
  - .3    Section 02 82 00.02 Asbestos Abatement – Medium Risk Precautions
  - .4    Section 13 82 2 Lead Paint Abatement – Intermediate Precautions

- .2 If material resembling spray or trowel-applied asbestos or other designated substances listed as hazardous be encountered in areas not listed in the attached Designated Substance Survey by EXP Service Inc., dated November 7, 2017, stop work, take preventative measures, and notify Departmental Representative immediately.
  - .1 Proceed only after receipt of written instructions have been received from Departmental Representative.
- .3 Notify Departmental Representative before disrupting building access or services.

## **1.5 SCHEDULE**

- .1 Not used.

## **Part 2 Products**

### **2.1 NOT USED**

- .1 Not used.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Scope of demolition work described on plans is for information only and should not be considered restrictive or limiting. Examine carefully the drawings of all specialties involved in order to measure the exact scope of work.
- .2 Plans should serve as a guide to the Contractor, who has overall responsibility with specialized contractors, to establish the size and scope of the demolition work required to complement and complete the work of the plans.
- .3 Inspect building with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.
- .4 Locate and protect utilities. Preserve active utilities traversing site in operating condition.
- .5 Notify and obtain approval of utility companies before starting demolition.
- .6 Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.
  - .1 Immediately notify Departmental Representative and utility company concerned in case of damage to any utility or service, designated to remain in place.
  - .2 Immediately notify the Departmental Representative should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

### 3.2 PREPARATION

- .1 Protection of In-Place Conditions:
  - .1 Prevent movement, settlement, or damage to adjacent structures, landscaping features, utilities, and parts of building to remain in place. Provide bracing and shoring required.
  - .2 Keep noise, dust, and inconvenience to occupants to minimum.
    - .1 Disconnect and cap ventilation ducts to prevent dust propagation throughout the interior system or other sectors of the building.
  - .3 Protect building systems, services and equipment.
  - .4 Provide temporary dust screens, covers, railings, supports and other protection as required.
  - .5 Protect existing building elements to remain in place and those to be recovered. If existing building elements are damaged, replace or repair immediately to the satisfaction of the Consultant at no cost.
  - .6 Proceed with caution as to not damage the works to be preserved, to minimize the work of subsequent occasions and never leave unprotected building elements.
- .2 Demolition/Removal:
  - .1 Remove items as indicated.
  - .2 Remove parts of existing building to permit new construction.
  - .3 Remove and store materials to be salvaged, in manner to prevent damage.
    - .1 Store and protect in accordance with requirements for maximum preservation of material.
  - .4 Trim edges of partially demolished building elements to tolerances as defined by Consultant to suit future use.
  - .5 Maintain structural integrity of structure.
  - .6 Openings in the exterior walls and roofs will be gradual, so as to be rebuilt on the same day, otherwise, the Contractor shall establish perfect temporary weather tightness. The Contractor shall be responsible for damage due to inadequate protection. Do not undertake this work in rain, snow or cold weather.
  - .7 Contractor shall perform all the required checks as to not cut water supply pipes, gas, electricity, telephone or other similar services.
  - .8 All existing furniture items and equipment to be removed by Departmental Representative.
    - .1 Departmental Representative to inform Contractor if furniture remains in areas of contract work.

### 3.3 HIDDEN OR UNKNOWN CONDITIONS

- .1 The Contractor shall perform all the required checks so as not to cut water supply pipes, gas, electricity, telephone or other similar services. This includes and should not be restrict or limit to consulting:
  - .1 Mechanical, electrical and existing plans, but also the Departmental Representatives's plans;

- .2 Information from maintenance team that have a special knowledge of the area;  
and
- .3 Suppliers or companies, installations owners, if they are aware of the exact  
location of supply conduits.
- .4 Should there be a lack of specific information, Contractor must track the conduits  
with a detector in the affected slabs or walls.

### **3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment  
in accordance with Section 01 74 11 - Cleaning.
- .3 Refer to demolition drawings and specifications for items to be salvaged for reuse.
- .4 Waste Management: separate waste materials for reuse and recycling.
  - .1 Remove recycling containers and bins from site and dispose of materials at  
appropriate facility.
- .5 Restore areas and existing works outside areas of demolition to match condition of  
adjacent, undisturbed areas.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 09 21 99 – Partitions for Minor Works

**1.2                REFERENCE STANDARDS**

- .1            American Society for Testing and Materials (ASTM International)
  - .1            ASTM A123/A123M-15, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .2            ASTM A653/A653M-11, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - .3            ASTM D1761-12, Standard Test Methods for Mechanical Fasteners in Wood.
- .2            CSA International
  - .1            CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
  - .2            CSA O121-08, Douglas Fir Plywood.
  - .3            CSA O141-05(R2009), Softwood Lumber.
  - .4            CSA O153-13, Poplar Plywood.
- .3            National Lumber Grades Authority (NLGA)
  - .1            Standard Grading Rules for Canadian Lumber 2014.

**1.3                QUALITY ASSURANCE**

- .1            Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2            Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.
- .3            All work shall be done by skilled mechanics of the trade in a neat workmanlike manner.

**1.4                DELIVERY, STORAGE AND HANDLING**

- .1            Deliver, store and handle materials in accordance with Section 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 so they do not rest on the floor in a clean, dry, well ventilated location and in accordance with manufacturer's recommendations.
  - .2            Store and protect wood from marks, scratches, and blemishes.
  - .3            Replace defective or damaged materials with new materials.

**Part 2 Products**

**2.1 FRAMING STRUCTURAL AND PANEL MATERIALS**

- .1 Lumber: softwood, S4S finish (bleached on all 4 sides), moisture content 19% (S-dry) or less in accordance with following standards:
  - .1 CAN/CSA O141 - latest edition, and CAN3-086 - latest edition.
  - .2 NLGA Standard Grading Rules for Canadian Lumber - Grade Category as follows:
    - .1 Light framing and blocking: species group spruce - 'Construction' grade.
- .2 Anti-rot treatment, coloured pentachlorophenol base, water repellent wood preservative to CSA 080.
- .3 Hardware: nails, bolts, screws, nuts, washers, lag screws and any other required item, to CSA B111 and ASTM D1761.
  - .1 Galvanized to CSA G164 for exterior work. Use galvanized fasteners where in contact with pressure-treated materials.
  - .2 Fasteners: to hollow masonry use toggle bolts; to solid masonry or concrete use expansion shields, friction fit pins or lag bolts; to steel use self-tapping, power driven screws. Use lead or inorganic fibre plugs with specified screws in concrete or masonry.
- .4 Furring, blocking, nailing strips, grounds, rough bucks, curbs, fascia backing and sleepers:
  - .1 S4S finish.
  - .2 Board sizes: "Standard" or better grade.
  - .3 Dimension sizes: "Standard" light framing or better grade.
- .5 Douglas fir plywood (DFP): for interior use, to CSA O121, standard construction, appropriate thickness, humidity 8%, good both sides for carpentry and interior work. Plywood for indoor use must not contain any added urea-formaldehyde resin.
- .6 Fire Retardant Plywood: to CSA O153-latest edition, Poplar plywood.
  - .1 Pressure treated to improve fire resistance. Treated in a closed cylinder, in accordance with CSA Standard 080-M.I.27 and ULC 102 with a maximum moisture content of 19% after treatment.
  - .2 Plywood panels to have flame spread rating of 25 or less when tested in accordance with ASTM E-84.
  - .3 Labelled by certified test agency such as Underwriters Laboratories of Canada.
- .7 Wood particle board for interior finishing: in accordance with standard NLGA.

**2.2 ACCESSORIES**

- .1 Rough hardware: Nails, bolts, screws, anchors, expansion shields, and other fastenings required to frame and fix rough carpentry as follows:
  - .1 All-purpose glue: complies with CSA standards 0112.9 series.
  - .2 Nails and staples: to CSA B111 and ASTM-D1761.

- .3 Bolts: ASTM A325, 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .4 Screws: Countersunk head, full thread type.
- .5 Patented Attachments: toggle bolts, expandable pads with coach screws, screws with lead sleeves or inorganic fibers, explosive actuated devices recommended by the manufacturer.
- .6 Fasteners for use in pressure treated wood: Provide hot dipped galvanized fasteners complying to ASTM A153 and connectors in accordance with ASTM A653, Class G185 for non-structural members.
- .7 Galvanized Metal: according to ASTM A123 / A123M and ASTM A653 for wood structures.

### **2.3 FINISHES**

- .1 Galvanizing: To CAN/CSA-G164, for galvanized fasteners for exterior work.

### **2.4 WOOD PRESERVATIVE**

- .1 Surface-applied wood preservative: Clear coloured or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product 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 furring and blocking as required to space-out and support other work as required.
- .2 Install members true to line, levels and elevations, square and plumb.
- .3 Construct continuous members from pieces of longest practical length and with square ends.
- .4 Install spanning members with 'crown-edge' up.
- .5 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, and other work as required.
- .6 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

- .7 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized fasteners.
- .8 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .9 Countersink bolts where necessary to provide clearance for other work.
- .10 Install rough carpentry to allow for expansion and contraction of the materials.
- .11 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

**3.3 ASSEMBLY**

- .1 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .2 Countersink bolts where necessary to provide clearance for other work.

**3.4 CLEANING**

- .1 Clean rough carpentry on exposed and semi-exposed surfaces. Touch up factory applied finishes to restore damaged or soiled areas.
- .2 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**3.5 PROTECTION**

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

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1        Section 06 10 00 - Rough Carpentry.
- .2        Section 07 92 00 – Joint Sealants.

**1.2                REFERENCES**

- .1        The Aluminum Association Inc. (AAI)
  - .1        AAI-Aluminum Sheet Metal Work in Building Construction-2002.
  - .2        AAI DAF45-03, Designation System for Aluminum Finishes.
- .2        American Society for Testing and Materials International (ASTM)
  - .1        ASTM A240/A240M-15b, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - .2        ASTM A792/A792M-10(2015), Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
  - .3        ASTM D523-14, Standard Test Method for Specular Gloss.
  - .4        ASTM D822/D822M-13, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .3        Canadian Roofing Contractors Association (CRCA)
  - .1        Roofing Specifications Manual.
- .4        CSA International
  - .1        CSA B111, Wire Nails, Spikes and Staples.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1        Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Product Data:
  - .1        Submit manufacturer's printed product literature for sheet metal flashing systems materials, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3        Shop Drawings:
  - .1        Submit shop drawings in accordance with Section 01 33 00 indicating:
    - .1        Details of miscellaneous flashings.

## **Part 2 Products**

### **2.1 SHEET METAL MATERIALS**

- .1 Aluminum-zinc alloy coated steel sheet: to ASTM A792/A792M, commercial quality, grade AZ180 coating, not chemically treated, for paint finish, 0.65 mm base metal thickness.
- .2 Aluminum sheet: commercial quality, 1.6 mm base metal thickness
- .3 Touch-up paint: Same colour and material as aluminum, as recommended by prefinished coating manufacturer.

### **2.2 PREFINISHED STEEL SHEET**

- .1 Flashing and metallic trim: prefinished steel sheets, coated at the factory with a layer of polyester-modified silicones, a minimum thickness of 0.65 mm unless otherwise stated.
  - .1 Category: F1S
  - .2 Colour: chosen by the Consultant, among the standard colors offered by the manufacturer.
  - .3 Coating thickness: at least 25 micrometers.
  - .4 Resistance to accelerated weathering with a chalk rating of 8, a bleach plus 5 units and an erosion of less than 20%: in accordance with ASTM D822 under the conditions of the following test.
    - .1 Exposure time weathering: 1000 hours.
    - .2 Duration of exposure to moisture: 1000 hours.

### **2.3 PREFINISHED ALUMINUM SHEET**

- .1 Finishing coating: visible surfaces of constituent aluminum elements must be finished in accordance with “Designation System for Aluminum Finishes” published by Aluminum Association.
- .2 Natural anodized finish, Class 1, designation AA-M12C22A41.
- .3 Thickness specified for prefinished aluminum sheet applies to base metal.

### **2.4 ALUMINUM SILL**

- .1 Extruded aluminum, tempered alloy 6063-T5, shaped as indicated in drawings. Depth to ensure projection of at least 30 mm with underlying coating.
- .2 Extruded aluminum anchors and staples devices to be pre-drilled in order to receive fasteners.
- .3 Finish: visible surfaces of constituent aluminum elements must be finished in accordance with “Designation System for Aluminum Finishes” published by Aluminum Association.
  - .1 Natural anodized finish, Class 1, designation AA-M12C22A41.

### **2.5 ACCESSORIES**

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Sealants: refer to 07 92 00 – Joint Sealants.

- .3 Underlay for metal flashing: self-adhesive membrane.
- .4 Cleats: of same material, and temper as sheet metal, minimum 100 mm wide. Thickness same as sheet metal being secured.
- .5 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .6 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

## **2.6 FABRICATION**

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details and as indicated.
- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with AAI-Aluminum Sheet Metal Work in Building Construction.
- .3 Form pieces in 2400 mm maximum lengths.
  - .1 Make allowance for expansion at joints.
- .4 Hem exposed edges on underside 13 mm.
  - .1 Mitre and seal corners with sealant.
- .5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance. Form bends with straight sharp lines, angles and arises.
- .6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

## **2.7 METAL FLASHINGS**

- .1 Form flashings, copings and fascias to profiles indicated, of galvanized prefinished steel, and include staples.

## **2.8 REGLETS AND CAP FLASHINGS**

- .1 Shape metal cap flashing and reglet strips of 0.65 mm thick sheet metal to be built-in work for base flashings as detailed.
  - .1 Provide slotted fixing holes and steel/plastic washer fasteners.

## **2.9 ALUMINUM FINISHES**

- .1 Finish exposed surfaces of aluminum components in accordance with AA DAF45.
- .2 Appearance and properties of anodized finishes designated by Aluminum Association as Architectural Class 1, Architectural Class 2, and Protective and Decorative: to AAMA/WDMA/CSA-101/I.S.2/A440, for coating Classes 1, 2 and 3 respectively.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 INSTALLATION**

- .1 Install sheet metal work as detailed and in accordance with CRCA.
- .2 Install sheet metal to prevent entry of water under service and weather conditions.
- .3 Use concealed fastenings except where approved before installation. Fasten sheet metal, clips and other components in an approved manner, with fasteners weathertight and evenly and neatly located.
- .4 Join sheet metal by slip lock seams to permit thermal movement. Space joints evenly where exposed. Lock seam and solder internal corners.
- .5 Provide underlay under sheet metal.
  - .1 Secure in place and lap joints 100 mm.
- .6 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs.
  - .1 Flash joints using S-lock seams forming tight fit over hook strips, as detailed.
- .7 Lock end joints and caulk with sealant.
- .8 Install surface mounted reglets true and level, and caulk top of reglet with sealant.
- .9 Insert metal flashing into reglets under cap flashing to form weather tight junction.
- .10 Turn top edge of flashing into recessed reglet or mortar joint minimum of 25 mm. Lead wedge flashing securely into joint.
- .11 Caulk flashing at reglet cap flashing with sealant to form weathertight seal between flashing and adjoining surfaces and between flashing and other Work. Tool sealant to concave profile where exposed.
- .12 Install pans, where shown around items projecting through roof membrane.

### **3.3 CLEANING**

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Leave work areas clean, free from grease, finger marks and stains.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1            Section 09 21 99 – Partitions for Minor Works.

**1.2                REFERENCES**

- .1            Underwriter's Laboratories of Canada (ULC)
  - .1            CAN/ULC-S115-11, Fire Tests of Fire stop Systems.
  - .2            CAN/ULC-S101-14, Standard Methods of Fire Endurance Tests of Building Construction and Materials Fifth Edition.
- .1            American Society for Testing and Materials (ASTM International)
  - .1            ASTM C612-14, Isolant thermique de fibre minérale en panneaux.
  - .2            ASTM E119-16, Standard Test Methods for Fire Tests of Building Construction and Materials.
  - .3            ASTM E814-13a, Standard Method of Fire Test of Through-Penetration Fire Stops.

**1.3                DEFINITIONS**

- .1            Work in strict accordance with data from flame resistance testing performed under ASTM E-119 (CAN/ULC-S101) and based on testing by Underwriters' Laboratories (ULC). Comply with municipal and provincial regulations and National Building Code requirements.

**1.4                ACTION AND INFORMATIONAL SUBMITTALS**

- .1            Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2            Product Data:
  - .1            Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3            Certification records
  - .1            Submit certification records to Departmental Representative for verification for each different fire seal situation.
  - .2            Each record must contain all necessary information on completion of sealing, implementation conditions, etc. It must include name of certification body, test number and name of product(s) to be used.

**1.5                DELIVERY, STORAGE AND HANDLING**

- .1            Deliver and store materials in dry place protected from weather, in their sealed container, intact, original, placed above-ground, with manufacturer's label and lead seal intact.
- .2            Do not use materials that have come into contact with water before being used.

## **1.6 TEMPERATURE**

- .1 Temperatures of substrates, materials and ambient air shall be those recommended by manufacturer of product to be used.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Fire stopping and smoke seal systems: in accordance with CAN-ULC-S115.
  - .1 Asbestos-free materials and systems capable of maintaining effective barrier against flame, smoke and gases in compliance with requirements of CAN-ULC-S115 and not to exceed opening sizes for which they are intended and conforming to specified special requirements described in PART 3.
  - .2 Mineral fibre flame-retardant insulation:
    - .1 Rock wool insulation, to CAN4-S115, Type 1, with density of 72 kg/m<sup>3</sup> and compressive strength of 6.9 kPa, compressed to 25% or more, minimum thickness of 89 mm; flame spread 0; smoke developed 0.
    - .2 Anchoring and restraint devices: based on manufacturer's recommendations and compatible with specified assemblies.
  - .3 Elastomeric sealant of modified acrylic latex, fire-resistant:
    - .1 Sealants against fire and smoke, water-soluble, non-toxic, meeting or exceeding requirements of CAN/ULC-S115, CAN/ULC-S1019, ASTM E814 and ASTM E119, to seal apertures around metal ducts, pipes, conduits, wall/ceiling junctions, etc., as indicated.
    - .2 Following variants will be considered:
      - .1 Floor; crossing duct, single or multiple: high-performance intumescent fire-resistant caulking.
      - .2 Masonry wall and drywall; single crossing duct: high-performance intumescent fire-resistant caulking.
      - .3 Masonry wall and drywall; multiple crossing ducts: fire-resistant mortar.
  - .4 Dual-component foam: formulated for complex orifices.
  - .5 Non-flexible mortar: waterproof, made of fibre-reinforced mortar cement foam.
  - .6 Intumescent foam: in form of prefabricated blocks, for complex orifices or those to be reopened in the short term.
  - .7 Intumescent rings: solid intumescent foam and galvanized steel collars.
  - .8 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
  - .9 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
  - .10 Restraining, support, backing and anchoring devices: based on manufacturer's recommendations and compatible with established entities, proven and deemed acceptable by competent authorities.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials.
- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

### **3.2 INSTALLATION**

- .1 Install fire stopping and smoke seal material and components in accordance with manufacturer's certified tested system listing.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

### **3.3 INSPECTION**

- .1 Inspections: before concealing or covering materials or fire-resistant entities, inform Departmental Representative that work is ready for inspection.

### **3.4 SCHEDULE**

- .1 Fire stop and smoke seal at:
  - .1 Penetrations through fire-resistance rated concrete, masonry and gypsum board partitions and walls.
  - .2 Top of fire-resistance rated masonry and gypsum board partitions.
  - .3 Intersection of fire-resistance rated masonry and gypsum board partitions.
  - .4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
  - .5 Penetrations through fire-resistance rated floor slabs, ceilings and roofs
  - .6 Access points and shafts set aside or placed in fire-resistant partitions for later use.
  - .7 Around mechanical and electrical assemblies penetrating fire separations.
  - .8 Rigid ducts: greater than 129 cm<sup>2</sup>: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.

**3.5 CLEANING**

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1     Section 07 62 00 - Sheet metal flashing and trim
- .2     Section 09 21 99 – Partitions for Minor Works.

**1.2                REFERENCES**

- .1     ASTM International
  - .1     ASTM C881/C881M-15, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
  - .2     ASTM C919-12, Standard Practice for Use of Sealants in Acoustical Applications.
  - .3     ASTM C920-14a, Standard Specification for Elastomeric Joint Sealants.
  - .4     ASTM C1135-15, Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants.
  - .5     ASTM C1248-08 (2012), Standard Test Method for Staining of Porous Substrate by Joint Sealants.
  - .6     ASTM D217-10, Standard Test Methods for Cone Penetration of Lubricating Grease.
- .2     Canadian General Standards Board (CGSB)
  - .1     CAN/CGSB-19.13-M87 Sealing Compound, One-component, Elastomeric, Chemical Curing.
  - .2     CAN/CGSB-19.17-M90, One-Component Acrylic Emulsion Base Sealing Compound.
  - .3     CAN/CGSB-19.21-M87, Sealing and Bedding Compound, Acoustical
- .3     Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1     Material Safety Data Sheets (MSDS).

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1     Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2     Product Data:
  - .1     Submit manufacturer's instructions, printed product literature and data sheets for joint sealants and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2     Manufacturer's product to describe:
    - .1     Caulking compound.
    - .2     Primers.
    - .3     Sealing compound, each type, including compatibility when different sealants are in contact with each other.

- .3 Manufacturer's Instructions:
  - .1 Submit instructions to include installation instructions for each product used.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 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 Replace defective or damaged materials with new.

#### **1.5 SITE CONDITIONS**

- .1 Ambient Conditions:
  - .1 Proceed with installation of joint sealants only when:
    - .1 Ambient and substrate temperature conditions are within limits permitted by joint sealant manufacturer or are above 5 degrees C.
    - .2 Joint substrates are dry.
    - .3 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.
- .2 Joint-Width Conditions:
  - .1 Proceed with installation of joint sealants only where joint widths are more than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
  - .1 Proceed with installation of joint sealants only after contaminants capable of interfering with adhesion are removed from joint substrates.

#### **1.6 WARRANTY**

- .1 Contractor warrants that work of this section shall remain free from leaks and from defects in materials and workmanship in accordance with General Conditions, but for a period of 2 years, and agrees to promptly make good any defects which become apparent within warranty period. Defects shall include, but shall not be limited to, sag and failure in adhesion or cohesion.

### **Part 2 Products**

#### **2.1 SEALANT MATERIALS**

- .1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .2 When low toxicity caulks are not possible, confine usage to areas which off gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off gas time.

- .3 Where sealants are qualified with primers use only these primers.
- .4 Sealants and caulking should not contain VOCs exceeding 5% by weight as calculated from description of quantity of constituents used to make product.
- .5 In this section, products and materials with following characteristics will be favoured: water-based, water-cleanable, non-flammable, low VOC content, made without compounds contributing to destruction of ozone layer in upper atmosphere, made without compounds contributing to increased smog in lower atmosphere, without methylene chloride content and without chlorinated hydrocarbon content.
- .6 Provide joint sealants that are compatible with backing material, accessories, substrates and adjacent sealants for the intended uses based on the testing, recommendations, experience and written instructions of the sealant manufacturer.

## 2.2 SEALANTS – DESCRIPTION

- .1 Single-component silicone-based sealant: to CAN/CGSB-19.13.
- .2 Sealant for acoustic insulation: to ASTM C919.
- .3 Preformed backing materials, compressible and non-compressible, as recommended by manufacturer.
  - .1 Polyethylene, urethane, neoprene or vinyl foam units.
    - .1 Extruded cellular foam filling rods.
    - .2 Units oversized by 30% to 50%.
  - .2 Neoprene units.
    - .1 Round and full rods, Shore A hardness of 70.
  - .3 High-density foam units.
    - .1 Extruded cellular PVC foam units of extruded cellular polyethylene foam, Shore A hardness of 20, tensile strength of 140 to 200 kPa; or of extruded polyolefin foam, density of 32 kg/m<sup>3</sup>; or of neoprene, in dimensions recommended by manufacturer.
- .4 Non-bonding tape.
  - .1 Polyethylene tape not adhering to sealant.
- .5 Type 1 product: Low-module silicone base sealant, to ASTM C920 and C1248.
  - .1 Zero flow and subsidence after 20 minutes.
  - .2 Shore A hardness: 15.
  - .3 Tensile strength (ASTM C1135): 0.24 Mpa.
  - .4 Tear strength (ASTM C1135): 0.7 kN/m.
  - .5 Adhesive strength on glass and aluminum: 5.2 kN/m.
  - .6 Joint movement: +100% to -50%.
- .6 Type 2 product: General silicone sealant, to ASTM C920.
  - .1 Zero flow and subsidence after 20 minutes.
  - .2 Shore A hardness: 30.
  - .3 Tensile strength: 1.4 Mpa.

- .4 Elongation: 500%.
- .5 Joint movement: +25%.
- .7 Type 3 product: Silicone latex sealant, to ASTM C834 and CAN/CGSB 19-GP-17M.
  - .1 Zero flow and subsidence after 20 minutes.
  - .2 Loss of adhesions: None.
  - .3 Recovery: 93%.
  - .4 Joint movement: +25%.
- .8 Type 4 product: Multi-component polyurethane sealant, to ASTM C920, Type M, Grade NS, Class 50.
  - .1 Zero flow and subsidence after 20 minutes.
  - .2 Shore A hardness: 35-40.
  - .3 Tensile strength: 0.95 Mpa.
  - .4 Elongation: 398%.
  - .5 Joint movement: +50%.
- .9 Type 5 product: Epoxy gel.
  - .1 Structural epoxy resin paste sealant, dual component, solvent-free, insensitive to moisture. To ASTM C881, Type I, II, IV and V, Grade 3, Class B and C.
- .10 Type 6 product: Soft synthetic rubber acoustic sealant:
  - .1 To CAN/CGSB-19.21 and ASTM D217, non-hardening, non-removable, non-staining and thick.
- .11 Type 7 product: Single-component acetoxysilicone sealant, to ASTM C920, Type S, Grade NS, G, A, O and CAN/CGSB-19.13. Zero flow and subsidence after 20 minutes.
  - .1 Shore A hardness: 30.
  - .2 Tensile strength: 2.06 to 2.75 Mpa.
  - .3 Elongation: 550%.
  - .4 Joint movement: +25%.
  - .5 Colour: translucent.

## **2.3 SEALANTS – LOCATIONS**

- .1 Sealant Type '1'
  - .1 Perimeter of apertures formed in exterior walls with frame contiguous with finishing coat. Colour to match masonry or surrounding surfaces. If not installed in brick veneer, then colour of sealant shall match adjacent wall finish.
  - .2 Junction of wall panels and abutting materials.
- .2 Sealant Type '2'
  - .1 Reserved.
- .3 Sealant Type '3'
  - .1 Inner perimeter of apertures formed in outside walls, based on details in drawings;

- .2 Visible dividing joints formed in drywall partition structures.
- .4 Sealant Type '6'
  - .1 Around drywall panels, against metal frames, in concealed position.
- .5 Sealant Type '7'
  - .1 Reserved.

## **2.4 JOINT CLEANER**

- .1 Non-corrosive and non-staining type, compatible with joint forming materials and sealant in accordance with sealant manufacturer's written recommendations.
- .2 Primer: in accordance with sealant manufacturer's written recommendations.

## **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 joint sealants 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 Departmental Representative.

### **3.2 SURFACE PREPARATION**

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair Work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 Prepare surfaces in accordance with manufacturer's directions.

### **3.3 PRIMING**

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

### **3.4 BACKUP MATERIAL**

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

### **3.5 MIXING**

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

### **3.6 APPLICATION**

- .1 Sealant:
  - .1 Apply sealant in accordance with manufacturer's written instructions.
  - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
  - .3 Where surfaces of adjacent materials are to be painted, do all caulking before these surfaces are painted.
  - .4 Apply sealant in continuous beads.
  - .5 Apply sealant using gun with proper size nozzle.
  - .6 Use sufficient pressure to fill voids and joints solid.
  - .7 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
  - .8 Tool exposed surfaces before skinning begins to give slightly concave shape.
  - .9 Remove masking tape and excess compound promptly as work progresses and upon completion.
- .2 Curing:
  - .1 Cure sealants in accordance with sealant manufacturer's instructions.
  - .2 Do not cover up sealants until proper curing has taken place.

### **3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
  - .2 Clean adjacent surfaces immediately.
  - .3 Remove excess and droppings, using recommended cleaners as work progresses.
  - .4 Remove masking tape after initial set of sealant.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

### **3.8 PROTECTION**

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

**END OF SECTION**

**Part 1            General**

**1.1                RELATED REQUIREMENTS**

- .1    Section 02 41 99 – Demolition for Minor Works
- .2    Section 06 10 00 – Rough Carpentry
- .3    Section 07 84 00 – Fire Stopping
- .4    Section 07 92 00 – Joint Sealants
- .5    Section 09 51 13 – Acoustical Panel Ceilings
- .6    Section 09 91 23 – Interior Painting

**1.2                REFERENCE STANDARDS**

- .1    ASTM International
  - .1    ASTM C1396/C1396M-09a, Standard Specification for Gypsum Wallboard.
  - .2    ASTM C475, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
  - .3    ASTM C514, Standard Specification for Nails for the Application of Gypsum Board.
  - .4    ASTM C645-09a, Standard Specification for Nonstructural Steel Framing Members.
  - .5    ASTM C840, Standard Specification for Application and Finishing of Gypsum Board.
  - .6    ASTM C954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.122 in. (2.84 mm) in Thickness.
  - .7    ASTM C1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
  - .8    ASTM C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
  - .9    ASTM C1178/C1178M-08, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Board.
- .2    South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards
  - .1    SCAQMD Rule 1168-[A2005], Adhesives and Sealants Applications.
- .3    Underwriters' Laboratories of Canada (ULC)
  - .1    CAN/ULC-S102-07, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

**1.3                ACTION AND INFORMATIONAL SUBMITTALS**

- .1    Submit in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum, framing, sealants and include product characteristics, performance criteria, physical size, finish and limitations.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in dry location, indoors, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Handle materials to prevent damage to edges or surfaces. Protect metal accessories and trim from being bent or damaged.
  - .3 Store and protect partition materials from nicks, scratches, and blemishes.
  - .4 Replace defective or damaged materials with new.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Performance / Design Criteria:
  - .1 Partition assembly to be non-combustible construction.
  - .2 Minimum sound transmission class rating of installed panel partition to be STC 45, tested to ASTM E90.
- .2 Non-structural Metal Framing:
  - .1 Non-load bearing channel stud framing: to ASTM C645 and CAN/ULC-S102, 41, 64, 92 and 152 mm stud size as indicated on drawings, roll formed from 0.53, 0.91 and 1.20 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres.
  - .2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 32 mm flange height.
  - .3 Metal channel stiffener: 19 x 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.
- .3 Gypsum Board:
  - .1 Standard board: to ASTM C1396/C1396M, standard or type X, 13mm, 16mm and 19mm thick as indicated on drawings, 1200 mm wide x maximum practical length, ends square cut, edges squared.
  - .2 Glass mat water-resistant gypsum backing board: to ASTM C1178/C1178M treated to resist moisture, 16mm thick, 1200 mm wide x maximum practical length, ends square cut, edges squared.
  - .3 Metal furring runners, hangers, tie wires, inserts, anchors: to CSA A82.30.

- .4 Drywall furring channels: 0.5 mm (26 ga.) core thickness galvanized steel channels for screw attachment of gypsum board.
- .5 Steel drill screws: to ASTM C1002.
- .6 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, zinc-coated by electrolytic process, 0.5 mm (26 ga.) base thickness, perforated flanges, one piece length per location.
- .7 Joint compound: To ASTM C475, asbestos-free.

## **2.2 ACCESSORIES**

- .1 Acoustical insulation: type recommended by manufacturer to achieve STC rating specified.
- .2 Sealants: in accordance with Section 07 92 00 - Joint Sealants.
- .3 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self sticking permanent adhesive on one face, lengths as required.
- .4 Joint filler and priming coat: to ASTM C475, smooth asbestos-free finish, standard white, in accordance with gypsum board manufacturer's recommendations.
- .5 Joint tape.

## **Part 3 Execution**

### **3.1 EXAMINATION**

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions prior to partition installation.
  - .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 ERECTION OF FRAMING**

- .1 Install steel framing members to receive screw-attached gypsum board in accordance with ASTM C754 except where specified otherwise.
- .2 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum.
- .3 Place studs vertically at spacing indicated and maximum of 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .4 Erect metal studding to tolerance of 1:1000.
- .5 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

- .6 Include two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .7 Install heavy gauge single jamb studs at openings.
- .8 Erect track at head of door/window openings and sills of sidelight/window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .9 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .10 Include blocking, 40 mm stud or furring channel secured between studs for attachment of fixtures behind fixtures attached to steel stud partitions.
- .11 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .12 Extend partitions to ceiling height except where indicated.
- .13 Maintain clearance under wood or steel deck to avoid transmission of structural loads to studs. Use deflection track.
- .14 Install continuous insulating strips to isolate studs from uninsulated surfaces.
- .15 Install two continuous beads of acoustical sealant and insulating strip under studs and tracks around perimeter of sound control partitions.

### **3.3 ERECTION OF GYPSUM BOARD AND ACCESSORIES**

- .1 Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.
- .2 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840 except where specified otherwise.
- .3 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.
- .4 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles. Do not apply gypsum board until bucks, anchors, blocking, electrical and mechanical work are approved.
- .5 Install furring channels parallel to, and at exact locations of steel stud partition header track.
- .6 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.
- .7 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.
- .8 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.
- .9 Install acoustical sealant and insulation in sound rated partitions to correspond with tested assembly.

- .10 Install gypsum boards in direction that will minimize number of end-butt joints. Stagger end joints 250 mm minimum.
- .11 Install control joints at steps in walls and bulkheads, at areas of anticipated deflection, twist, creep and sway, and at walls subject to vibration.

### **3.4 APPLICATION**

- .1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.
- .2 Apply single layer gypsum board to metal furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.
- .3 Apply water-resistant gypsum board adjacent to slop sinks, sinks, janitors closets. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads.
- .4 Apply water resistant gypsum board where wall tiles to be applied. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads. Do not apply joint treatment on areas to receive tile finish.

### **3.5 INSTALLATION**

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges.
- .2 Install casing beads around perimeter of suspended ceilings.
- .3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.
- .4 All connections where wallboard butts against a surface having no trim concealing the junctions, require galvanized steel casing beads along their entire length, fastened with screws, to finish edge plumb or level. 401 or similar moldings are not accepted.
- .5 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.
- .6 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.
- .7 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .8 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.
- .9 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .10 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

**3.6 RESURFACING OF PLASTER**

- .1 Following demolition work, in place indicated in drawings, resurface existing plasterwork.
- .2 Use products compatible with and that adhere to existing surfaces.
- .3 Match finished work seamlessly with adjacent surfaces.

**3.7 REPAIR**

- .1 Make good cut-outs for services and other work, fill in defective joints, holes and other depressions with joint compound.
- .2 Make good defective work, and ensure that surfaces are smooth, evenly textured and within specified tolerances to receive finish treatments.

**3.8 CLEANING**

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

**3.9 PROTECTION**

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

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 02 41 99 – Demolition for Minor Works
- .2 Section 09 21 99 – Acoustical Panel Ceilings

**1.2 REFERENCE STANDARDS**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C423-02a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
  - .2 ASTM E1264-98, Standard Classification for Acoustical Ceiling Products.
  - .3 ASTM E1477-98a(2003), Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-92.1-M89, Sound Absorptive Prefabricated Acoustical Units.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .5 Underwriter's Laboratories of Canada (ULC)
  - .1 CAN/ULC-S102-2003, Surface Burning Characteristics of Building Materials and Assemblies.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for ceiling panels and ceiling suspension system and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
  - .2 For special arrangement of frame components, submit plan views of reflected ceiling, as specified.
  - .3 Shop drawings shall clearly indicate arrangement and method of suspending acoustic items near ceilings.
- .4 Submit two (2) 300mm x 300mm samples of acoustical units.

#### **1.4 QUALITY ASSURANCE**

- .1 Regulatory Requirements:
  - .1 Fire-resistance rated floor/ceiling and roof/ceiling assembly: certified by Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Mock-up:
  - .1 Construct mock-up 10 m<sup>2</sup> minimum of fire-rated acoustical panel ceiling assembly including one inside corner.
  - .2 Construct mock-up where directed.
  - .3 Allow 24 hours for inspection of mock-up by Consultant before proceeding with ceiling work.
  - .4 When accepted, mock-up will demonstrate minimum standard for this work.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Protect on site stored or installed absorptive material from moisture damage.
- .2 Store extra materials required for maintenance, where directed by Departmental Representative.
- .3 Waste Management and Disposal:
  - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .2 Handle and dispose of hazardous materials in accordance with Regional and Municipal regulations.

#### **1.6 ENVIRONMENTAL REQUIREMENTS**

- .1 Permit wet work to dry before beginning to install.
- .2 Maintain uniform minimum temperature of 15 degrees C and humidity of 20% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.

#### **1.7 EXTRA MATERIALS**

- .1 Provide acoustical units amounting to 2% of gross ceiling area for each pattern and type required for project.
- .2 Ensure extra materials are from same production run as installed materials.
- .3 Clearly identify each type of acoustic unit, including colour and texture.
- .4 Deliver to Departmental Representative, upon completion of the work of this section.

### **Part 2 Products**

#### **2.1 MATERIALS**

- .1 Acoustic units for suspended ceiling system: to CAN/CGSB-92.1 and ASTM E1264.

- .1 T-bar system to consist of exposed pre-finished satin white baked enameled flanges in 610mm x 1220mm grid pattern approximately 25mm wide (Armstrong or equivalent). Tile shall conform to ASTM C635-69, Heavy-Duty and ASTM C636-69.
  - .1 Basic materials for fabricating frame components: commercial quality cold rolled steel, aluminum sheet.
- .2 Suspension for acoustic panels ACT1:
  - .1 T suspension, exposed 24mm, medium resistance, to ASTM C 635.
  - .2 Material: hot-dipped galvanized steel, commercial grade.
  - .3 Colour: white.
- .3 All hangers and carrying members shall be designed and spaced to adequately support the entire ceiling system, including lighting fixtures, diffusers and air return grills. Provide seismic bracing as required.
- .4 Acoustic tile for T-bar system shall be 610mm x 1220mm x 5/8" thick, non-combustible mineral fibre, white fissured tile.
- .5 ACT2 acoustical panels: [For use in 1 hr ULC R221 assembly]
  - .1 Pattern: medium texture.
  - .2 Flame spread rating: to suit assembly.
  - .3 Smoke developed: to suit assembly.
  - .4 Noise Reduction Coefficient (NRC): 0.70.
  - .5 Light Reflectance (LR): 0.72, to ASTM E1477.
  - .6 Edge: sealed, square.
  - .7 Colour: white.
- .6 ACT1 acoustical panels:
  - .1 Pattern: medium texture.
  - .2 Flame spread rating: to suit assembly.
  - .3 Smoke developed: to suit assembly.
  - .4 Noise Reduction Coefficient (NRC): 0.70.
  - .5 Light Reflectance (LR): 0.72, to ASTM E1477.
  - .6 Edge: sealed, square.
  - .7 Colour: white.
- .2 Adhesive: low VOC type recommended by acoustic unit manufacturer.
- .3 Staples, nails and screws: to CSA B111 non-corrosive finish as recommended by acoustic unit manufacturer.
- .4 Polyethylene: to CAN/CGSB-51.34, 0.15 mm thick.

## 2.2 ACCESSORIES

- .1 Touch-up paint: in accordance with manufacturer's recommendations for surface conditions.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Do not install acoustical panels and tiles until work above ceiling has been inspected by Departmental Representative.

**3.2 INSTALLATION**

- .1 Installation: in accordance with ASTM C636 except where specified otherwise.
- .2 Install acoustical panels and tiles in ceiling suspension system.
- .3 Install fibrous acoustical media and spacers over entire area above light fixtures.
- .4 In fire rated ceiling systems, secure lay-in panels with hold-down clips and protect over light fixtures, diffusers, air return grilles and other appurtenances according to Certification Organizations design requirements.
- .5 Suspension System:
  - .1 Install suspension system to manufacturer's instructions and tested design requirements of certification bodies.
  - .2 Install new frame suspension by making the necessary connections with existing ceilings as indicated on drawings.
  - .3 Do not erect ceiling suspension system until work above ceiling has been inspected and approved by Engineer.
  - .4 Secure hangers to overhead structure using attachment methods acceptable to Departmental Representative.
  - .5 Install hangers spaced at maximum 1000mm centres and within 150mm from ends of main tees.
  - .6 Lay out two perpendicular medians on ceiling to provide balanced borders at room perimeter. Arrange frame with border units not less than 50% of standard unit width.
  - .7 Install spacers for double tees for suspension frame.
  - .8 Install wall moulding to provide correct ceiling height.
  - .9 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers and grilles.
  - .10 Attach cross-frames to load-bearing frames for rigid assembly. Screw clips in place to auxiliary tees and main double tees.
  - .11 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.
  - .12 Finished ceiling system to be square with adjoining walls and level within 1:1000.
- .6 Acoustic Panels:
  - .1 Co-ordinate ceiling work with work of other sections such as light fixtures, diffusers, to be built into acoustical ceiling.

**3.3 APPLICATION**

- .1 Refer to reflected ceiling plan for layout.
- .2 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.

**3.4 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
- .2 Touch up scratches, abrasions, voids and other defects in painted surfaces.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 02 41 99 - Demolition for Minor Works

**1.2 REFERENCE STANDARDS**

- .1 ASTM International
  - .1 ASTM F1066-04(2010)e1, Standard Specification for Vinyl Composition Floor Tile.
  - .2 ASTM F1861-08 (2012) Standard Specification for Resilient Wall Base.
  - .3 ASTM F710-11, Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/ULC-S102.2 Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies
  - .2 CAN/CGSB-25.20-95, Surface Sealer for Floors.
  - .3 CAN/CGSB-25.21-95, Detergent-Resistant Floor Polish.
- .3 South Coast Air Quality Management District (SCAQMD)
  - .1 SCAQMD Rule 1168-A2011, Adhesive and Sealant Applications.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for resilient tile flooring and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
  - .1 Submit two (2) samples, 300mm x 300mm of tile base, nosing and edge strips.

**1.4 LIMITED WARRANTY**

- .1 Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.
- .2 Limited Warranty Period: 5 years and as per manufacturer's written instructions.

**1.5 MAINTENANCE MATERIAL SUBMITTALS**

- .1 Extra Materials:
  - .1 Provide maintenance materials of resilient tile flooring, base and adhesive to Owner. Furnish extra materials from same production run as products installed.

Packaged with protective covering for storage and identified with appropriate labels.

- .1 Quantity: Furnish quantity of flooring units equal to 2 % of amount installed, of each type and colour.
- .2 Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra material.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in a clean, dry, enclosed location, off the ground and in accordance with manufacturer's recommendations in well-ventilated area.
  - .2 Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.
  - .3 Store and protect specified materials from nicks, scratches, and blemishes.
  - .4 Replace defective or damaged materials with new.

## **1.7 SITE CONDITIONS**

- .1 Ambient Conditions:
  - .1 Maintain air temperature and structural base temperature at flooring installation area above 18 degrees C for 48 hours before, during and for 48 hours after installation.
- .2 Install barriers and clear signage at entrances to keep floors free of traffic and no trades permitted during application and curing of floor finish/sealer.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Provide flooring which has been manufactured, fabricated and installed to performance criteria certified by manufacturer without defects, damage or failure.
- .2 Vinyl composition tile: Premium Excelon Chromaspin Vinyl Composite Tile Flooring manufactured by Armstrong Flooring, Inc. or approved equivalent.
  - .1 Description: Tile composed of polyvinyl chloride resin, plasticizers, fillers, stabilizers and pigments with colors and texture dispersed uniformly throughout its entire thickness.
  - .2 Vinyl composition tile shall conform to the requirements of ASTM F 1066, "Standard Specification for Vinyl Composition Floor Tile", Class 2, through-pattern

- .3 Pattern and Color: color selected from the range currently available from Armstrong Flooring, Inc. Refer to finish plans to tile selection.
- .4 Size: 12 in. x 12 in.
- .5 Thickness: 1/8"/0.125 in. (3.2mm)
- .3 Resilient base: to coved, rubber, minimum 2400 mm length, complete with pre-molded end stops and external corners. Colour to be selected by Architect.
  - .1 Type: 1/8"/0.125 in. (3.2mm) thick, 4" (102mm) high Wall Base with a matte finish, conforming to ASTM F 1861, Type TP – Rubber, Thermoplastic, Group 1 – Solid, Style B – cove.
- .4 Primers and adhesives: waterproof, recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade.
- .5 Sub-floor filler and leveller: 2 part latex-type filler requiring no water as recommended by flooring manufacturer for use with their product.
  - .1 Acceptable product: Mapei Planipatch 1 to 3mm thickness or approved equivalent.
- .6 Accessories:
  - .1 For patching, smoothing, and leveling monolithic subfloors (concrete, terrazzo, quarry tile, ceramic tile, and certain metals), provide Cement-Based Patch and Underlayment.
  - .2 For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.
  - .3 Provide transition/reducing strips tapered to meet abutting materials.
    - .1 Transition trims: Metal edge strips: Aluminum extruded, smooth, mill finished stainless steel with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.
  - .4 Provide threshold of thickness and width as shown on the drawings.
  - .5 Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.
  - .6 Metal edge strips: aluminum extruded, smooth, mill finish, with lip to extend under floor finish, shoulder flush with top of adjacent floor finish. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage, or overlap-type metal edge strips for exposed anchorage.
- .7 Sealer: to CAN/CGSB-25.20, Type 2-water based.
  - .1 Sealant:
    - .1 Two (2) coats, Enviro Solutions ES82 Barricade Sealer/Floor Finish.
    - .2 Three (3) coats, Enviro Solutions ES96 High Traffic Floor Finish.
      - .1 High Traffic Floor Areas include Corridors and Classrooms.

**Part 3 Execution**

**3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions, and product carton instructions for installation and maintenance procedures as needed.

**3.2 EXAMINATION**

- .1 Site Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for resilient tile flooring installation in accordance with manufacturer's written instructions.
- .2 Visually inspect flooring materials, adhesives and accessories prior to installation. Flooring material with visual defects shall not be installed and shall not be considered as a legitimate claim.
- .3 Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
- .4 Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
- .5 Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- .6 Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.
- .7 Ensure concrete floors are dry, by using test methods recommended by tile manufacturer.

**3.3 INSPECTION**

- .1 Ensure concrete floors are dry, by using test methods recommended by tile manufacturer.

**3.4 SUB-FLOOR TREATMENT**

- .1 Remove existing resilient flooring. Broadcast sand over fill area to ensure good compatibility with subsequent patch. Provide skim coat by applying Portland cement-type underlayment, as required by tile manufacturer to provide smooth, even finish. Depth of underlayment as per manufacturer's requirements for installation of tile.
- .2 Where existing resilient flooring is removed adjacent to existing floor levels at different elevations, build up subfloor using Portland cement-type underlayment to height of adjacent existing flooring. Sub-floor should be level full extent of room. Smooth sub-floor to leave smooth, flat hard surface.
- .3 Remove or treat old adhesives to prevent residual, old flooring adhesives from bleeding through to new flooring and/or interfering with the bonding of new adhesives. Smooth

concrete surfaces, removing rough areas, projections, ridges and bumps and filling low spots, control or construction joints.

- .4 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler cured and dry. The surface shall be free of dust, solvents, varnish, paint, wax, oil, grease, sealers, release agents, curing compounds, residual adhesive, adhesive removers and other foreign materials that might affect the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below.
- .5 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents. Spray paints, permanent markers and other indelible ink markers must not be used to write on the back of the flooring material or used to mark the concrete slab as they could bleed through, telegraphing up to the surface and permanently staining the flooring material. If these contaminants are present on the substrate they must be mechanically removed prior to the installation of the flooring material.

### **3.5 TILE APPLICATION**

- .1 Provide high ventilation rate, with maximum outside air, during installation, and for 48 to 72 hours after installation. If possible, vent directly to outside. Do not let contaminated air recirculate through district or whole building air distribution system. Maintain extra ventilation for at least one month following building occupation.
- .2 Install flooring in strict accordance with the latest edition of Manufacturer's Installation Systems Manual.
- .3 Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
- .4 Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
- .5 Apply adhesive uniformly using recommended trowel in accordance with flooring manufacturer's instructions. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .6 Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.
- .7 Lay flooring with joints parallel to building lines to produce symmetrical tile pattern. Border tiles minimum half tile width.
- .8 Install flooring to square grid pattern with joints aligned.
- .9 Cut tile and fit neatly around fixed objects.
- .10 Install feature strips and floor markings where indicated. Fit joints tightly.
- .11 Install flooring in pan type floor access covers. Maintain floor pattern.
- .12 Terminate flooring at centerline of door in openings where adjacent floor finish or colour is dissimilar.

- .13 Install metal edge strips at unprotected or exposed edges where flooring terminates.

### **3.6 BASE APPLICATION**

- .1 Lay out base to keep number of joints at minimum. Base joints at maximum length available or at internal or premoulded corners.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.
- .4 Set base against wall and floor surfaces tightly by using 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions or permanent fixtures in areas where top-set base is required. Use premoulded end pieces at flush door frames.
- .7 Cope internal corners. Use premoulded corner units for right angle external corners.
- .8 Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.

### **3.7 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
  - .1 Clean flooring and base surfaces to flooring manufacturer's printed instructions.
- .3 Remove excess adhesive from floor, base and wall surfaces without damage.
- .4 Clean, seal and wax floor and base surface to flooring manufacturer's instructions. In carpeted areas clean, seal and wax base surface before carpet installation.

### **3.8 PROTECTION**

- .1 Protect new floors from after initial waxing, at time of final set of adhesive until final waxing and final inspection.
- .2 Prohibit traffic on floor for 48 hours after installation.
- .3 Prohibit all heavy wheeled traffic on covered floors for 72 hours after floor covering is laid.

**END OF SECTION**

**Part 1 General**

**1.1 SUMMARY**

- .1 Related Requirements
  - .1 Section 07 92 00 – Joint Sealing.
  - .2 Section 09 21 99 – Partitions for Minor Works.
  - .3 Section 09 65 19 – Resilient tile flooring.

**1.2 REFERENCES**

- .1 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33
- .2 Environmental Protection Agency (EPA)
  - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).
- .4 Master Painters Institute (MPI)
  - .1 MPI Architectural Painting Specifications Manual, 2004.
- .5 National Fire Code of Canada - 1995
- .6 Society for Protective Coatings (SSPC)
  - .1 SSPC Painting Manual, Volume Two, 8th Edition, Systems and Specifications Manual.
- .7 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

**1.3 QUALITY ASSURANCE**

- .1 Qualifications:
  - .1 Contractor: minimum of five years proven satisfactory experience. Provide list of last three comparable jobs including, job name and location, specifying authority, and project manager.
  - .2 Journeymen: qualified journeymen who have "Tradesman Qualification Certificate of Proficiency" engaged in painting work.
  - .3 Apprentices: working under direct supervision of qualified tradesperson in accordance with trade regulations.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:

- .1 Submit product data and instructions for each paint and coating product to be used.
- .2 Submit product data for the use and application of paint thinner.
- .3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application and curing.
- .3 Samples:
  - .1 Submit full range colour sample chips to indicate where colour availability is restricted.
  - .2 Submit duplicate 200 x 300 mm sample panels of each paint, stain, clear coating special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:
    - .1 Use sample of each different base material (take minimum thickness prescribed for sample) receiving paint to apply to respective products.
  - .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
- .4 Test reports: submit certified test reports for paint from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
  - .1 Lead, cadmium and chromium: presence of and amounts.
  - .2 Mercury: presence of and amounts.
  - .3 Organochlorines and PCBs: presence of and amounts.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .6 Manufacturer's Instructions:
  - .1 Submit manufacturer's installation application instructions.

## **1.5 MAINTENANCE**

- .1 Extra Materials:
  - .1 Deliver to extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels.
  - .2 Quantity: provide one - one four litre can of each type and colour of primer stain finish coating. Identify colour and paint type in relation to established colour schedule and finish system.
  - .3 Delivery, storage and protection: comply with Departmental Representative requirements for delivery and storage of extra materials.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, Shipping, Handling and Unloading:
  - .1 Pack, ship, handle and unload materials in accordance with manufacturer's written instructions.

- .2 Acceptance at Site:
  - .1 Identify products and materials with labels indicating:
    - .1 Manufacturer's name and address.
    - .2 Type of paint or coating.
    - .3 Compliance with applicable standard.
    - .4 Colour number in accordance with established colour schedule.
- .3 Remove damaged, opened and rejected materials from site.
- .4 Storage and Protection:
  - .1 Provide and maintain dry, temperature controlled, secure storage.
  - .2 Store materials and supplies away from heat generating devices.
  - .3 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.
- .5 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .6 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.
- .7 Remove paint materials from storage only in quantities required for same day use.
- .8 Fire Safety Requirements:
  - .1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
  - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
  - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.
- .9 Waste Management and Disposal:
  - .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
  - .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
  - .3 Separate for reuse recycling and place in designated containers Steel Metal Plastic waste in accordance with Waste Management Plan (WMP).
  - .4 Place materials defined as hazardous or toxic in designated containers.
  - .5 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.
  - .6 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

- .7 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
- .8 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:
  - .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
  - .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
  - .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
  - .4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.
  - .5 Empty paint cans are to be dry prior to disposal or recycling (where available).
- .9 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.
- .10 Set aside and protect surplus and uncontaminated finish materials: Deliver to or arrange collection by employees, individuals, or organizations for verifiable re-use or re-manufacturing.

## **1.7 SITE CONDITIONS**

- .1 Heating, Ventilation and Lighting:
  - .1 Coordinate use of existing ventilation system with Departmental Representative and ensure its operation during and after application of paint as required.
  - .2 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
  - .3 Provide minimum lighting level of 323 Lux on surfaces to be painted.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
  - .1 Unless pre-approved written approval by Specifying body Paint Inspection Agency Authority and product manufacturer, perform no painting when:
    - .1 Ambient air and substrate temperatures are below 10 degrees C.
    - .2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.
    - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
    - .4 The relative humidity is under 85% or when the dew point is more than 3 degrees C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.

- .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
- .6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.
- .2 Perform painting work when maximum moisture content of the substrate is below:
  - .1 Allow new concrete and masonry to cure minimum of 28 days.
  - .2 15% for wood.
  - .3 12% for plaster and gypsum board.
- .3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".
- .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
  - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
  - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
  - .3 Apply paint when previous coat of paint is dry or adequately cured.
- .4 Additional interior application requirements:
  - .1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
  - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Departmental Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Provide paint materials for paint systems from single manufacturer.
- .2 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing.
- .3 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.
- .4 Provide paint products meeting MPI "Environmentally Friendly" E2 ratings based on VOC (EPA Method 24) content levels.
- .5 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:
  - .1 Water-based Water soluble Water clean-up.

- .2 Non-flammable biodegradable.
- .3 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
- .4 Manufactured without compounds which contribute to smog in the lower atmosphere.
- .5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.

## 2.2 COLOURS

- .1 Refer to finish plans for number and location of different colours.
- .2 Selection of colours from manufacturers full range of colours.
- .3 Where specific products are available in restricted range of colours, selection based on limited range.
- .4 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

## 2.3 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from for tinting of painting materials.
- .2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.
- .3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .4 Thin paint for spraying in accordance with paint manufacturer's instructions.
- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

## 2.4 GLOSS/SHEEN RATINGS

- .1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

| Level                             | Gloss @ 60 degrees | Sheen @ 85 degrees |
|-----------------------------------|--------------------|--------------------|
| 1 - Matte Finish                  | Max. 5             | Max. 10            |
| 2 - Velvet-Like Finish            | Max. 10            | 10 to 35           |
| 3 - Eggshell Finish               | 10 to 25           | 10 to 35           |
| 4 - Satin-Like Finish             | 20 to 35           | min.35             |
| 5 - Traditional Semi-Gloss Finish | 35 to 70           |                    |
| 6- Traditional Gloss              | 70 to 85           |                    |
| 8 – High Gloss Finish             | More than 85       |                    |

- .2 Gloss level ratings of painted surfaces as indicated.

## 2.5 INTERIOR PAINTING SYSTEMS

- .1 Concrete masonry units: smooth and split face block and brick:

- .1 INT 4.2A – Latex, satin-like finish.
  - .1 1 coat of primer.
  - .2 2 coats of acrylic latex paint.
- .2 Galvanized metal: doors, frames, railings, misc. steel, pipes, overhead decking, and ducts.
  - .1 INT 5.3N - Institutional low odour/low VOC, satin-like or transparent finish as indicated on plans.
    - .1 2 coats of dual-constituent water-based epoxy, satin-like finish.
- .3 Veneered cabinetwork (factory finished): panels, shelving, millwork.
  - .1 INT 6.4 - Latex clear velvet-like finish (over latex primer).
- .4 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:
  - .1 INT 9.2A – Latex, satin-like finish (over latex sealer), for high traffic:
    - .1 1 coat of latex primer.
    - .2 2 coats of acrylic latex paint, satin-like finish.
  - .2 INT 9.2B High performance architectural latex for washrooms.
    - .1 1 coat of latex primer.
    - .2 2 coats of latex paint, velvet-like finish.
  - .3 INT 9.2M - Institutional low odour/low VOC for office spaces and low traffic zones:
    - .1 1 coat of latex primer.
    - .2 2 coats of latex paint, matte finish for ceilings and velvet-like finish for walls.

### **Part 3 Execution**

#### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

#### **3.2 GENERAL**

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.

#### **3.3 EXAMINATION**

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Departmental Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test".

Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

- .3 Maximum moisture content as follows:
  - .1 Stucco, plaster and gypsum board: 12%.
  - .2 Concrete: 12%.
  - .3 Clay and Concrete Block/Brick: 12%.
  - .4 Wood: 15%.

### **3.4 PREPARATION**

- .1 Protection:
  - .1 Protect existing building surfaces and adjacent structures from paint splatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by Departmental Representative.
  - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
  - .3 Protect factory finished products and equipment.
  - .4 Protect passing pedestrians, building occupants and general public in and about the building.
- .2 Surface Preparation:
  - .1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.
  - .2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
  - .3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of Departmental Representative.
- .3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
  - .1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.
  - .2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
  - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
  - .4 Allow surfaces to drain completely and allow to dry thoroughly.
  - .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
  - .6 Use trigger operated spray nozzles for water hoses.
  - .7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.

- .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
  - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
  - .2 Apply wood filler to nail holes and cracks.
  - .3 Tint filler to match stains for stained woodwork.
- .6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .7 Metal radiators to be sandblasted and finished smooth prior to painting.
- .8 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes blowing with clean dry compressed air vacuum cleaning.
- .9 Touch up of shop primers with primer as specified in relevant section. Major touch-ups, including cleaning and painting field assemblies, welds, rivets, bolts, nuts and washers and rusted surfaces must be done by supplier of products.
- .10 Caulk gaps around doors and windows before painting.
- .11 Masonry surfaces: Clean using solution of 25% bleach and 75% water.
- .12 Ferrous metal surfaces: Manual sanding in accordance with SSPC-SP2 Hand Tool Cleaning. Remove rust or flaking paint.
- .13 Galvanized metal and aluminum surfaces: Clean with solvents in accordance with SSPC-SP1 Solvent Cleaning. Remove any trace of oil, grease, dirt, cutting patterns and compounds and other soluble contaminants from steel surfaces with solvent, steam, alkalis or emulsifiers.

### **3.5 APPLICATION**

- .1 Method of application to be as approved by Departmental Representative. Apply paint by brush roller, or air sprayer airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
  - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
  - .2 Work paint into cracks, crevices and corners.
  - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
  - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
  - .5 Remove runs, sags and brush marks from finished work and repaint.

- .3 Spray application:
  - .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
  - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
  - .3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.
  - .4 Brush out immediately all runs and sags.
  - .5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.
- .4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.
- .5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

### **3.6 MECHANICAL/ELECTRICAL EQUIPMENT**

- .1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.
- .2 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .3 Do not paint over nameplates.
- .4 Do not paint interior transformers and substation equipment.
- .5 Sandblast radiators and make smooth prior to painting.

### **3.7 FIELD QUALITY CONTROL**

- .1 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer shall provide as part of this work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to Departmental Representative.
- .2 Standard of Acceptance:
  - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

- .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
- .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
- .3 Advise Departmental Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .4 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Departmental Representative.

### **3.8 RESTORATION**

- .1 Clean and re-install hardware items removed before undertaking painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Departmental Representative. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

### **3.9 LISTS AND TABLES**

- .1 Finish schedule, construction plans.

**END OF SECTION**

PROJECT N° 211-06664-00

# MECHANICAL SPECIFICATIONS

CONSEIL DES ÉCOLES PUBLIQUES DE L'EST DE L'ONTARIO  
KEMPTVILLE SCHOOL AIRCONDITIONING ADDITION  
ADMINISTRATION BUILDING

ISSUED FOR PERMIT/TENDER  
JUNE 30, 2021



1 **General**

1.1 **DEFINITIONS**

- .1 Priority Two (P2) Buildings are buildings in which life safety is paramount concern. It is not necessary that P2 buildings remain operative during or after an earthquake.
- .2 SRS: acronym for Seismic Restraint System.

1.2 **LIMITATIONS**

- .1 One trade to be responsible for the design, supply and installation of all seismic restraint systems for all mechanical systems and equipment installed under the Division 21 Contract.

1.3 **GENERAL DESCRIPTION**

- .1 This section covers design, supply and installation of complete SRS for all mechanical systems, equipment specified for installation on this project. This includes both static and dynamic components.
- .2 It is the responsibility of the Mechanical Contractor to engage the services of an experienced SRS Engineer who is an active member of the Professional Engineers of Ontario, and the costs for these services shall be included in the Contract amount.
- .3 The SRS Engineer shall design restraining systems, provide shop drawings for review, and provide inspection services during and after construction.
- .4 The building is defined as a Priority Two (P2), in which life safety is the first priority.
- .5 SRS to be fully integrated into, and compatible with the noise and vibration controls specified elsewhere in this project specification.
- .6 The systems and equipment are not required to be operational during and after a seismic event.
- .7 During seismic event, SRS to prevent systems and equipment from causing personal injury or from moving from normal position.

1.4 **RELATED SECTIONS**

- .1 21 05 01 – Mechanical General Provisions.

1.5 **REFERENCES**

- .1 Canadian Standards Association (CSA):
  - .1 CAN/CSA G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 American National Standards Institute (ANSI):
  - .1 ANSI/NFPA 13 (2019) – Installation of Sprinkler Systems.

1.6 **SUBMITTALS**

- .1 Submit shop drawings and product data in accordance with Section 21 05 01 Common work results for mechanical.
- .2 Submittals to include:
  - .1 Full details of design criteria.
  - .2 Working drawings (prepared to same standard of quality and size as documents forming these tender documents), materials lists, schematics full specifications for all components of each SRS to be provided.
  - .3 Design calculations (including restraint loads resulting from seismic forces in accordance with National Building Code, detailed work sheets, tables).
  - .4 Separate shop drawings for each SRS and devices for each system, equipment.
  - .5 Identification of location of each device.
  - .6 Schedules of types of SRS equipment and devices.
  - .7 Details of fasteners and attachments to structure, anchorage loadings, attachment methods.
  - .8 Installation procedures and instructions.
  - .9 Design calculations including restraint loads to be to NBCC and Supplement.
  - .10 Detailed work sheets, tables.
  - .11 Detailed design of SRS including complete working drawings [prepared to same standard of quality and size as Contract Documents], materials lists, design calculations, schematics, specifications.
- .3 Submit one additional copy of shop drawings and product data to Structural Engineer for review of connection points to building structure.
- .4 The SRS are to be inspected and certified by the Seismic Engineer upon completion of the installation, and a written report with certification of compliance submitted to the Engineer.

1.7 **MAINTENANCE DATA**

- .1 Provide maintenance data including monitoring requirements for incorporation into manual specified in Section 21 05 01.

2 **Products**

2.1 **SRS MANUFACTURER**

- .1 SRS to be provided by one manufacturer regularly engaged in the production of SRS.
- .2 Acceptable manufacturers:
  - .1 Korfund.
  - .2 Mason.
  - .3 Vibro-Acoustics.
  - .4 Vibron.

2.2 **GENERAL**

- .1 SRS to provide gentle and steady cushioning action and avoid high impact loads.
- .2 SRS to restrain seismic forces in all directions.

- .3 Fasteners and attachment points to resist same load as seismic restraints.
- .4 SRS of Piping systems to be compatible with expansion, anchoring and guiding requirements and equipment vibration isolation and equipment SRS.
- .5 SRS utilizing cast iron, threaded pipe and other brittle materials not permitted.
- .6 Use high strength mechanical expansion anchors for attachment to concrete structure. Drilled or power driven anchors not permitted.
- .7 Seismic control measures are not to interfere with integrity of firestopping.

**2.3 SRS FOR STATIC EQUIPMENT, SYSTEMS**

- .1 Floor-mounted equipment, systems:
  - .1 Anchor equipment to equipment supports.
  - .2 Anchor equipment supports to structure.
  - .3 Use size of bolts as indicated in approved shop drawings.
- .2 Suspended equipment, systems:
  - .1 Use one or combination of following methods:
    - .1 Install tight to structure.
    - .2 Cross-brace in all directions.
    - .3 Brace back to structure.
    - .4 Slack cable restraint system.
  - .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, and sliding and buckling in axial direction.
  - .3 Hanger rods to withstand compressive loading and buckling.

**2.4 SRS FOR VIBRATION ISOLATED EQUIPMENT**

- .1 Floor-mounted equipment, systems:
  - .1 Use one or combination of following methods:
    - .1 Vibration isolators with built-in snubbers.
    - .2 Vibration isolators and separate snubbers.
    - .3 Built-up snubber system approved by Engineer, consisting of structural elements and elastomeric layer.
  - .2 SRS to resist complete isolator unloading.
  - .3 SRS not to jeopardize noise and vibration isolation systems. Provide 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.
  - .4 Cushioning action to be gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.
- .2 Suspended equipment and systems:
  - .1 Use one or combination of following methods:
    - .1 Slack cable restraint system.
    - .2 Brace back to structure via vibration isolators and snubbers.

**2.5 SLACK CABLE RESTRAINT SYSTEM (SCS)**

- .1 Use elastomer materials or similar to avoid high impact loads and provide gentle and steady cushioning action.
- .2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.
- .3 Hanger rods to withstand compressive loading and buckling.

**2.6 SERVICE UTILITIES ENTRANCE INTO BUILDING**

- .1 Provide sufficient flexibility to prevent breakage in the event of an earthquake.

**3 Execution**

**3.1 INSTALLATION**

- .1 Provide attachment points and fasteners to withstand the maximum load that the seismic restraint is to resist in all directions.
- .2 Slack Cable Systems (SCS):
  - .1 Connect to suspended equipment so that axial projection of wire passes through centre of gravity of equipment.
  - .2 Use appropriate grommets, shackles, and other hardware to ensure alignment of restraints and to avoid bending of cables at connection points.
  - .3 Provide transverse SCS at 10 m spacing maximum on piping systems, with longitudinal SCS at 20 m maximum or as limited by anchor/slack cable performance.
  - .4 Small pipes may be rigidly secured to larger pipes for restraint purposes, but not the reverse.
  - .5 Arrange restraint wires on ceiling hung equipment at approximately 90° to each other (in plan), tie back to structure at maximum angle of 45° to structure.
  - .6 Adjust restraint cables so that they are not visibly slack, but permit vibration isolation system to function normally.
  - .7 Tighten cable to reduce slack to 1½" (40 mm) under thumb pressure. Cables shall not support weight during normal operation.
- .3 Install SRS at least 1" (25 mm) from all other equipment, systems, and services.
- .4 Bolt miscellaneous equipment that is not vibration-isolated, through house-keeping pad to structure.
- .5 Co-ordinate connections with all disciplines.
- .6 Anchor vertical tanks through house-keeping pad to structure and provide steel bands above centre of gravity.
- .7 Provide at least two (2) straps with anchor bolts fastened to structure for horizontal tanks:

**3.2 INSPECTION AND CERTIFICATION**

- .1 SRS to be inspected and certified by Seismic Engineer upon completion of installation.
- .2 Provide written report to Engineer with certificate of compliance.

**3.3 COMMISSIONING DOCUMENTATION**

- .1 Upon completion and acceptance of certification, hand one (1) complete set of construction documents to Engineer revised to show "as-built" conditions.

**END OF SECTION**

**1.1 GENERAL**

- .1 Apply Section 15010 to the work of all Sections of Division 15.

**1.2 REGULATIONS AND PERMITS**

- .1 Comply with most stringent requirements of the Ontario Building Code, Federal, Provincial and Municipal regulations and by-laws, specified standards, codes, and this specification.
- .2 Furnish inspection certificates prior to final payment to show that the installed work conforms with the drawings and specifications and to laws and regulations of all Authorities having jurisdiction.
- .3 Obtain and pay for all permits and inspections required by Authorities having jurisdiction for all aspects of work of Division 15.

**1.3 RELATED SECTIONS**

- .1 Division 22, 23, 25, 26 and 28
- .2 23 09 00 – Heating
- .3 23 05 93 – Testing, Balancing and Commissioning
- .4 25 05 01 – EMCS: General Requirements
- .5 Division 26

**1.4 REFERENCES**

- .1 Systems and installation must comply with the latest editions and all amendments of the following codes and standards and those listed in each section. Where conflicts in requirements occur, the higher standards shall apply.
  - .1 ASHRAE Standards
  - .2 American National Standards Institute (ANSI):
    - .1 ANSI B31.1-2010, Power Piping.
    - .2 ANSI/MSS SP-58-2009, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
    - .3 ANSI/MSS SP-69-2010, Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
  - .3 Canadian General Standards Board (CGSB):
    - .1 CGSB 19-GP-5M, Sealing Compound, one Component, Acrylic Base, Solvent Cure
    - .2 CAN/CGSB 24.3-92, Identification of Piping Systems
  - .4 Canadian Standards Association (CSA):
    - .1 CSA Z85-83, Abbreviations for Scientific And Engineering Terms.
  - .5 The Ontario Building Code
  - .6 All governing Municipal requirements
  - .7 Ontario Plumbing Code Part 7
  - .8 Sections 41 and 42 regarding provision of sewers and water mains, Ontario Regulation 54/76 of the Ontario Water Resources Act

- .9 Underwriters Laboratories of Canada (ULC):
  - .1 UL 2225-2011, Cables and Cable-Fittings For Use In Hazardous (Classified) Locations.
- .10 CSA B149-2015 and applicable TSSA adoption revisions and requirements.
- .11 All items mentioned in this Section of the Specifications.

**1.5 ABBREVIATIONS**

- .1 Abbreviations used on the drawings and in the specifications include the following:
  - .1 bd balancing damper.
  - .2 bdd backdraft damper.
  - .3 bgc by general contractor.
  - .4 co cleanout.
  - .5 fd fire damper.
  - .6 f.dr floor drain
  - .7 g.s.s galvanized sheet steel.
  - .8 nc normally closed.
  - .9 no normally open.
  - .10 os&y outside screw and yoke.
  - .11 prv pressure reducing valve.
  - .12 rh relative humidity.
  - .13 rwl rainwater leader.
  - .14 sp static pressure.
  - .15 ss stainless steel.
  - .16 wb wet bulb temperature.
- .2 Other abbreviations shall be as defined in the CSA Z85 Standard, or as defined in technical literature of the trade or technique concerned.

**1.6 WORK SCHEDULE**

- .1 Review starting dates, milestone dates, and completion dates of all aspects of the Work Schedule and confirm that these dates can be met. The absence of comments will be construed as agreement and ability to meet the schedule dates.
- .2 Interim reviews of the project schedule will be made as work progresses and the schedule will be updated where necessary by the General Contractor in conjunction with the Owner and/or Architect.

**1.7 EXAMINATION OF SITE**

- .1 Examine access to project site, to the building, and all conditions affecting the execution of this Contract.
- .2 Failure to examine site conditions will not justify cost increases or extension of the project schedule.
- .3 Present to the Architect in writing any anticipated problems at least nine (9) days prior to tender closing, otherwise no extra costs or extension of the tendering period will be granted.

**1.8 DESIGN DOCUMENTS**

- .1 The design drawings are partly diagrammatic, intended to convey the scope of work and indicate the general arrangement of systems. Off-sets in piping and ductwork may not be indicated in all cases, but are to be included in Contract as required.
- .2 The drawings are not intended to show Structural details or Architectural features. Refer to Architectural and Structural drawings.
- .3 Do not determine locations of equipment and materials by measurement from the drawings.
- .4 Verify that there will be no obstructions or interferences caused by the work of other Divisions or existing systems in advance of commencing work.
- .5 All Sections to coordinate their work with the work of other Sections and other Divisions. This applies particularly to service shafts and ceiling spaces.

**1.9 OMISSIONS AND DISCREPANCIES**

- .1 The drawings and specifications are intended to describe complete working systems including all necessary labour and materials.
- .2 Bring obvious discrepancies or omissions to the attention of the Architect during the Tender Period, at least nine (9) working days prior to Tender Closing. Questions presented after this time cannot be answered during the Tender Period.

**1.10 SHOP DRAWINGS**

- .1 Refer to Section 01005 – General Work, for shop drawing requirements.
- .2 Submit shop drawings for all new equipment and materials, including the following:
  - .1 Valves (control, isolation, check, etc.).
  - .2 Heating coils.
  - .3 Controls (Stand Alone) and relays.
  - .4 Grilles/diffusers.
  - .5 Louvres.
  - .6 Duct accessories (sealants, balancing dampers, fire dampers, back draft dampers, etc).
  - .7 Energy Recovery Ventilator.
- .3 All shop drawings shall be submitted complete with wiring diagrams and control contact diagrams, where applicable.

**1.11 SAMPLES**

- .1 Provide samples of special products, assemblies or components when so specified in individual work sections. Include for costs of such samples in the Contract Price, unless samples are to be returned to the contractor for installation.
- .2 Label samples as to origin and intended use in Work.
- .3 Do not order materials until approval of samples is obtained. Notwithstanding such approval, ensure that such materials conform to requirements of Contract Documents.

**1.12 RECORD DRAWINGS**

- .1 Retain on site one (1) set of working drawings solely for recording variations and additions to the original layouts. Record such changes as work progresses, on a weekly basis. Make drawings available for Engineer's review at any time during the project.
- .2 Submit completed record drawings to the Engineer prior to starting testing, adjusting, and balancing procedures, for approval, and make corrections as directed.
- .3 This set of drawings will form the Owner's records and must be accurate in terms of all services including locations for hidden or buried services, etc. Record drawings shall indicate depth (inverts) of all buried services and elevations to underside of all above floor services. Provide dimensions of all buried services to nearest column lines.
- .4 Submit completed reproducible record drawings with the Operating and Maintenance Manuals, and in the final TAB report.

**1.13 TESTING**

- .1 Pressure-test all new systems to Code.

**1.14 PROGRESS DRAW FORMS**

- .1 Immediately after Award, submit a proposed progress draw form to the Engineer for approval. The form should indicate the contract breakdown, showing material and labour components for all categories and sections of the mechanical contract. This format, once agreed, shall be used for all monthly progress draw applications.

**1.15 APPROVAL OF ALTERNATIVES**

- .1 Manufacturers' names and model numbers of equipment listed below to be considered acceptable:
  - .1 Grilles & Diffusers: Nailor Industries, Titus, E.H. Price, Carnes, Kreuger.
  - .2 Louvres: Ventex, Nailor Industries, Titus, Construction Specialties, Ruskin.
  - .3 Energy Recovery Ventilator: Aldes, VanEE, Venmar.
- .2 Propose alternative manufacturers at least nine (9) working days prior to tender closing.
- .3 Manufacturers, their agents, or contractors wishing alternative products to be considered for acceptance shall submit written applications to the Engineer. The applications shall include the manufacturer's data concerning product involved. In order to receive consideration, such applications must be received at least nine (9) working days prior to Tender Closing date. Approval of alternative products will be indicated in an appropriate Addendum.
- .4 Acceptance of alternatives does not absolve the mechanical contractor from making all necessary adjustments to the work of other trades incurred by selection of alternative equipment or materials. Division 15 to bear all costs incurred by the selection of alternative materials.

**1.16 TEMPORARY LIGHTING, POWER AND WATER SERVICE**

- .1 Temporary lighting, temporary power, temporary water service not by Division 15. The general contractor shall co-ordinate and carry the cost.

- .2 Extension cords and other sources of power, required for work by Division 15 must be obtained and paid for by Division 15.
- .3 Hoses for extension of service, required for work by Division 15, are to be provided by Division 15.

**1.17 TEMPORARY HEAT**

- .1 Temporary heat will not be provided by Division 15. The General Contractor shall coordinate and carry the cost.

**2 Products**

**2.1 MATERIALS**

- .1 Submit a complete list of equipment and materials intended for use on this project at time of tender. Include manufacturers' names, model numbers and details of materials.
- .2 Materials and equipment to be new, unless otherwise indicated, and free from blemishes, oxidation, damage, etc. New materials and equipment to be of proven design and quality, and for which replacement parts are readily available. Use current models of equipment, for which published ratings are available.
- .3 Materials used for similar purposes and functions shall be the product of one manufacturer unless specified otherwise.
- .4 Comply with manufacturers' latest printed instructions, unless stated otherwise.

**2.2 ACCESSORIES**

- .1 Provide equipment supports, fabricated bases, brackets, cleats, connectors, sealants, lubricants, cleaners, protection, etc., whether specified or not, so that the Work is complete and will perform as required by the Contract.

**2.3 PIPE MATERIAL SCHEDULE**

| <b>Service</b>                                   | <b>Pipe</b>          | <b>Joint</b> | <b>Fitting</b>  | <b>Pr. Rating</b>     |
|--|----------------------|--------------|-----------------|-----------------------|
| Hot Water Heating<br>¾" (20 mm) to<br>2" (50 mm) | Schedule 40<br>Steel | Screwed      | Malleable Steel | 150 psi<br>(1035 kPa) |
| Hot Water Heating<br>2½" (65 mm) and<br>larger   | Schedule 40<br>Steel | Welded       | Flanged         | 150 psi<br>(1035 kPa) |

- .1 Non-compliance with the lead free solder requirements of this project will result in the removal, replacement and re-testing of all fittings.

**2.4 PIPING ACCESSORIES**

- .1 Strainers:
  - .1 50 mm and smaller, with iron body, (bronze for domestic water service), screwed connections, Y-pattern, 1380 kPa WOG and 20-mesh 304 stainless steel screen.
  - .1 Crane 9882, Sarco YS, Leitch BE, Streamflo T-250.

- .2 65 mm and larger with iron body, (bronze for domestic water service), flanged connections, Y-pattern, 1380 kPa WOG and 20-mesh Monel or stainless steel screen.
  - .1 Crane 9892, Sarco YF, Streamflo F-250.
- .3 Provide strainers on upstream of the control valves, and where indicated.

## 2.5 PIPE HANGERS AND SUPPORTS

- .1 Fabricate hanger, supports and sway braces in accordance with ANSI B31.1, and with requirements of ULC 2225 (Volume 1-General). All hangers and supports will be seismic rated.
- .2 Support hangers from structural members. Provide supplementary structural members where required. Do not suspend hangers from metal decks, ductwork, conduit or other pipes. Anchor piping and equipment in accordance with manufacturer's recommendations.
- .3 Use split adjustable steel ring hanger on all sizes of piping.
- .4 Use 10 mm rod diameters, spaced at 2.1 m.
- .5 On uninsulated copper piping provide isolation between copper and ferrous hanger by means of tapes or felts, to the approval of the Engineer.
- .6 Provide rigid insulation saddles for insulated pipe.
- .7 Perforated band iron/copper strapping will not be accepted.
- .8 Provide manufactured pipes shields to protect pipe insulation.

## 2.6 PIPE AND DUCT SLEEVES

- .1 Provide sleeves at all points where pipes and ducts pass through walls and floors.
- .2 Construct metal sleeves of min. 0.8 mm thick galvanized sheet steel with lock seam joints.
- .3 Use cast iron sleeves with caulking recess and flashing clamp device for passage of pipes through roof, unless indicated otherwise. Anchor sleeves in roof construction. Fasten roof flashing to clamp device, caulk between sleeve recess and pipe and form a watertight, durable joint.
- .4 Where pipes or ducts pass through fire rated walls, floors and partitions pack the space between the pipe or duct and sleeve with mineral fibre and seal with caulking compound conforming to CGSB 19-GP-9M, or as indicated. Seal at both sides of wall or floor using 1.6 mm galvanized sheet plates to form a proper fire stop. Method used for sealing around penetrations must comply with appropriate ULC test designs.
- .5 In finished areas where pipes are concealed, extend the pipe sleeves 6 mm beyond finished walls. In exposed areas terminate sleeves flush with walls and floors.
- .6 Provide for expansion and contraction of pipes. Where pipes or ducts are insulated, make sleeves of sufficient size to pass pipe or duct insulation. Pipe and duct insulation to be continuous through sleeves.
- .7 In locations subject to wetness, extend sleeves 25 mm above finished floor level.

- .8 Where piping passes below footings, provide minimum clearance of 50 mm between sleeve and pipe. Backfill to underside of footing with concrete of same strength as the footing.

**2.7 PIPE ESCUTCHEONS AND PLATES**

- .1 Provide escutcheons and plates for pipes passing through finished walls, partitions, floors and ceilings in finished areas.
- .2 Use chrome or nickel plated brass, or solid type stainless steel no. 302 with set screws for ceiling or wall mounting. Use cast iron type for equipment rooms.
- .3 Do not use split-type escutcheon plates.

**2.8 PIPE TROUGHS**

- .1 Provide galvanized steel troughs below all pipes or groups of pipes passing through electrical and telephone rooms, or above electrical panels, disconnects or switch gears.
- .2 Slope troughs away from the elements to be protected.

**2.9 ELECTRIC EQUIPMENT AND CONTROLS**

- .1 All electrical work shall conform to Division 16 requirements.
- .2 All line voltage power wiring for Division 15 equipment shall be provided by Division 16. Disconnects will be provided by Division 16 except when provided as part of packaged equipment, as indicated in equipment specifications.
- .3 All line voltage wiring and devices from load side of disconnect devices shall be provided by Division 16 unless noted otherwise. All low voltage control wiring is to be provided by Division 15. Refer to Section 15900.
- .4 Electrical equipment shall bear CSA labels.
- .5 Conform to requirements of Canadian Electrical Code, local, municipal and provincial authorities, and specified standards.
- .6 All details of motors including phase, cycle, voltage and construction are specified in Division 16. Mechanical equipment motors are to be provided by Division 15.
- .7 Use 1750 rpm premium efficiency motors unless otherwise indicated.
- .8 Motors shall have the following characteristics unless otherwise specified.
  - .1 Motors smaller than 562 watts are to be 120/1/60.
  - .2 Motors 562 watts and larger are to be 600/3/60.
- .9 Ensure that electrical contractor has provided for auxiliary contacts for the building controls systems to integrate different control systems.
- .10 Furnish composite schematic wiring and interconnection diagrams for equipment, including description of performance and sequence of operation of mechanical systems. Submit to Engineer for approval as part of shop drawing submission. Coordinate with Controls contractor, Section 15900.

- .11 Equipment provided with electric devices shall have all required CSA and/or ULC approvals to comply with Ontario Hydro requirements. Include for all special approvals of equipment not conforming to these requirements. Electrical equipment to be of weatherproof design and construction where installed outdoors.
- .12 Co-ordinate the electrical requirements for Division 15 equipment with Division 16.
- .13 If "approved alternative" equipment is selected, ensure that the electrical requirements are not changed. If revisions to electrical requirements are necessary to accommodate the alternative equipment, make arrangements for these revisions at no additional cost to the Contract.

2.10 **VALVE SCHEDULE**

- .1 Gate Valves:

| Service                   | Crane | Jenkins | Toyo  | WOG Pressure |
|---------------------------|-------|---------|-------|--------------|
| Heating (50 mm & smaller) | 428   | 810     | 293   | 1380 kPa     |
| OR                        | 9302  | 901A    | 5044A | 4140 kPa     |
| Heating (65 mm & larger)  | 465½  | 404     | 421A  | 1380 kPa     |

- .2 Check Valves:

| Service                   | Crane | Jenkins | Toyo | WOG Pressure |
|---------------------------|-------|---------|------|--------------|
| Heating (50 mm & smaller) | 37    | 4092    | 236  | 1380 kPa     |
| Heating (65 mm & larger)  | 373   | 587     | 435A | 1380 kPa     |

**Note:** Wherever possible, install check valves on a horizontal run of pipe. Where check valves must be mounted in a vertical pipe, use "Mission" check valves.

- .3 Globe Valves:

| Service                   | Crane | Jenkins | Toyo | WOG Pressure |
|---------------------------|-------|---------|------|--------------|
| Heating (50 mm & smaller) | 7     | 106B    | 221  | 1380 kPa     |

- .4 Refer to Section 15900 for control valves.

2.11 **VALVE TAGS**

- .1 Provide brass tags with 12 mm high stamped lettering and numbers filled with black paint, secured with non-ferrous chains or "S" hooks for valves and operating controllers.
- .2 Use consecutive numbering for valves in each system.

2.12 **VALVE DIRECTORY**

- .1 Provide in duplicate a neat typewritten directory giving the valve "number" and "service" of each valve and indicate its location in the building on a reduced floor plan and by room number on the valve directory. Valve directories to be plasticized.

- .2 Upon receipt of approval from the Engineer, enclose one valve directory under glass in a neat, polished, 460 x 610 mm hardwood frame, complete with mounting clips and mount the directory on the wall in a location selected by the Engineer.

**2.13 DIE-ELECTRIC COUPLINGS**

- .1 Install die-electric couplings wherever pipes of dissimilar materials are to be connected.
- .2 Provide die-electric unions for pipes 40 mm nominal and smaller, and flanges for pipes 50 mm nominal and larger.

**2.14 EQUIPMENT BASES, SUPPORTS AND STANDS**

- .1 Concrete bases, pits, curbs, etc., associated with mechanical equipment are not part of Division 15 unless indicated otherwise.
- .2 Equipment stands and supports are part of Division 15.
- .3 All equipment, including ductwork, hangars shall be hung from structural members and not metal pan decking. Where a hanger falls between joists, unistrut shall be installed bridging the top chords of the two nearest joists and the hanger shall be hung from this.

**2.15 EQUIPMENT IDENTIFICATION**

- .1 Do not obscure nameplates, CSA approval pressure vessel approval and other attached plates do not become obscured by insulation, paint or other materials.
- .2 Provide equipment identification plate in English for each piece of major equipment:
  - .1 Energy Recovery Ventilator.
  - .2 Outdoor VRF condenser units.
  - .3 Indoor heat pump units.
- .3 Nameplates to be made from laminated phenolic plastic sheet with white face and black centre, minimum size 100 mm wide x 40 mm high, engraved with min. 20 mm high letters.
- .4 Division 15 shall be responsible for the installation of maintenance and inventory tagging of all equipment. School board shall supply tags.

**2.16 SYSTEM NAMEPLATES**

- .1 Provide identification nameplates for all systems in each mechanical room, and on all terminal cabinets and control panels.
- .2 Nameplates to be made from laminated phenolic plastic sheet, minimum size 4" wide x 1½" high (100 mm x 40 mm), engraved with min. 3/4" (20 mm) high letters, red letters on white background for fire protection and hazardous systems, black letters on white background elsewhere.

**2.17 IDENTIFICATION OF PIPING SYSTEMS**

- .1 Identify all piping systems according to the following:
  - .1 Colour band, according to the legend following, to the full circumference of piping, including insulation where applied. Length of colour band to accommodate legend and flow directional arrows.

- .2 System legend to be applied in block capital letters, colour and sizes according to CAN/CGSB-24.3.
- .3 Arrows indicating flow direction to be 4" long x 2" high (100 mm x 50 mm) for piping up to 3" (75 mm) in diameter, and 6" long x 2" high (150 mm x 50 mm) for piping 4" (100 mm) diameter and larger.
- .4 Where required, pictograms to be applied in conformance with WHMIS regulations.

.2 Materials for background colour markings, legend and arrows to be waterproof and heat-resistant pressure sensitive plastic marker tags for piping 3/4" (20 mm) diameter and smaller.

.3 For piping 1" (25 mm) diameter and above, use pressure sensitive plastic-coated cloth or vinyl material with protective coating, waterproof contact adhesive undercoating, suitable for 100% RH ambient conditions and operating temperature of 300°F (150°C).

.4 Colours for lettering and arrows:

| BACKGROUND | LETTERING AND ARROWS |
|------------|----------------------|
| Yellow     | Black                |
| Green      | White                |
| Red        | White                |

.5 Background colour marking and legend for piping systems:

| SERVICE                  | BACKGROUND COLOUR MARKING | LEGEND         |
|--------------------------|---------------------------|----------------|
| Hot water heating supply | Yellow                    | HEATING SUPPLY |
| Hot water heating return | Yellow                    | HEATING RETURN |

**2.18 IDENTIFICATION OF DUCTWORK SYSTEMS**

- .1 Identify all ductwork systems using min. 2" (50 mm) high stenciled capital letters and directional arrows. Arrows to be minimum 6" long x 2" high (150 mm x 50 mm).
- .2 Identification to be applied using black paint on a light-coloured background.

**2.19 ACCESS DOORS**

- .1 Access doors shall be flush mounted 450 x 450 mm minimum unless otherwise noted. Doors shall open 180 degrees and have rounded safety corners, concealed continuous piano hinges, and anchor straps. All steel to be perm coated. Doors shall be of approved manufacture with published literature.
- .2 Access panels and doors to be as follows:
  - .1 Plaster Ceilings and Walls:
    - .1 Le Hage 1008 or approved alternative, with fully concealed hinges.
  - .2 Drywall:
    - .1 3 mm thick steel, recessed type 300 x 300 mm door with screwdriver cam locks with framing channels. LeHage 1006 or approved alternative.

- .3 Glazed Tile Walls:
    - .1 Stainless steel with master keyed cylinder lock, concealed mounting flange, heavy duty rust-resistant concealed hinge and adjustable anchor straps.
    - .2 Use for access through all walls in washrooms. LeHage 1001-CD or approved alternative.
  - .3 Provide fire rated access doors in walls or ceilings which form part of a fire-rated enclosure or barrier.
  - .4 Co-ordinate locations of access doors with the appropriate trades and the Architect.
  - .5 LeHage, Zurn, Buensod, or approved alternative.
- 2.20 **SPARE PARTS AND SPECIAL TOOLS**
- .1 Furnish spare parts as follows:
    - .1 One set of V-belts for each piece of belt-driven machinery.
    - .2 One additional set of filters for each air or water filter bank installed.
    - .3 Two keys for each lockable cabinet.
  - .2 Identify spare parts' containers as to contents and replacement part numbers.
  - .3 Provide one set of special tools required to service, operate and adjust installed equipment as recommended by manufacturers.
  - .4 Upon completion of project, immediately before handover, replace all air and water filters with new filters. These filters are in addition to the spare set identified above.
- 3 **Execution**
- 3.1 **GENERAL**
- .1 Co-operate and co-ordinate work prior to starting and during execution with respective Trades as required for satisfactory and expeditious completion of the contract. Take field dimensions relative to this Work. Fabricate and erect work to suit field dimensions and field conditions. Pay cost or extra work caused by, and make up time lost as a result of, failure to provide necessary co-operation and/or information.
  - .2 Supply equipment measurements to other Sections to allow for necessary openings to be left in the structure.
  - .3 Ducts and tubing which are to be concealed are to be installed neatly and as close as possible to building structure so that the necessary furring can be kept to a minimum.
  - .4 Obtain approval of Structural Engineer prior to core drilling any structural members.
  - .5 Provide all forms, templates, anchors, sleeves, inserts and accessories required to execute the Work and instruct related trades as to location.
  - .6 Provide unions and flanges to allow for maintenance and dismantling.
  - .7 Allow adequate space for servicing, and dismantling and removal of equipment and components.

- .8 Provide drains for equipment as applicable, piped to sanitary drainage system.
- .9 Install equipment and system components parallel or perpendicular to building lines, unless indicated otherwise.
- .10 Maximize usable space.

**3.2 CUTTING AND PATCHING**

- .1 Perform cutting and patching required to allow passage of pipes and ducts.
- .2 Obtain Structural Engineer's approval before cutting, boring or sleeving load-bearing members and floors.
- .3 Make cuts with clean, true, smooth edges. Make patches inconspicuous.
- .4 After making good, caulk gaps between pipes, sleeves, ducts and conduits, and openings.

**3.3 EXCAVATION AND BACKFILL**

- .1 Excavation and backfill required for the mechanical services will be performed by Division 02 with the co-operation of Division 15.

**3.4 SITE MEETINGS**

- .1 Attend all regularly scheduled Contractors' site meetings, and commissioning meetings.
- .2 Acquire full knowledge of the nature of the Work involved in this project and be familiar with the progress made.

**3.5 DELIVERY AND STORAGE**

- .1 Store materials and equipment delivered to the site and pending installation in a safe, dry location, protected against weather, damage, corrosion and theft with manufacturer's seals and labels intact. Arrange for storage space with General Contractor.
- .2 Prevent damage and soiling of material and equipment during delivery, handling and storage. Remove rejected material and equipment from the site immediately.
- .3 Touch up damaged factory-finished surfaces to Engineer's satisfaction. Use primer or enamel to match original. Do not paint over nameplates or labels.

**3.6 PROTECTION OF MATERIALS**

- .1 Protect openings in pipes, ducts and factory fabricated equipment stored or installed on site from damage and the entry of dust, grit, sand, water or any other foreign material. Protect threaded connections with temporary threaded caps.

**3.7 PROTECTION OF BUILDING**

- .1 Do not overload any part of the structure during construction. Make every temporary support as strong as permanent support. Place no load on concrete slabs until they have cured (as specified in the Concrete Section) and have achieved sufficient strength to safely carry such loads.

- .2 Adequately protect concrete floors and finished flooring from damage. Take special measures when moving heavy loads or equipment.
- .3 Keep floors free from oils, grease or other materials likely to discolour them or affect bond of applied surfaces.
- .4 Protect work of other Sections from damage.
- .5 Damaged work shall be made good by appropriate trades but at the expense of those causing damage.
- .6 Attach and fasten fixtures and fittings in place in a safe, sturdy, secure manner so that they cannot work loose, fall or shift out of position during normal use of the building.
- .7 Protect existing buildings, curbs, roads and lanes. If, during work, any existing items are damaged, arrange for repair or replacement at no extra expense to the contract.

**3.8 WORKMANSHIP**

- .1 Perform the work in a neat and careful manner so that items are installed, and will remain, plumb, square and straight. Items not so installed will be rejected and redone at no extra cost to the project.
- .2 Ensure that products are properly related to form close joints and appropriately aligned junctions, edges and surfaces, and that elements are free of warp, twist or other irregularities.
- .3 Except where specified otherwise, use products in strict accordance with manufacturers' published or written instructions, specifications or recommendations regarding handling, storage, preparation, site conditions, ancillary products or accessories, methods of installation, protection and cleaning.
- .4 When required either by the specifications or manufacturers' instructions, have manufacturer or his accredited agent or the supplier supervise the work.

**3.9 LOCATION OF EQUIPMENT AND FIXTURES**

- .1 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space, and in accordance with manufacturers' recommendations for safety, access and maintenance.
- .2 Mount classroom thermostat beside switch with top of thermostat level with top of switch-plate. Co-ordinate with Division 16. Refer to detail on electrical drawing.

**3.10 LOCATION OF GAUGES AND INSTRUMENTS**

- .1 Locate thermometers, gauges, etc., in correct positions in systems and to allow for easy view from floor level.
- .2 Provide all wells, connections, etc., in pipework, ductwork, etc., to allow for the installation of thermometers, gauges and control components. Co-ordinate with Section 15900.

**3.11 INSTALLATION OF ABOVE-GROUND PIPEWORK**

- .1 Slope piping to allow for drainage and air venting.
- .2 Conceal piping in partitions and pipe spaces in finished areas.

- .3 Install access doors where valves, gauges, indicators and adjustable or maintenance items are to be concealed.
- .4 Make proper allowance for thermal expansion and contraction.
- .5 Locate valves, strainers, etc., in close proximity to pumps and other equipment, valves, strainers etc. are to be line size and not reduced pipe sizes. (Refer to Section 15600.3.1.9 for control valve exceptions.) No horizontal pipe chases will be permitted in any masonry walls. Groups of fixtures backing onto a masonry wall must be serviced by individual drops.

**3.12 IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS**

- .1 Apply identification after painting has been completed.
- .2 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 55 ft (17 m) intervals, and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .3 Adjacent to each change in direction.
- .4 At least once in each room through which piping or ductwork passes.
- .5 On both sides of visual obstruction, or where service is difficult to follow.
- .6 On both sides of separations such as walls, partitions.
- .7 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces: at entry and exit points, and at each access opening.
- .8 At beginning and end points of each run, and at each piece of equipment in run.
- .9 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .10 Identification to be easily and accurately readable from usual operating areas and from access points. Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.
- .11 Provide standoffs for nameplates on insulated surfaces.
- .12 Secure valve tags with non-ferrous chains or closed S-hooks.
- .13 Provide and hang one copy of flow diagrams and valve schedules, mounted in frames behind non-glare glass where directed by Engineer. Additional copies of flow diagrams and schedules to be included in maintenance manuals.
- .14 Valves in each system to be numbered consecutively.
- .15 Use 50 mm high black stencilled letters (e.g.: Cold", "Hot", "Return") with directional flow arrows for ductwork.
- .16 Stencil over final duct finish only.

**3.13 CEILING IDENTIFICATION SYSTEM**

- .1 The Contractor shall apply matching lamacoid plates to T-bar ceiling tile support system to signify that equipment exists behind tile.

**3.14 HOISTING AND RIGGING**

- .1 Provide and arrange for all transportation of equipment and materials to the site, and for rigging, hoisting, storing and setting in place in accordance with the construction schedule.

**3.15 ISOLATION**

- .1 Select and install equipment, pipe and duct supports so as to prevent the transmission of noise and vibration within the structure. Where supports are attached to building structure and vibration or noise could be transmitted to the structure, insert resilient members between support and structure.
- .2 In occupied areas of the building, isolate adequately all equipment to maintain noise levels which are acceptable to the Engineer.

**3.16 BALANCING, START UP**

- .1 To be read in conjunction with Section 15850.
- .2 Testing, Adjusting and Balancing shall be carried out in full by this contractor. All TAB functions will be witnessed and verified by an independent Commissioning Authority (CxA).
- .3 As soon as conditions permit, conduct adjustment and acceptance tests to demonstrate that the equipment and systems meet the specified requirements.
- .4 Operate equipment for a minimum of five (5) days. Repair defects and repeat tests until satisfactory results are obtained, lubricate bearings and adjust and set drives for proper alignment and tensions.
- .5 Calibrate and adjust thermostats, thermometers, linkages and dampers. Operate and test motors and speed switches for correct wiring sequences, check overload heaters in motor starters, replace and clean filters, flush out lines and equipment, remove and clean strainers, and flush out systems with chemically treated water to recommendations of the chemical treatment manufacturer. Fill water systems to purge air. Clean fan wheels and heating coils. Comb fins on air coils. Check all bolts and screws for tightness.
- .6 After completion of air and water balancing, vary loads to demonstrate start-up sequence and normal shut-down. Simulate emergency conditions to demonstrate safety shut-down, and automatic and/or manual reset.
- .7 Conduct functional tests in the presence of the Engineer. Give advance notice in writing that pre-functional tests have been completed and that functional tests are ready to be conducted.
- .8 Include for at least two (2) tests, one (1) in winter and one (1) in summer.
- .9 Change all filters after three (3) months from date of substantial completion.
- .10 Start-up and recording procedure of equipment by Division 15.

**3.17 TRIAL USAGE**

- .1 Protect work against loss or damage until accepted by the Engineer.
- .2 Obtain written permission from the Engineer to use and test permanent equipment and systems prior to acceptance by Engineer.
- .3 Guarantee period and commencement date shall not be affected, ie: guarantees commence at the time of final acceptance of the project by the Engineer and/or the Owner.
- .4 The Engineer may use equipment and systems for test purposes prior to acceptance. Supply labour, material and instruments required for such testing.
- .5 Trial usage of any mechanical device, machinery, apparatus, equipment or other work supplied under this Division before final completion and written acceptance is not to be construed as evidence of acceptance.
- .6 No claim for damage is to be made by this Division for the injury to or the breaking of any parts of such tested work, whether caused by weakness or inaccuracy of structural parts or by defective material or workmanship of any kind whatsoever.
- .7 Use of the building HVAC equipment will not be permitted until after all gypsum board work and spray painting operations are completed. If the systems are required to be utilized after this time but before hand over to the Owner, the contractor shall obtain permission from the owner and carry out an additional complete filter change.

**3.18 PAINTING**

- .1 Appropriate Sections of Division 15 shall touch up minor damage to finish on equipment to match standard factory applied baked enamel finish.

**3.19 OPERATING AND MAINTENANCE MANUALS**

- .1 The commissioning contractor is to compile the operations and maintenance manual. Each sub-trade is to provide the required information for each section as applicable.
- .2 Prepare and submit two (2) bound hardcopies and one (1) digital copy of Operating and Maintenance Manuals in accordance with Section 01005, each containing 11 Sections as follows. Manuals to be provided in English.
  - .1 Section 1:
    - .1 Introduction, abbreviations, health and safety requirements and warning notices, etc.
  - .2 Section 2:
    - .1 Full description of each system together with the main plant components and locations and mode of operation of automatic control systems associated with each system.
  - .3 Section 3:
    - .1 Complete plant technical data of each item of equipment, e.g., manufacturer name and address, type and size of unit, serial number, order number, bearing pulley and belt details, motor details, wiring diagram, unit performance and duty details, etc.
    - .2 This information shall be derived from a site inspection of identification plates plus information obtained from manufacturers.

- .3 Bulletins shall pertain to equipment installed on this job only.
- .4 General bulletins describing any items of equipment not installed on this job are not acceptable.
- .4 Section 4:
  - .1 Detail description of the operating procedures necessary for starting up, running and shutting down each individual system.
  - .2 This shall include the control panel starter and selection facilities together with any alarm and safety interlocks as identified on the control panel(s), and shall be derived from site inspection plus information obtained from manufacturers.
- .5 Section 5:
  - .1 Maintenance operations required to be performed on a daily, weekly, monthly or yearly basis for each item of plant.
  - .2 Preparation of this section shall be carried out by obtaining recommendations for lubrication, adjustment and routine maintenance from the manufacturers.
- .6 Section 6:
  - .1 Emergency procedures to be adopted by personnel engaged on the operation and maintenance of the mechanical and electrical services, with respect to fire, general failures to water and electrical systems, gas lines, chiller refrigerant pipework, and procedures for maintenance personnel in and out of working hours.
- .7 Section 7:
  - .1 Recommended action on system malfunction to assist both the user and maintenance engineer in the event of a fault developing in a system, by indicating the nature of the fault and recommended action.
- .8 Section 8:
  - .1 List of recommended spares and lubricants.
  - .2 Preparation of this section shall be carried out by obtaining manufacturers' recommendations and incorporating client's requirements regarding spares.
- .9 Section 9:
  - .1 Schedule of "as-built" drawings together with 50% reduced copies of the "as-built" drawings in numerical order.
  - .2 The reduced copies of the "as-built" drawings shall be printed on good quality paper compatible to the paper used for the remainder of the manual.
- .10 Section 10:
  - .1 Valve number list and chart, test certificates and commissioning reports.
- .11 Section 11:
  - .1 Warranties and guarantees plus a list of manufacturers' addresses and telephone numbers and equipment supplied.
  - .2 Manufacturers' literature shall also be included within this section and arranged in alphabetical order to match the manufacturers list.
- .3 Compile manuals in good quality 3-ring binders subdivided into sections as described, complete with index page, separators and index tabs.
- .4 On the front cover, permanently identify:
  - .1 Project Name.

- .2 "Maintenance and Operating Instructions For (Project Name)."
  - .3 Mechanical Contractor's name, address and telephone number.
  - .5 Completed manuals are to be submitted to the Engineer and approved before final inspection can be completed.
- 3.20 **INSTRUCTION OF STAFF**
- .1 Demonstrate operation of all systems and equipment to building operating staff before requesting Certification of Substantial Performance.
  - .2 Use operation and maintenance manuals for instruction purposes. Upon completion of instruction turn manuals over to the Owner.
  - .3 Instruction of the Board staff will be coordinated in accordance with Commissioning TAB, as part of this contract.
  - .4 Div. 15 and equipment manufacturer's representatives shall carry out the training of Owner's staff. The Commissioning Authority shall organize, schedule, monitor and record the training.
- 3.21 **FINAL INSPECTION**
- .1 When the work required under this Division has been completed to the best of the Contractor's knowledge, inform the Engineer in writing that the job is ready for final inspection.
  - .2 Do not submit this written request until:
    - .1 All deficiencies recorded during site review(s) have been corrected.
    - .2 All systems have been successfully balanced and tested and are ready for operation.
    - .3 Balancing reports have been submitted, reviewed, corrections made on site if required, and the reports have been accepted by the Engineer.
    - .4 Completed O&M Manuals have been delivered and accepted.
    - .5 Equipment and system identification is complete, including valve tags, nameplates, etc., and valve charts and flow diagrams have been submitted and accepted.
    - .6 Cleaning has been completed.
    - .7 Spare parts have been delivered to the Owner as specified.
    - .8 Record Drawings have been completed, delivered and accepted.
    - .9 Instruction sessions have been delivered.
  - .3 If a preliminary inspection by the Engineer indicates that a list of the outstanding deficiencies will exceed 25 items, the job shall not be considered ready for final inspection and no further action will be taken by the Engineer until further confirmation is received. Contractually, this will count as one regular site inspection. The Mechanical Contractor shall arrange to have themselves, their sub-trades and the General Contractor accompany the Engineer on the final inspection.
  - .4 Upon receipt of a deficiency list proceed immediately with steps to correct the deficiencies and report to the Engineer within fifteen (15) days as to the status of same.

- .5 Before final payment is made provide a written guarantee covering all defects in equipment, materials and workmanship for a period of one year from the date of substantial completion.

3.22 **GUARANTEES**

- .1 Furnish a written guarantee for the satisfactory operation of all work and apparatus installed under this contract. At no cost to the Owner, replace immediately any part which may fail or prove defective within a period of twelve months (unless specified otherwise) after final acceptance of the complete contract. Guarantees do not apply to failure due to improper usage or ordinary wear and tear.

**END OF SECTION**

**PART 1 General**

**1.1 RELATED SECTIONS**

- .1 Division 01.
- .2 Section 21 05 01 - Common Work Results for Mechanical.
- .3 Section 23 36 01 – Air Distribution.
- .1 Section 25 05 01 – EMCS: General Requirements.
- .2 Testing, Adjusting, Balancing (TAB) shall be performed as part of this contract by the trades that installed the respective equipment.
- .3 This section should be read in conjunction with the “Request for Fees to Provide Commissioning Agent Services”.

**1.2 SCOPE OF WORK AND SERVICES**

- .1 Furnish all labour and equipment for the testing, adjustment and balancing of all systems as indicated on the drawings and described in the specifications, to obtain design quantities as indicated, and record all readings for submission in the form of a commissioning report.
- .2 Owner will be engaging a separate Commissioning Authority to oversee commissioning activities. Coordinate with requirements of commissioning authority specifications to understand impact on this contract.
  - .1 Commissioning authority specifications indicate the following responsibilities for the mechanical contractor:
    - 1. Providing labour, material, equipment, etc., required within the scope of the respective sub-trade or specialty trade to facilitate the commissioning process.
    - 2. Performing Pre-Functional and Functional and Integrated Performance Inspections and Tests as required by the commissioning process.
    - 3. Performing certification testing on designated systems and providing completed certificates to the CxA.
    - 4. Performing all TAB functions. after the Pre-Functional Tests have been completed and documented.
    - 5. Correcting deficiencies with regards to the labour and materials that they provided for the project.
    - 6. Delivery of field records of commissioning documentation
    - 7. Delivery of training under the direction of the CxA
    - 8. Provide assistance in the preparation, of all reports and provide copies of all systems certificates to the CxA.
  - .2 Commissioning authority specifications indicate the following responsibilities for the controls contractor:
    - 1. Providing labour, material, equipment, etc., required within the scope of the trade to facilitate the commissioning process.
    - 2. Performing point verification and testing full sequence of operations on all systems

3. Correcting deficiencies with regards to the labour and materials that they provided for the project.
4. Delivery of training under the direction of the CxA
- .3 All divisions shall include in the costs for this contract, the necessary time and labour needed to comply with requirements of commissioning authority.
- .4 Where there are conflicts between this specification section and the instructions of the commissioning authority, the commissioning authority shall be followed.
- .3 Verify operating conditions and/or adjust the following systems:
  - .1 Air Conditioning.
  - .2 Ventilation.
  - .3 Heating/cooling System: Boiler, Pumps, Coils, Dry Cooler, etc.
  - .4 Electrical power transformation switching and distribution.
  - .5 Controls.
  - .6 VRF System
- .4 The work of this section is to be coordinated with the work of other sections. Refer to work schedule.

### 1.3 SCOPE OF WORK AND SERVICES

- .1 Testing Adjusting Balancing and Commissioning:
  - .1 Ensure that:
    - .1 The systems are installed to Manufacturer's instructions for physical clearances, isolation and mechanical and electrical connections.
    - .2 The systems are operating within the allowable parameters of flow and temperature indicated on the construction documents and that all components are operating within manufacturer's nameplate and/or shop drawing parameters [i.e., rpm amperage flow (max/min) output, etc.]
    - .3 All equipment and systems are operating under the specified control and that they are capable of fulfilling the full range of function outlined in the Sequence of Operation. (See Section 23 09 20 - Controls)
    - .4 All safety and alarm devices are operating correctly and that external notification of alarm states are properly processed. (Note: ensure that all devices designed to automatically reset to normal status following an alarm or safety failure are capable of doing so and that all manual reset devices are installed in such a manner to indicate their "shut-off" condition and facilitate their reset.)
  - .2 Reporting:
    - .1 Utilizing standard equipment verification forms, performance test procedure forms, provided by the CxA, and AABC Balancing Report forms and manufacturer's start-up forms complete the TAB activities outlined in this document. (The CxA shall witness, verify and transfer "Field" reports to the final electronic copies for inclusion in the commissioning manuals.)
  - .3 Training:
    - .1 Training to be organized, coordinated, witnessed and recorded by the CxA.
    - .2 To coordinate the building operator's training program as specified in the Construction Documents and supplement this training as required to provide a comprehensive systems approach.

- .3 All training of the owner's O&M personnel
- .4 The individual construction contractors shall carry out the actual training.

#### 1.4 PRE-FUNCTIONAL AND FUNCTIONAL PERFORMANCE TEST

- .1 Objectives:
  - .1 The objectives are to verify the performance of systems.
  - .2 The performance of all the systems operating together and ensure the building design intent is met.
  - .3 Verification of all control sequences
- .2 Mechanical Systems:
  - .1 Pre-functional and Functional performance testing shall follow the schedule developed by CxA.
  - .2 No functional testing shall begin until the Mechanical and Electrical contractors have completed the pre-functional and that the equipment is under control.
  - .3 The EMCS may be used as well as any other instrumentation deemed necessary for mechanical systems testing. The EMCS shall be programmed to record point data over a specific time period. Performance of the systems shall be evaluated by reviewing the EMCS recorded data and other recorded data.
  - .4 Test shall be conducted systematically, i.e., starting from the primary energy system through to the VRF system and controls, etc.
- .3 Building Operator Training:
  - .1 Ensure all training has been provided by the Contractors and equipment manufacturers.
- .4 Final Mechanical System Acceptance:
  - .1 Prior to the final acceptance date, complete all tests including the system functional performance tests.
  - .2 Prior to the final acceptance date, assemble all completed testing forms and EMCS system printouts, and include them in the commissioning report.
  - .3 If a test on any equipment did not meet the design intent or performance test, the equipment will be re-tested prior to the system's acceptance.
  - .4 If necessary, the consultant shall issue corrective measures if an acceptable performance is not achieved.
  - .5 Acceptance shall not be given until all tests results are satisfactory.
  - .6 The Contractor and CxA shall analyze the result of the system performance test and submit a report on the findings. The report shall make recommendations to improve the performance of the systems.
- .5 Seasonal Commissioning:
  - .1 All seasonal commissioning not completed shall be performed during the respective season at the earliest possible date.
  - .2 The Contractor, Consultants and CxA shall coordinate the seasonal commissioning plan with the Owners, the Project Manager the mechanical contractor and the Electrical Contractor.
  - .3 Seasonal Commissioning shall take place within 12 months of building acceptance and in a period of time in which the building systems can be tested to demonstrate their performance under summer and winter outdoor design conditions.

- .4 Arrange with CxA to prepare a seasonal Commissioning Schedule.
- .5 Should the Contractor uncover problems during the seasonal test the report should highlight these problems and submit suggested corrective actions.
- .6 Seasonal Commissioning documentation including verification forms, test forms, system functional performance tests, are compiled by the CxA for insertion into the commissioning manuals.

**PART 2 Products**

**2.1 ACCESS**

- .1 Provide scaffolding and ladders required.
- .2 Support from floor, independent of finished surfaces.
- .3 Construct and maintain scaffolding and ladders in accordance with relevant Municipal, Provincial and other regulations.

**2.2 TEST PORTS AND CAPS**

- .1 Coordinate with the mechanical contractor for drilling of test holes in locations indicated, and where required for proper flow measurement. Refer to drawings for test hole locations and to Section 23 36 01 – Air Distribution for description. Provide tools, materials and labour for this work.
- .2 Section 23 36 01 – Air Distribution shall provide additional test holes if and where requested by the Engineer to verify system operation.
- .3 Section 23 36 01 – Air Distribution shall provide neoprene expansion plugs equal to Duro-Dyne Model IP-4 to seal all test ports.

**2.3 HYDRONIC BALANCING**

- .1 Systems consist of:
  - .1 Hot water radiators.
  - .2 Hot water radiant panels.
  - .3 Hot water coils.
  - .4 VRF and heat pump units.
- .2 Flow rates are shown on drawings and equipment schedules. Employ pressure differentials across the circuit balancing valves or ultra-sound or similar instrument to confirm flow rates. Adjust system valves as required to attain flows specified.
- .3 Provide schematic and confirmation of flows.

**PART 3 Execution**

**3.1 CONDITIONS REQUIRED FOR AIR BALANCING**

- .1 System pressure tests to be completed.
- .2 Systems in continuous operation and under proper control.

- .3 Engineer's prior approval for proposed balancing procedures has been obtained.

### **3.2 BALANCING AGENDA**

- .1 Submit balancing agenda to CxA for approval. Do not start balancing work until agenda has been approved. Agenda shall include descriptive data, procedure data, and data record form as outlined below.
- .2 Include general description of each air system with its associated equipment.
- .3 Describe specific procedures to verify performance of instrument to be used, and method of instrument application.
- .4 Submit for approval one (1) copy of all balancing data forms with all design data, system names and numbers, system schematics etc. entered.

### **3.3 EQUIPMENT AND SYSTEM CHECK**

- .1 The CxA shall provide equipment- and system-specific pre-functional and functional testing check list for use by the contractor.
- .2 Place all fans in operation and immediately check the following:
  - .1 Motor amperage and voltage to guard against possible overload.
  - .2 Fan rotation.
  - .3 Automatic dampers for proper position.
  - .4 Air and water resets operating to deliver required temperatures.
  - .5 Check for air leaks in the casing around the coils and filter frames by moving a light along the outside of the joint while observing the darkened interior of the casing. Caulk any leaks. Note points where piping enters the casing to be sure that escutcheons are tight. Do not rely on pipe insulation to seal these openings. In prefabricated units, check that all panel fastening holes are filled and airtight.
- .3 The contractor shall "Field" complete the test forms and shall return to CxA for completion and inclusion in the commissioning manuals.

### **3.4 AIR SYSTEM PROCEDURE AND DATA**

- .1 Adjust air handling systems as described in this specification and/or shown on the accompanying drawings, to provide the required supply, return and exhaust air quantities for each part, to within 10% accuracy unless indicated otherwise.
- .2 Submit methodology of execution.

### **3.5 FINAL INSPECTION AND ACCEPTANCE**

- .1 At the time of final inspection, in accordance with the Balancing Schedule, re-check in the presence of the Engineer random selections of data recorded in the Certified Report.
- .2 Following final acceptance of Certified Reports by the Engineer, permanently mark in an approved manner the settings of all dampers and other adjustment devices so that settings can be restored at any time. Do not mark such devices until after final acceptance.

**3.6 FINAL REPORT**

- .1 Following the final inspection and acceptance, update System Performance Report and submit three (3) copies of the Final Report, bound in 3-ring binders.
- .2 Provide a written guarantee, effective for a period of twelve months following final inspection and acceptance by the Engineer, that the mechanical systems have been tested, adjusted and balanced as specified herein and that steps will be undertaken by the balancing contractor to correct same if necessary.
- .3 Final reports shall be submitted on the standard AABC forms.

**3.7 TEMPERATURE CONTROL VERIFICATION**

- .1 The testing, adjusting and balancing company shall work in close co-operation with CxA and the control contractor to ensure a complete project. The balancing technician need only verify proper operation, not adjust, relocate or recalibrate any controls.
- .2 Upon completion the testing, adjusting and balancing of all HVAC systems to produce design objectives, stage the automatic control system(s) to prove its capability of matching system capacity to varying load conditions. Verification or checkout of the control system must be accomplished during the cooling and heating cycles of operation for a period of time to ensure control response and overall stability.

**3.8 SYSTEM TESTING**

- .1 Systematically check and test components of all systems to ensure correct functioning of each system before balancing commences.
- .2 Record all checking and testing on proper forms, provided by the CxA
- .3 Items listed in .4 and .5 below, will be typical on all test forms.
- .4 System Commissioning Check List:
  - .1 Air distribution products installation is completed.
  - .2 Lubrication of equipment completed.
  - .3 Instrumentation installation completed.
  - .4 System start-up complete.
  - .5 Rotation of electric motor and ratings of overload heaters verified.
  - .6 Control diagrams and sequences corrected to "as-builts"
  - .7 Safety and operating control setpoints are as designed and automatic control sequences have been checked.
  - .8 Installation cleaned up and temporary coverings, stickers and tags removed.
  - .9 Painted finishes touched up where damaged.
  - .10 Equipment and duct identification work completed.
  - .11 Fins on extended surface heat transfer coils combed out where damaged.
- .5 Check List of Start-up Procedure:
  - .1 Pre-Start-Up Inspection:
    - .1 Verify proper equipment mounting and setting.
    - .2 Verify that control, interlock and power wiring is correct.
    - .3 Verify alignment of motor and drives.
    - .4 Verify proper piping connections and accessories.

- .5 Verify that lubrication is completed.
- .2 First Run Observation: (Pre-functional)
  - .1 Verify direction of rotation.
  - .2 Verify setting of safety controls.
  - .3 Monitor heat build-up in bearings.
  - .4 Check motor loads against nameplate.
- .3 Equipment Check: (Functional)
  - .1 Verify proper heater sizes.
  - .2 Verify function of safety and operating controls.
  - .3 Verify proper operation of equipment.
  - .4 Report on inspection, observation and checking procedures.

**3.9 OPERATING AND MAINTENANCE MANUALS**

- .1 The construction contractor is to compile the operations and maintenance manual. Each sub-trade is to provide the required information for each section as applicable. The CxA shall compile the commissioning manuals.
- .2 Refer to 23 05 00 – Common Work Results for Mechanical for specific details.

**END OF SECTION**

**PART 1            General**

**1.1                RELATED SECTIONS**

- .1            Division 01.
- .2            Section 21 05 01 – Common Work Results for Mechanical.
- .3            Section 23 36 01 – Air Distribution.

**1.2                REFERENCES**

- .1            American Society for Testing and Materials (ASTM):
  - .1            ASTM C411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
  - .2            ASTM E84-15a, Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2            Canadian General Standards Board (CGSB):
  - .1            CGSB 51-GP-52MA, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
  - .2            CGSB 51-GP-11b.
  - .3            CGSB-51-GP-2M.
  - .4            CGSB-51-GP-6M.
  - .5            CGSB-51-GP-7M.
- .3            Conform to CHVAC.
- .4            National Fire Protection Association (NFPA):
  - .1            NFPA(Fire)90A (2015 Edition), Installation of Air Conditioning and Ventilating Systems.
  - .2            NFPA(Fire)225 (2013 Edition), Model Manufactured Home Installation Standard.
- .5            Thermal Insulation Association of Canada (TIAC).
- .6            Underwriters' Laboratories of Canada (ULC):
  - .1            ULC S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
  - .2            ULC S102-10, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .7            ASHRAE 90.1 – 2013, Standard 90.1-2013 (I-P Edition) -- Energy Standard for Buildings Except Low-Rise Residential Buildings.

**1.3                REQUIREMENTS OF REGULATORY AGENCIES**

- .1            Insulation system materials shall satisfy fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with ASTM E84.

**1.4 DEFINITIONS**

- .1 "Concealed" means insulated mechanical services in trenches, chases, furred spaces, pipe shafts, or hung ceilings.
- .2 "Exposed" will mean all work which is not "concealed" as defined herein.

**1.5 COMPATIBILITY OF COMPONENTS**

- .1 Mechanical fasteners, adhesives, sealers, vapour coatings, mastics, laggings and bedding compounds shall be only those recommended by the manufacturer.

**1.6 SUBMISSIONS**

- .1 Mechanical contractor shall submit shop drawings for review for all insulation and jacketing products before installing or ordering.
- .2 Provide sample board of all insulation types to Engineer for review before ordering.

**PART 2 Products**

**2.1 STANDARD OF ACCEPTANCE**

- .1 Insulation Materials: Only the following materials listed are acceptable for use on this project. All accessories shall comply with TIAC.
- .2 Coatings, Sealers and Adhesives:
  - .1 Benjamin Foster Co.
  - .2 Minnesota Mining and Mfg.of Canada Ltd.
  - .3 The Flintkote Co.
  - .4 Jacobs and Thompson.
  - .5 Duro-Dyne.
- .3 Caulking Compound:
  - .1 Canadian General Electric.
  - .2 Dow Corning.
- .4 Tape:
  - .1 ARNO Dr. Scholl's Tape Division.
  - .2 3M.
  - .3 Duro-Dyne.
- .5 Glass Fibre Insulation for Fittings and Equipment:
  - .1 Insulcoustics Ltd., Ottawa.
  - .2 Ottawa Fibre Industries Ltd.
  - .3 Manson.
  - .4 Fibreglass Canada.
  - .5 Armstrong World Industries.
  - .6 Knauf.
- .6 ULC Labelled Canvas Jackets or Fittings:
  - .1 S. Fattal Cotton Inc.
  - .2 Thermocanvas.

## **2.2 JACKETS**

- .1 Thermo-Canvas Jackets, c/w ULC S-102 Label:
  - .1 Use 225 g thermo-canvas jacket finish on all insulated, exposed piping and ductwork indoors, on all concealed valves and fittings for heating.
  - .2 No PVC jackets on piping or elbows will be permitted on this project. Exceptions - preformed insulation for CBV's.
- .2 Acceptable Products:
  - .1 Fattal's Thermocanvas.
  - .2 Clairmont Display Co.
  - .3 Alpha Maritex 3451 RW.

## **2.3 Vapour Barrier:**

- .1 Provide to CGSB 51-GP-52MA vapour barriers for pipe, duct and equipment insulation. Type 2: moderate puncture resistance.
  - .1 Acceptable Products:
    - .1 Canadian Johns Manville Flamebar.
    - .2 WFB and BFB Alumi-seal "Zero-Perm."

## **2.4 WEATHERPROOF CAULKING**

- .1 At flashings, wherever barrier joint is required, and at expansion joints, provide silicone based heat resistant caulking, set into fabric reinforcing cloth extending 75 mm each side of caulk line.

## **2.5 DUCTWORK COMPONENTS**

- .1 Fastening:
  - .1 Insulation cement and self-adhesive aluminum tape.
  - .2 Insulation cement and weld pins with clip stops.
- .2 Jackets:
  - .1 Jackets on exposed ductwork of types indicated shall be continuous over any vapour barrier or coating.
  - .2 Lap seams minimum 50 mm in least visible location. Use adhesive lagging to secure overlapping edges.
  - .3 Provide, in mechanical rooms, galvanized steel corner beads on rigid insulation complete with thermocanvas covering.

## **2.6 DUCT INSULATION**

- .1 Flexible Insulation:
  - .1 Ducting and Fittings:
    - .1 Flexible insulation with factory applied vapour barrier to be composed of fibrous glass formed into a flexible blanket and be suitable for application on exterior of round and rectangular ducts.
    - .2 Specification Compliance:
      - .1 CGSB 51-GP-11b (Type 1)
      - .2 Class 6 ASTM C411, to meet CUA-90A (NFPA 90A).

- .2 Vapour Barrier:
  - .1 The vapour barrier shall be composed of aluminum foil min 24 gauge (0.7 mil) thick, reinforced with fibreglass yarn mesh and laminated to permanently treated fire resistant kraft paper.
  - .2 Specification Compliance:
    - .1 ASTM-C411 to meet NBC 1974 or CUA-90A.
  - .3 Application:
    - .1 All rectangular and rigid round exhaust air ductwork for a minimum distance of 6'-0" (2 meters) from the terminal at the exterior wall or as noted on the drawings, 1" (25 mm) thick.
    - .2 All rectangular and rigid round supply air ductwork, 1" (25 mm) thick (Insulation not required on acoustically lined ducts – Coordinate with Section 23 36 01 - Air Distribution).
      - .1 Thermal insulation not to be installed on exposed ductwork within the gymnasium.
    - .3 Insulated flexible ductwork, refer to Section 23 36 01 - Air Distribution.
    - .4 Round outdoor air and combustion air 2" (50 mm) thick.
    - .5 All rectangular ductwork downstream of duct mounted heating coils, 1" (25 mm) thick.
  - .4 Finishes:
    - .1 All concealed ductwork will be left with factory applied vapour barrier facing as specified above, with no further finish required.
    - .2 Cover all exposed ductwork with a thermocanvas jacket as specified under "Jackets".
- .2 Rigid Insulation:
  - .1 Ducting and Fittings: Pre-formed mineral fibre rigid insulation with vapour barrier.
  - .2 Vapour Barrier:
    - .1 Vapour barrier shall be composed of aluminium foil (min. 0.7 mil thick), reinforced with fibreglass yarn mesh and laminated to permanently treated fire resistant kraft paper.
  - .3 Application:
    - .1 Rectangular combustion air and relief ductwork, 2" (50 mm) thick.
  - .4 Finishes:
    - .1 All concealed ductwork, factory applied vapour barrier facing as specified above with no further finish required.
    - .2 Cover all exposed ductwork with thermo-canvas jacket as specified under "Jackets".

## **2.7 ACOUSTIC INSULATION**

- .1 Refer to Section 23 36 01 - Air Distribution under 2.3 for acoustic insulation.

## **PART 3 Execution**

### **3.1 APPLICATION**

- .1 Apply insulation after required tests have been completed and approved by the Engineer. Insulation and surfaces shall be clean and dry when installed and during application of any finish.
- .2 Work to be performed by insulation journeymen

**3.2 DUCT INSULATION**

- .1 General:
  - .1 Joints to be on top of ducts.
  - .2 Adhere and seal vapour barrier using vapour seal adhesives.
  - .3 Stagger longitudinal and transverse joints on multi-layered insulation.
- .2 Mechanical Fasteners:
  - .1 On rectangular ducts use 50% coverage of insulating cement and weld pins at not more than 200 mm centres, but not less than two (2) rows per side.
  - .2 On round ducts use 100% coverage of insulating cement and self-adhesive tape on joints.

**3.3 SIZING**

- .1 Provide ULC approved fire retardant coating on canvas jackets.
- .2 Coat canvas covering exposed in finished spaces with diluted coat of lagging adhesive, as recommended by insulation manufacturer for priming.

**3.4 PIPE AND DUCT PENETRATIONS OF FIRE RATED PARTITIONS**

- .1 Coordinate and comply with the ULC system standards.

**3.5 PIPE AND DUCT PENETRATIONS AT SLEEVES**

- .1 Pipe and duct insulation is to be continuous through sleeves. Insulation is not to be butted at the sleeve.

**END OF SECTION**

**PART 1           General**

**1.1               RELATED SECTIONS**

- .1     Section 21 05 01 – Common Work Results for Mechanical.
- .2     Section 25 05 01 – EMCS: General Requirements.

**1.2               REFERENCES**

- .1     American National Standards Institute (ANSI):
  - .1     ANSI/UL 737-2011, Fireplace Stoves.
  - .2     ANSI/NEMA C84.1-2011, Electric Power Systems and Equipment - Voltage Ratings (60 Hz).
  - .3     CSA ANSI Z21.13-2014/CSA 4.9-2014, Gas-Fired Low Pressure Steam and Hot Water Boilers.
- .2     American Society of Mechanical Engineers (ASME).
- .3     Canadian Standards Association (CSA):
  - .1     CSA C22.2 No. 14-13, Industrial Control Equipment.
- .4     International Electrotechnical Commission (IEC):
  - .1     IEC 60259 ED. 2.2b:2013, Degrees of Protection Provided by Enclosure.
  - .2     BS PD IEC/TR 60664-2-1:2011, Insulation Coordination for Equipment within Low-voltage Systems - Part 1: Principles, Requirements and Tests.
- .5     National Electrical Manufacturers Association (NEMA):
  - .1     NEMA ICS 1-2000 (R2008), Industrial Control & Systems General Requirements.
  - .2     NEMA ICS 7-2014, Adjustable-Speed Drives.
  - .3     NEMA ICS 7.1-2006, Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.
- .6     Underwriters Laboratories of Canada (ULC):
  - .1     UL 508-1999, Industrial Control Equipment.
  - .2     UL 508C-2002, Standard for Power Conversion Equipment.

**1.3               INTERFERENCE DRAWINGS**

- .1     Provide interference drawings at each roof top unit showing duct penetration and distribution within vicinity. Drawing shall show plumbing, fire protection and heating piping in order to avoid conflicts.

**PART 2           Products**

**2.1               MANUAL AIR VENTS**

- .1     Standard float vent with brass body, 1/8" (4 mm) male thread, rated of 150 psi (1034 kPa) and 230°F (110°C). For use at heating terminal units. Do not use where system pressures exceed rating of air vent.
- .2     Acceptable material:
  - .1     Amtrol.

- .2 Armstrong.
- .3 Braukman.

## 2.2 CIRCUIT BALANCING VALVES

- .1 Install circuit balancing valves as indicated on the detail and equipment schedules, in accordance with manufacturer's instructions.
- .2 Each valve to have two (2) 1/4" (6 mm) NPT brass metering ports with check valves and gasketed caps, located on each side of valve seat. Two (2) additional 1/4" (6 mm) NPT brass ports with brass plugs are to be provided on the opposite side to the metering ports for use as drain connections, and interchangeable with the metering connections.
- .3 Valves to be Y-pattern, Class 125, with equal percentage plugs, and to provide three (3) functions:
  - .1 precise flow measurement.
  - .2 precision flow balancing.
  - .3 positive flow shut-off.
- .4 Valves to provide multi-turn adjustment with a micrometer indicator located on the valve handwheel. Valve handwheel to have a memory feature to lock the valve position after the system is balanced.
- .5 Valve bodies to be bronze for sizes up to 2" (50 mm), with high strength resin plug. Minimum of four (4) full turns of adjustment.
- .6 Valve bodies to be ductile iron for sizes 2½" (65 mm) and up, with high strength resin plug. Minimum of five (5) full turns of adjustment.
- .7 Each valve to be supplied with pre-formed insulation and a preformed removable PVC insulation jacket. Jackets are to be manufactured by the valve company, made to match the valve.
- .8 Acceptable Products:
  - .1 Armstrong CBV series.
  - .2 Newman-Hattersley 1700 AT and 737 ANSI.
- .9 Flow measurement kit to be provided to allow for adjusting and monitoring flow rates at circuit balancing valves. Kit to be housed in a rugged lockage carrying case, and to include the following:
  - .1 Main display and micro-processing unit with analog output socket and software serial output socket.
  - .2 Semi-flexible nylon connection hoses with isolating valves and quick-release connectors.
  - .3 Insertion temperature probe.
  - .4 Power supply adapter/charger.
  - .5 Test point adapters.
  - .6 User guide.
- .10 Flow measurement kit to be turned over to School Board after commissioning.
- .11 Acceptable Manufacturers:
  - .1 Armstrong.
  - .2 Newman-Hattersley.
  - .3 Tour & Anderson.

**PART 3 Execution**

**3.1 INSTALLATION**

- .1 Check and locate all units or equipment upon arrival.
- .2 Install according to piping layout. Make provision for pipe movement during normal operation. Pipe drains and/or blow-off connections to nearest drain. Level and make secure.
- .3 Maintain proper clearance around equipment to permit service and maintenance. Check final location with Engineer if different from that shown, prior to installation.
- .4 Should deviations beyond allowable clearance arise, request and follow Engineer's directive.
- .5 Refer to manufacturer's installation drawings. Check electrical service work with characteristics stamped on unit.
- .6 Check that all openings for appurtenances and operating weight conform to shop drawings.
- .7 Inspect openings and interiors of equipment, remove any foreign matter from, and clean.
- .8 If accessories and/or ancillaries are delivered separately, assemble to form complete assembly.
- .9 Install control valves, wells, etc. (supplied by Section 23 09 20 - Controls) and circuit balancing valves in pipework as indicated. Provide reducing fittings immediately upstream and downstream of control valves and circuit balancing valves where smaller than line size. Coordinate this work with Controls Contractor.

**3.2 TERMINAL UNITS**

- .1 Install isolating valve on supply and return runouts, and circuit balancing valves for flow balancing on return. Install control valves where specified.

**3.3 CIRCUIT BALANCING VALVES**

- .1 Install strictly in accordance with manufacturer's installation instructions.
- .2 Provide correct lengths of straight pipe upstream and downstream from valves.
- .3 Provide at all hydronic duct coils, terminal units, cabinet unit heaters, on each heating zone, at each boiler and at hydronic water to the domestic water.

**3.4 CONTROL VALVES**

- .1 Control valves are to be provided by the controls contractor (See Section 23 09 20 - Controls) for installation in the piping by the plumbing contractor (See this Section). Controls connections shall be made by Controls Contractor.

**3.5 ASSISTANCE TO BALANCING COMPANY**

- .1 Assist TABC company by providing scaffolds, ladders, tools, extra valves, air vents, testholes, fittings, covers etc. as directed by the balancing company.

- .2 Consult the TABC company for location of water measuring balancing devices, access doors, pressure gauges, thermometers, wells etc. and parts or equipment to provide pertinent data for the testing. Complete the systems, pre-run them and then turn them over to the balancing company for testing and adjusting in working condition.
- .3 After testing is completed, place systems back to original condition, without affecting flow rates. Arrange to repair insulation and painting if damaged.
- .4 For the purposes of this section, TAB Company shall refer to Division 23 contractor. Commissioning Authority shall only be responsible for supervision of commissioning; all commissioning work to be completed by Division 23.

**END OF SECTION**

**PART 1        General**

**1.1            RELATED SECTIONS**

- .1        Section 21 05 01 – Common Work Results for Mechanical.
- .2        Section 25 05 01 – EMCS: General Requirements.

**1.2            REFERENCES**

- .1        American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
- .2        Air Movement Control Association (AMCA):
- .3        American Refrigeration Institute (ARI):
  - .1        ARI 430-2009, Central Station Air-Handling Units.
- .4        Canadian Standards Association (CSA):
  - .1        CSA B139-Series 15, Installation code for oil-burning equipment.
- .5        Sheet Metal Air Conditioning Contractor's National Association (SMACNA).
- .6        National Fire protection Association (NFPA):
  - .1        NFPA(Fire)90A, 2015 Edition, Installation of Air Conditioning and Ventilating Systems.
  - .2        NFPA(Fire)211, 2013 Edition, Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances.
- .7        Underwriters' Laboratories of Canada (ULC):
  - .1        UL 181B-2013, Closure Systems for Use with Flexible Air Ducts and Air Connectors

**PART 2        Products**

**2.1            LOW PRESSURE DUCTWORK**

- .1        Fabricate and install low-pressure sheet metal ductwork and fittings in accordance with ASHRAE "Equipment" Manual, latest edition, Chapter 1 "Duct Construction" and SMACNA Low Pressure Duct Construction standards.
- .2        All joints and seams to be covered with sealant, Duro-Dyne GS or approved equal.

**2.2            FLEXIBLE DUCTWORK**

- .1        Comply with UL 181B Class 1 and NFPA(Fire)90A, latest edition, and SMACNA Standards for Flexible Ductwork.
- .2        Use flexible ductwork for duct runouts, where indicated.
- .3        Insulate all supply main and branch ductwork including flexible ducts for the ERV.
- .4        Insulated flexible duct to be Flexmaster Triple Lock type V thermal or approved alternative, with 25 mm thick glass fibre insulation and UL listed vapour barrier.

- .5 Maximum length of flexible ductwork runs to be 2.0 m.

### **2.3 ACOUSTIC LINING**

- .1 Provide acoustic lining for rectangular supply and return air ducts in locations indicated on the drawing.
- .2 Lining shall consist of 25 mm thick rigid fibreglass with neoprene coated vapour barrier, secured to inside of duct with approved adhesive and metal clips and washers on 300 mm centers. Seal edges and joints with approved fire resistant mastic. Increase indicated duct sizes to accommodate lining seal and smooth all exposed edges.

### **2.4 BALANCING DAMPERS**

- .1 Provide balancing dampers with locking quadrants in all branch duct runouts, as close to main duct as practical and in locations indicated.
- .2 Dampers to be Duro Dyne ½" Shaft Loc Quadrant Set.
- .3 Use single blade dampers up to and including 300 mm duct, multi-blade opposed patterns above 300 mm duct dimension, to SMACNA details.
- .4 Use elevated regulators for ducts which are to be insulated.
- .5 Do not use splitter type dampers or other flow diverting devices.

### **2.5 FLEXIBLE CONNECTIONS**

- .1 Neoprene and metal assembly, 150 mm wide neoprene attached to 75 mm wide g.s.s. strips at each edge.
- .2 Provide at every inlet and discharge connection to the ERV.
- .3 Fabric of 1,000 gram neoprene-glass fabric retardant treatment.
- .4 Install connections with minimum 25 mm and maximum 50 mm slack, with metal bands firmly attached to ductwork and air handling units to prevent leakage.

### **2.6 PITOT TUBE TEST OPENINGS**

- .1 Provide openings in ductwork at supply fan discharges, exhaust and return fan intakes, major duct branches, and other locations to allow proper balancing of air handling systems. Coordinate with Section 23 05 93 – Testing, Adjusting and Balancing for HVAC as required by the commissioning contractor.
- .2 Openings to be at least 2 m from duct fittings.
- .3 Provide openings at 150 mm centers across ducts with removable neoprene expansion plugs type IP-4, as manufactured by Duro-Dyne.

### **2.7 DUCT ACCESS DOORS**

- .1 Provide access doors upstream and downstream of each duct hot water coil.
- .2 Doors to be Buensod type S or approved alternative, insulated doors in insulated or acoustically lined ductwork.

**2.8 GRILLES AND DIFFUSERS**

- .1 Grilles and diffusers to be the product of a single manufacturer.
- .2 Select grille frames to suit the construction finish. Refer to the Architectural room finish schedule.
- .3 All grilles and diffusers to have factory-applied baked off-white enamel finish unless otherwise indicated. Door grills to be ordered primed for field painting by door manufacturer.
- .4 All grilles and diffusers are to be mounted with concealed fasteners.
- .5 E.H. Price model numbers indicated. Alternatives by Carnes, Titus, Kreuger Metalaire and Nailor Industries are acceptable.
- .6 Schedule: As indicated on the drawing.

**2.9 MOTORIZED DAMPER**

- .1 Parallel blade type. Size to match duct size.
- .2 Structurally formed steel, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals, structurally formed and welded galvanized steel frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Leakage: in closed position less than 2% of rated air flow.

**2.10 LOUVRES**

- .1 Louvres to be factory-made from extruded aluminum sections, with stainless steel or aluminum fastenings.
- .2 Mating sections of large louvres shall slide together and remain interlocked but shall allow expansion and contraction. Cover-plates and field fastenings are not permitted.
- .3 Head, sill and jamb sections to be one piece structural members with extruded caulking slots. All components to have drip lips, water stops and returns to prevent water entry.
- .4 Provide 1/2" (12 mm) mesh aluminum birdscreen in a removable aluminum frame.
- .5 Louvres to be free of scratches and blemishes, and finished in a factory applied coating guaranteed in writing for 20 years.
- .6 Blades for intake louvres to be stormproof pattern with integral water stop.
- .7 Blades for transformer room louvres to be chevron (inverted vee) pattern.
- .8 Ventex model numbers indicated; alternatives by Alumavent and Ruskin are acceptable.

**2.11 BUILDING AUTOMATION SYSTEM (BAS)**

- .1 Refer to Section **25 05 01 – EMCS General Requirements**.

- .2 All control relays installed at this time shall be capable of sending inputs to, and receiving commands from, a single central processing unit. The architecture of the CPU, on which the micro processors are based, must be such that it will be capable of communicating with the School Board's central monitoring station located at a remote facility. Communications must be IBM compatible.

**PART 3 Execution**

**3.1 DUCTWORK**

- .1 In accordance with SMACNA Standards.

**3.2 GRILLES AND DIFFUSERS**

- .1 Fit frames tightly to prevent leakage and smudging, and to completely cover openings.
- .2 Furnish mounting frames to suit construction finish schedule, with concealed fastenings.
- .3 Install grilles plumb with building lines, in alignment where several grilles occur in line, and centrally in ceiling tiles unless otherwise indicated.

**3.3 WORK FOR OTHER SECTIONS**

- .1 Install all thermostats, limit switches, sail switches and safety controls required for control and alarm systems.

**3.4 LEAKAGE**

- .1 Pressure test ductwork systems. Ductwork and connections to be free from audible leaks in quiet ambient. System leakage is not to exceed 1½% of design air volume at design static pressure.

**END OF SECTION**

**1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 21 05 01 Common Work Results for Mechanical
- .2 23 05 00 Common Work Results for HVAC
- .3 26 05 00 Common Work Results for Electrical

**1.2 REFERENCES**

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - .1 ASHRAE 84, Latest Edition – Method of Testing Air-to-Air Heat/Energy Exchangers (ANSI approved)
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
  - .1 Material Safety Data Sheets (MSDS).

**2 PRODUCTS**

**2.1 GENERAL**

- .1 Comply with ASHRAE 84.

**2.2 ENERGY RECOVERY VENTILATORS (ERV) (COMMERCIAL)**

- .1 CSA approved ERV's as shown on the drawings and/or specified.
- .2 Cross-flow energy recovery core to transfer energy between the two airstreams, easily removable for cleaning or service.
- .3 Two PSC motors and centrifugal blowers 0.4 HP each.
- .4 Plate-type polymeric membrane cores.
- .5 Quiet operation.
- .6 Merv-8 filters.
- .7 Defrost system with re-circulating damper and controls. Recirculation Defrost (E650-Ri) controls 24 VAC, 10 VA output for motorized dampers Low-voltage dry contact (24 VAC, 20 VA).
- .8 Casing to be 20 gauge pre-painted galvanized sheet steel with thermal insulator to prevent condensation. Unit to have condensate drain connection.
- .9 Wall-mounted unit controls to include
  - .1 5-Speed operation in each mode
  - .2 Four user selectable operational modes
    - .1 Continuous re-circulation
    - .2 20 min ON / 40 min OFF
    - .3 20 min ON / 40 min re-circulation
    - .4 Continuous ventilation

- .3 Humidity control, adjustable
- .4 Built-in relay for interfacing operation with heating system (radiators)
  
- .10 Unit performance as shown on drawings.
- .11 Unit to have a 15 year warranty on the heat recovery core, and 2 year warranty on all other parts.
- .12 Units manufactured by Aldes, VanEE and Venmar are acceptable.
  
- 3 EXECUTION**
- 3.1 MANUFACTURER'S INSTRUCTIONS**
  - .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- 3.2 INSTALLATION**
  - .1 Install in accordance with manufacturers recommendations.
  - .2 Install access doors in accordance with Section 23 33 00 – Air Duct Accessories.
  - .3 If required, connect condensate drain from ERV unit to the indirect connection to the funnel drain in the basement janitor room.

**END OF SECTION**

## **1 GENERAL**

### **1.01 SUBMITTALS**

- .1 Submit shop drawings/product data sheets for air-to-air heat pumps, including accessories, and required power and control wiring schematics.
- .2 Submit with delivery of each unit a copy of the factory inspection report, and include a copy of each report with O & M Manual project close-out data.
- .3 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.

### **1.02 QUALITY ASSURANCE**

- .1 Heat pump equipment, as required, is to be stamped with a Canadian Registration Number (CRN).
- .2 Heat pumps and accessories are to be in accordance with following:
  - .1 CAN/CSA B52, Mechanical Refrigeration Code.
  - .2 CAN/CSA C22.2 No. 236, Heating and Cooling Equipment.
  - .3 UL 1995, Heating and Cooling Equipment.
  - .4 ANSI/AHRI Standard 210/240, Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
  - .5 ANSI/ASHRAE Standard 12 – 2019: Safety standard for refrigeration system.
  - .6 Governing Provincial and/or Municipal Codes and Regulations.
- .3 Acceptable manufacturers are:
  - .1 Mitsubishi Group.
  - .2 Daikin Industries Limited.
  - .3 Hitachi.
  - .4 Fujitsu Limited.

## **2 PRODUCTS**

### **2.01 AIR-TO-AIR HEAT PUMPS – OUTDOOR CONDENSING UNITS**

- .1 LG Multi V 5 Variable Refrigerant Flow (VRF) or approved equal, outdoor unit shall be single, dual, or triple frame outdoor unit combinations connected to indoor units with a single refrigerant piping system using factory designed and supplied Y-branches, Headers, and/or Heat Recovery Units and have integrated controls. The Heat Recovery Unit shall be capable of changing mode of individual indoor units or zones (cooling to heating or heating to cooling) within a maximum time frame of three 3 minutes to ensure indoor temperature can be properly maintained.

- .2 Temperature Ranges: The system shall operate in heating only mode (i.e. all indoor units in heating mode) from -22°F to 61°F outdoor ambient wet bulb. Heat Pump systems can operate in cooling mode from 5°F to 122°F outdoor ambient dry bulb.
- .3 Casing: Outdoor units shall be constructed of galvanized steel, bonderized and finished with baked enamel paint. Each frame shall have a removable inspection panel to allow access to service tool connections, DIP switches, auto addressing, and error codes. The entire front panel of the outdoor unit shall be removable for maintenance. Outdoor unit frames are completely factory assembled, piped and wired. Dual and triple frame outdoor units are field piped with factory designed and supplied outdoor unit Y-branch kits to manifold them together into a single refrigerant circuit.
- .4 Refrigerant System: The refrigeration system consists of a single refrigeration circuit and uses R410A refrigerant. The outdoor unit shall be provided with factory installed components, including a refrigerant strainer, check valves, oil separator, oil level sensor, accumulator, four-way reversing valves, electronically controlled expansion valve (EEV), high and low side charging ports, high pressure safety switch, service valves, and interconnecting piping. Integral sub-cooler assembly consisting of a double spiral tube-type subcooling heat exchanger and EEV providing modulation of up to 23°F subcooling.
- .5 Compressors: Vibration isolated, hermetic, oil lubricated scroll compressor(s), each equipped with an overload protected motor and high discharge pressure and low suction pressure safety cut-outs.
- .6 Fans and Motors: Two direct drive, variable speed, biomimetic enhanced, propeller type fans. Fan motors shall have inherent protection, permanently lubricated bearings, and variable speed with a maximum speed up to 1,150 rpm. Fan guards to limit contact with moving parts.

## **2.02 MASTER CONTROLLER**

- .1 Master controller to be LG-Smart5-PACS5A000 (or approved equal).
- .2 Controller is to monitor the following:
  - .1 Two Setpoint Auto-changeover.
  - .2 Two Setpoint Setback.
  - .3 200 Programmable Schedule Events with control of Setpoint, On/Off.
  - .4 Mode, Fan Speed and Controller Lock.
  - .5 Temperature Setpoint Range Limit.
  - .6 Remote Controller Lock (All, Setpoint, Mode, Fan Speed).
  - .7 Run Time Limit (Unoccupied Override).
  - .8 Software Device Interlocking.
  - .9 Manual Control and Scheduling of IO Module.
  - .10 Peak/Demand Control.

.11 Visual Floor plan Navigation.

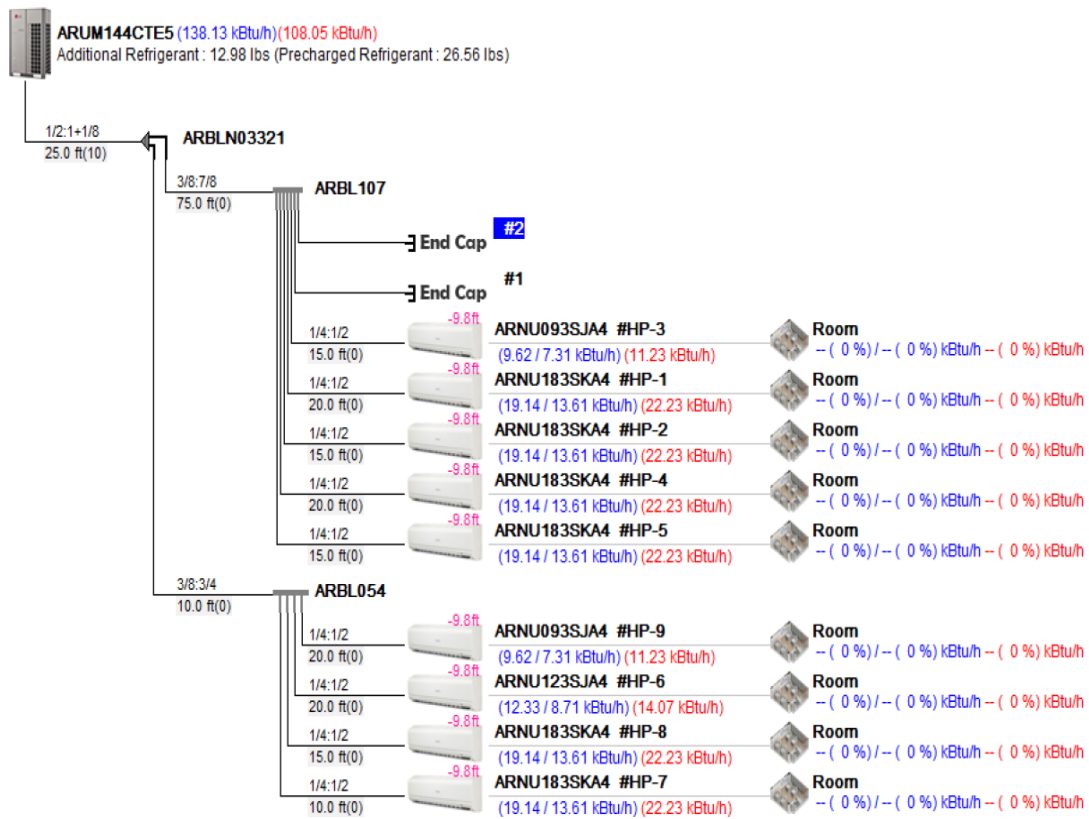
.12 Error E-mail Notification.

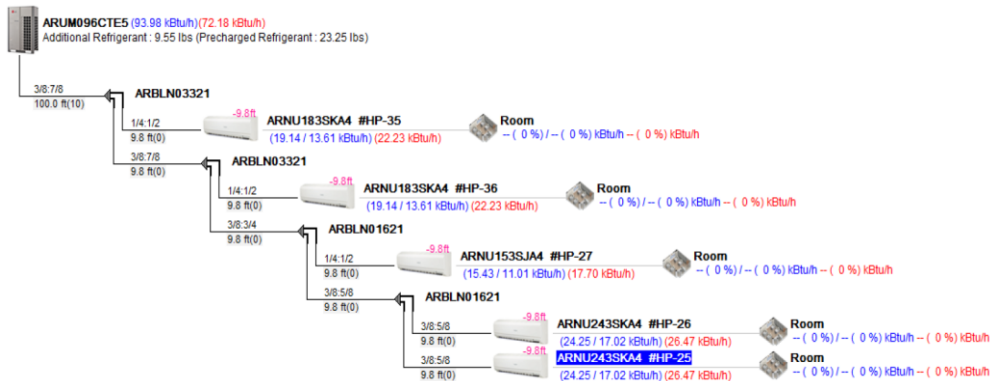
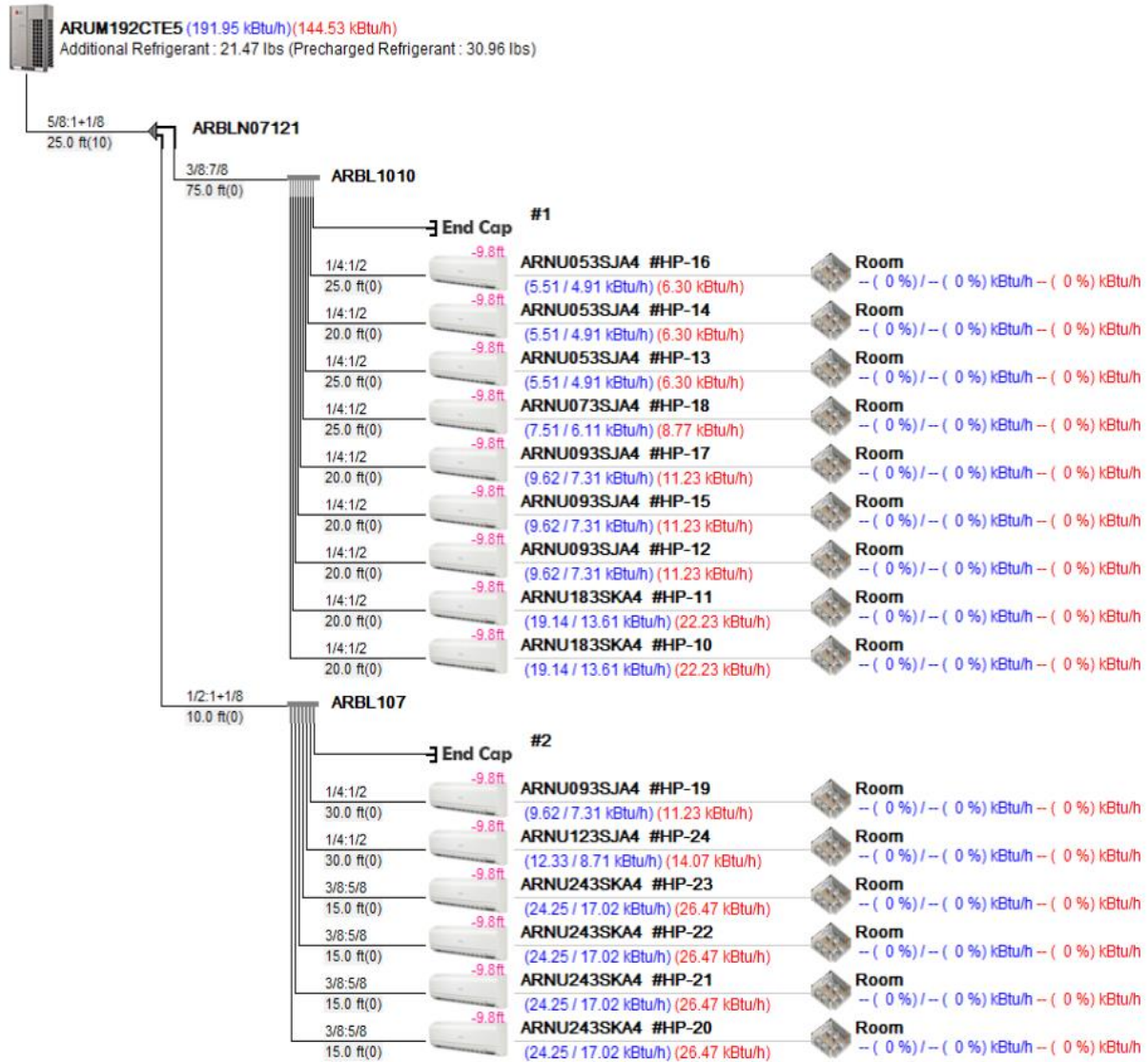
**2.03 ADDITIONAL CONTROLS AND ACCESSORIES**

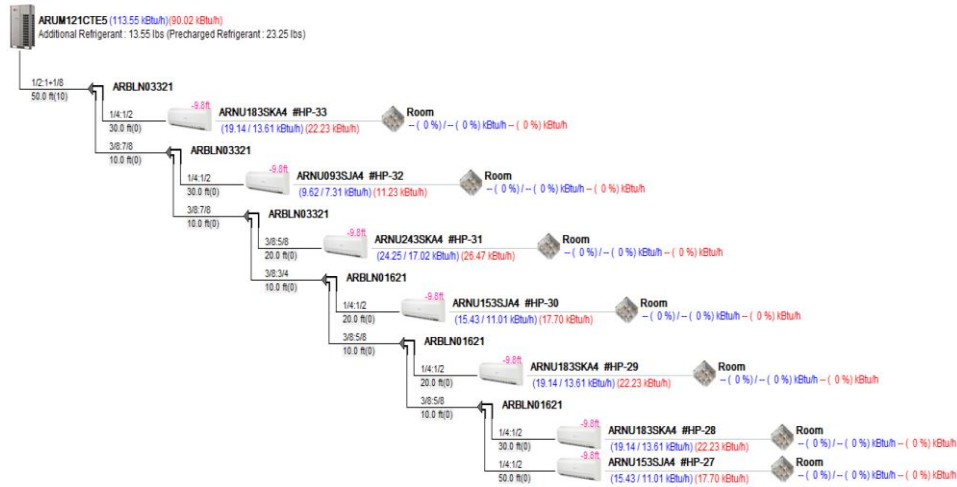
.1 Wall mount Auxiliary heater controller LG M# PRARS1 (or approved equal).

.2 Dry contact for the thermostat LG M# PDRYCB320 (or approved equal).

**2.04 HEAT PUMP SYSTEM DIAGRAM**







### 3 EXECUTION

#### 3.01 INSTALLATION OF AIR-TO-AIR HEAT PUMPS

- .1 Provide air-to-air heat pumps.
- .2 Secure each heat pump assembly in place, level and plumb, on full length steel rails supplied with heat pump assembly and in accordance with manufacturer's instructions.
- .3 Brace and secure each assembly in accordance with requirements specified in Section entitled Seismic Control and Restraint.
- .4 Include for a 1/2 day on-site heat pump operation demonstration and training session. Training is to be a full review of all components including but not limited to a full heat pump internal inspection, construction details, operation, maintenance, abnormal events, and setting up controls.

END OF SECTION

**1 GENERAL**

**1.01 SUBMITTALS**

- .1 Submit shop drawings/product data sheets for radiation units, including accessories, and any required control wiring schematics.
- .2 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.
- .3 Submit manufacturer's standard color chart for tube panel radiation.

**2 PRODUCTS**

**2.01 FIN-TUBE TYPE RADIATOR**

- .1 The contractor shall furnish and install Zehnder Rittling Architectural Series Fin Tube Enclosure (or approved equal) with required mounting components and accessories to meet size, capacity and characteristics as required on the Equipment Schedule or on the plans. Units shall be installed in a neat and workmanlike manner in accordance with specifications and manufacturer recommendations. All material shall be manufactured by Zehnder Rittling (or approved equal manufacturer).
- .2 Baseboard radiation complete with:
  - .1 Heating elements: Seamless copper tubes mechanically expanded into collars integral with continuous plate type aluminum fins.
  - .2 Enclosure: One-piece #18 gauge cold rolled steel front louvred panel with a factory prime coat finish, #10 gauge galvanized steel support brackets, and all required enclosure accessories (including valve boxes) to suit mounting arrangements shown.
- .3 Finish:
  - .1 All enclosures and accessories shall be degreased and chemically phosphatized before application of a durable, attractive electrostatic epoxy powder coating. Color to be selected by architect.
- .4 Acceptable manufacturers are:
  - .1 Modine Manufacturing Co.
  - .2 Rosemex Inc.
  - .3 Slant/Fin Ltd.
  - .4 Engineered Air.

**2.02 LINEAR RADIANT CEILING PANELS**

- .1 The contractor shall furnish and install Zehnder Rittling LRCP linear radiant ceiling panels (or approved equal) with required mounting components and accessories to meet continuous linear radiant ceiling panels sized and arranged as shown and scheduled on drawings, complete with:

- .1 Extruded aluminum panels with aluminum saddles to secure 12 mm (½") diameter type "L" copper piping, non-hardening heat conductive paste between piping and panels, and a white finish factory applied to face of each panel.
- .2 Cross channel braces in quantities as recommended by panel manufacturer to suit panel length, and end and center clips.
- .3 All required type "L" copper piping return bends and connection fittings.
- .2 Finish:
  - .1 All Linear Radiant Ceiling Panels shall be degreased and chemically phosphatized before application of a durable, attractive electrostatic epoxy powder coating. Color to be selected by architect.
  - .3 Acceptable manufacturers are:
    - .1 Adair Industries "Airtex"
    - .2 Rosemex Inc.
    - .3 TWA Panel Systems Inc.
    - .4 Sigma Corp.

### **3 EXECUTION**

#### **3.01 INSTALLATION OF FIN-TUBE DIRECT RADIATION UNITS**

- .1 Provide fin-tube type direct radiation units.
- .2 Secure enclosure brackets in place at maximum 900 mm (35") centers and install element supports or cradles. Slope elements to ensure proper water circulating and to eliminate air. Ensure enclosures are level and plumb. Provide required enclosure accessories.
- .3 Connect elements with piping. Provide radiator type valves in piping at each element or group of series connected elements, shut-off type in supply piping, balancing type in return piping. Unless otherwise noted or specified, locate valves and accessories inside enclosures or behind trim, and ensure valves are accessible.
- .4 Where 2 or more heating elements are connected in series, join elements with piping the full size of the element tubes or use piping sized to supply pipe size and connect elements with eccentric fittings.
- .5 Equip each element or group of series connected elements with a manual air vent installed in an accessible location.
- .6 Provide proper height, cleaned and prime coat painted, flanged steel pipe supports for free-standing radiation units. Size inside diameter of supports to suit diameter of heating piping which is to extend through the supports to the elements. Secure supports to floor over floor openings.

#### **3.02 INSTALLATION OF RADIANT CEILING PANELS**

- .1 Provide linear radiant ceiling panels. Install cross channel braces, end and center clips in accordance with panel manufacturer's details.
- .2 Secure panels in place on T-bars and/or wall channel molding provided as part of suspended ceiling system work and provide ceiling hanger wire at 1.2 m (48") centers between structure and cross channel braces.
- .3 Interconnect radiant panels by means of 12 mm dia. (1/2") soft copper tubing or connection accessories supplied with panels, as required. Ensure heating piping system has been flushed and cleaned prior to connecting radiant panels.
- .4 Personnel handling unprotected panels are to wear clean white gloves to avoid soiling panel face finish.
- .5 When installation of the panels is complete, cover the top of active panels with 25 mm (1") thick glass fiber batt insulation.

**END OF SECTION**

**PART 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 22 42 00 – Plumbing and Drainage.
- .2 Section 23 09 00 – Heating.
- .3 Section 23 36 01 – Air Distribution.
- .4 Section 23 05 93 – Testing, Adjusting and Balancing for HVAC
- .5 Division 26.

**1.2 GENERAL REQUIRES**

- .1 All control work will be done by a controls contractor to be carried by the mechanical contractor. For the purposes of tendering, this shall be carried as an allowance as defined in the front end specifications. Detailed control equipment requirements will be established with the school board's preferred controls contractor after tender, in conjunction with the winning mechanical contractor.
- .2 The sequences of operations have been provided here to indicate minimum controllability requirements of equipment to be provided.
- .3 The building automation system technology used shall be the proprietary controls networking developed by KMC Controls, Inc.

**1.3 WORK BY OTHER SECTIONS**

- .1 Sections 23 09 00 - Heating and Section 23 36 01 – Air Distribution shall provide and install pipe wells and duct insertion test holes as required to accommodate the needs of the Building Automation System (BAS). Pipe wells shall be stainless steel, separable socket type; duct insertion points shall be prefabricated type with neoprene gasketing as required.
- .2 Division 26 will provide hardwire interlocking between starters. Division 26 to coordinate with this section for the installation of relays etc.
- .3 Low voltage wiring to be by controls contractor, line voltage to be by Division 26.

**PART 2 Products**

**2.1 BUILDING AUTOMATION SYSTEM (BAS)**

**2.2 CONTROL COMPONENTS**

- .1 Indoor Unit Thermostats:
  - .1 Thermostats shall be provided with the VRF system from the same manufacturer for each indoor unit, as shown on the mechanical drawings.

- .2 Individual thermostats shall be the Simple Controller with Mode Selection, model PQRCL0QW (White), by LG (or approved equal) complete with the following features:
  - .1 On/Off operation
  - .2 Mode selection – Cool/Heat/Dry/Fan/Auto
  - .3 Fan speed selection
  - .4 Static pressure setting
  - .5 Child lock
  - .6 LED indicator
  - .7 Manual central control addressing
- .3 Individual thermostats shall be able to be locked out from the VRF system's central controller.
- .4 Install LG Aux heat relay kit M# PRARH1 (or approved equal) to interlock indoor heat pump unit with radiator control valve. VRF system to be the first stage system and hot water radiator to be the second stage. Install dry contact LG M# PDRYCB320 (or approved equal) if connecting to the different manufacturer thermostat.
- .2 Damper Actuators (for all dampers, whether connected to the BAS or not):
  - .1 All operators to be oil-immersed, gear train or electro-hydraulic, suitable for PWM (pulse width modulation) control or with solid state positioner to accept analog control signal. Actuators shall be provided and installed by the controls contractor unless specifically mentioned otherwise in equipment specifications. The dampers are to be provided and installed by Section 23 36 01 – Coordinate with Section 23 36 01 under paragraph 2.5.
  - .2 Acceptable manufacturers:
    - .1 Belimo.
- .3 Control Valves:
  - .1 This section shall supply the temperature control valves. Valves shall be installed in the piping by Section 23 09 00 - Heating.
  - .2 Automatic control valves shall be sized properly by the manufacturer in accordance with published data to match the load requirement of the equipment to which they are supplied. Pressure drop to be limited to 3 psi (20 kPa) on air handling coils.
  - .3 Bodies to be cast bronze up to and including 2" (50 mm) and cast iron for 3" (75 mm) and over. All valve bodies to be rated for a minimum of 250 psi (1700 kPa) at 260°F (125°C) water temperature.
  - .4 All valves 2-1/2" (65 mm) and over to be equipped with raised face flanges rated at a minimum of 250 psi (1700 kPa).
  - .5 Valves shall have following characteristics:
    - .1 Hydronic duct coils (Cv below 5) 2-way and 3-way, 1/2" and 3/4" (12 mm and 20 mm).
      - .1 Bronze body & seat.
      - .2 Stainless Steel Stem.
      - .3 Brass plug.
      - .4 Operating pressure 230 psig.
      - .5 Operating temperature range 40° to 210°F.

- .6 Close-off pressure 40 psi.
- .2 Other 2-way and 3-way (Cv. 5 and above) ¾" (20 mm) and up:
  - .1 Cast iron body.
  - .2 Stainless Steel Stem.
  - .3 Brass plug.
  - .4 Operating pressure 230 psig.
  - .5 Operating temperature range 40° to 210°F.
  - .6 Close-off pressure 40 psi.
- .6 Acceptable manufacturers:
  - .1 Belimo.
- .4 Temperature Sensors:
  - .1 All fluid and duct temperature sensors shall be immersion type. Section 22 42 00 – Plumbing and Drainage (the plumbing contractor) will provide wells for all piping applications. Section 23 36 01 – Air Distribution (the ventilation contractor) shall provide all duct ports and accessories. Strap on sensors will not be accepted. Coordinate sensors with divisions providing the wells and ports.
- .5 Temperature Transmitters:
  - .1 Transmitters shall be furnished in scaled ranges compatible with system operating range.
- .6 Relays and Signal Transmitters:
  - .1 All necessary relays, contacts and interface devices shall be furnished by the controls contractor to make the system a full and operable system.

### **2.3 SEQUENCE OF OPERATION – VRF SYSTEM**

- .1 VRF: VRF systems shall be fully controlled by a dedicated controller provided by VRF system manufacturer.
- .2 In cooling mode, VRF system shall activate the heat pumps to achieve temperature set point of each zone.
- .3 In heating mode, VRF system shall activate the heat pumps to achieve temperature set point of each zone. When the temperature setpoint is not achieve, signal shall be sent to the radiator valve to open.
- .4 Minimum features of this controller shall be:
  - .1 20x4 character LCD
  - .2 Indoor unit monitoring and control
  - .3 Error history log
  - .4 On/off control
  - .5 Mode, setpoint and fan speed control
  - .6 200 programmable schedule events with control of all indoor unit functions
  - .7 Auto-changeover between modes
  - .8 Temperature setpoint range limit
  - .9 Remote controller lock (all, setpoint, mode)
  - .10 Peak/demand control

- .5 Output points for monitoring of system by BAS
- .6 The following points shall be monitored by the BAS system
- .1 Status and mode of each condensing unit.
  - .2 Status and mode of each indoor evaporator unit.
  - .3 Alarm status of each condensing unit.
  - .4 Alarm status of each indoor evaporator unit.
- .7 Heat pumps:  
Run Conditions - Scheduled:  
The unit shall run according to a user definable time schedule in the following modes:
- Occupied Mode: The unit shall maintain
    - A 24°C (adj.) cooling setpoint
    - A 21°C (adj.) heating setpoint
  - Unoccupied Mode (night setback): The unit shall maintain
    - A 29.5°C (adj.) cooling setpoint.
    - A 13°C (adj.) heating setpoint.

Alarms shall be provided as follows:

- High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
  - Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

Zone Setpoint Adjust:

The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.

Fan:

The fan shall run anytime the unit is commanded to run, unless shutdown on safeties.

The fan speeds shall be indexed as follows:

- Low speed shall run anytime the zone temperature is within setpoints.
- Medium speed shall run anytime the zone temperature is outside of setpoints.
- High speed shall run anytime the zone temperature is outside of setpoints by a user definable amount (adj.).

**2.4 SEQUENCE OF OPERATION – HOT WATER RADIATOR AND RADIANT CEILING PANELS**

.1 Run Conditions –  
Heating Coil Valve:

When the heat pump does not maintain the temperature set point of the room, the thermostat shall send signal to the heating valve to open.

The thermostat shall measure the zone temperature and modulate the heating coil valve to maintain its heating setpoint.

The heating shall be enabled whenever:

- The zone temperature is below heating setpoint.

Alarms shall be provided as follows:

- Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

**2.5 SEQUENCE OF OPERATION – ERV**

1. Run Conditions - Scheduled:

The unit shall run according to a user definable time schedule in the following modes:

- Occupied Mode: Unit shall run continuously between 5am to 9pm.
- Unoccupied Mode: Unit shall be off between 5am to 9pm.

Emergency Shutdown:

The unit shall shut down and generate an alarm upon receiving an emergency shutdown signal.

Supply Fan:

The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties.

Alarms shall be provided as follows:

- Supply Fan Failure: Commanded on, but the status is off.
- Supply Fan Runtime Exceeded: Status runtime exceeds a user definable limit (adj.).

Heating Coil Valve:

The controller shall measure the zone temperature and modulate the heating coil valve to maintain its heating setpoint.

The heating shall be enabled whenever:

- The zone temperature is below heating setpoint.
- AND the supply fan status is on.
- AND the cooling is not active.

**END OF SECTION**

PROJECT N° 211-06664-00

# ELECTRICAL SPECIFICATIONS

CONSEIL DES ÉCOLES PUBLIQUES DE L'EST DE L'ONTARIO  
KEMPTVILLE SCHOOL AIRCONDITIONING ADDITION  
ADMINISTRATION BUILDING

ISSUED FOR PERMIT/TENDER  
JUNE 30, 2021



SECTION.      TITLE

**DIVISION 26 - ELECTRICAL**

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| 26 05 21 | Wires and Cables (0-1000 V)                       |
| 26 05 29 | Hangers and Supports for Electrical Systems       |
| 26 05 31 | Splitters, Junction, Pull Boxes and Cabinets      |
| 26 05 34 | Conduits, Conduit Fastenings and Conduit Fittings |
| 26 24 00 | Distribution Equipment – Low Voltage              |
| 26 57 01 | Commissioning – Electrical                        |

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1 **General**

1.1 **REFERENCES**

- .1 Ontario Electrical Safety Code, 27<sup>th</sup> Edition, 2018
- .2 Canadian Standards Association (CSA International)
  - .1 CSA C22.1-09, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.
- .3 Electrical and Electronic Manufacturer's Association of Canada (EEMAC), Canadian Electrical Manufacturers Association (CEMA)
  - .1 EEMAC 2Y-1-1958, CEMA Standard for CEMA Light Gray Colour for Indoor Switchgear.
- .4 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NEK)
  - .1 IEEE 100(SP1122) 2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition. Codes and Standards.

1.2 **DEFINITIONS**

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE 100 (SP1122).

1.3 **DESIGN REQUIREMENTS**

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
  - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates and labels for control items in English and French.
- .4 Use one nameplate or label for each language.

1.4 **SUBMITTALS**

- .1 Submittals: in accordance with Section 01 30 00 - Submittals.
- .2 Product Data: submit WHMIS MSDS in accordance with Section 01 61 00 - Common Product Requirements.
- .3 Shop drawings:
  - .1 Submit one (1) copy of shop drawings up to 8½" x 11" original sheet size and descriptive data for electrical equipment and components. Reproduce shop drawings on 8½" x 14" sheets, leaving the bottom end blank for applying shop drawing stamps, comments, etc. Submit six (6) copies of shop drawings, which are larger than 8½" x 11" sheet size.
  - .2 Each shop drawing shall clearly indicate:

- .1 Name of Contractor
- .2 Name of Consultant
- .3 Name of Component
- .3 Show details of construction, dimensions, capacities, weights, electrical data and performance characteristics, on shop drawings.
- .4 Wiring diagrams, control schematics and descriptions of operation must also be included.
- .5 Submit pertinent shop drawings to pertinent electrical utilities and authorities for approval prior to submission to the Consultant.
- .6 Review of shop drawings by the Consultant indicates only that the quality and general design of the equipment is acceptable. Verification of detailed design compliance, dimensions and quantities, or the location of connections to equipment, shall be the responsibility of the Contractor.
- .7 Submit shop drawings for at least the following:
  - .1 Disconnect switches, circuit breaker and fuse details and tripping characteristics, instrument transformers and protection relays, etc., and complete protection co-ordination study. Include also descriptions of operation together with at least the following:
    - .1 Physical sizes, assemblies, weights, etc.
    - .2 Single line and three line drawings.
    - .3 Wiring diagrams.
    - .4 Schematic/control diagrams.
  - .2 Motor control equipment including starters, contactors, overload heater data, control relays, time delay relays, special relays, motor circuit and control circuit fuses/breakers as applicable, pilot lights, control transformers and selector switches, power factor correction capacitors, etc. Include also complete motor control schematics, etc.
    - .1 Detailed wiring schematics specific to this installation. Use of typical drawings is not acceptable. The wiring schematics shall show and individually identify wiring from the individual field device to its termination point. Terminals in panels and wiring conductors to be identified and field tagged by a numerical numbering system. Field wiring shall be tagged with a sleeve type PVC marker system such as the Electrovert "Z Markers".
    - .2 Details of customer wiring related to terminal numbers as well as specific wiring circuits, such as for fire pump, automatic detectors, generator circuits, sprinkler systems, door hold open devices, auxiliary functions, signals, etc.
    - .3 Cabinet sizes and complete internal layouts, showing location of cards (alarm, monitor and auxiliary function cards), batteries and terminal locations, etc.
  - .3 Seismic installation details for equipment and conduits.
  - .4 Schedule of nameplates.
- .4 Construction and Interference Drawings:
  - .1 Where indicated, as called for below and where it is perceived that an interference with electrical work to be installed may occur which would result in changes to ceilings, walls or the location of outlets or equipment, prepare interference drawings, in conjunction with pertinent trades, in advance of the work to show proposed detailed and coordinated solutions for review by the Consultant.

- .2 Prepare composite construction drawings, fully dimensioned, in metric, of cable, conduit, bus duct, shafts, mechanical and electrical equipment rooms, including switchgear rooms, ceiling spaces and all other critical locations to avoid a conflict of trades. Base equipment drawings upon shop drawings and include, but do not necessarily limit to, all details pertaining to clearances, access, sleeves, electrical connections, location and elevation of pipes, ducts, conduits, etc., obtained from consultation with and agreement of the trades involved.
  - .3 Prepare a complete set of drawings showing all conduit runs and wiring using the information provided in riser diagrams, circuit numbers on floor plans, relevant details, specifications and with reference to drawings of other trades.
  - .4 Prepare all sections and elevations as part of the construction drawings to illustrate complete co-ordination between trades and compliance with all applicable rules for this project.
  - .5 Start preparing the construction drawings immediately on award of contract to ensure that all installations are properly coordinated to the satisfaction of the Consultant, and construction schedule objectives are achieved.
- .5 As Built Drawings:
- .1 During construction, keep on site one (1) complete set of electrical drawings on which shall be clearly indicated deviations made to the original design. The deviations shall include any changes to the following:
    - .1 Equipment location
    - .2 Conduit, system raceways and cable tray, etc.
    - .3 Circuiting and wiring
    - .4 System interwiring
    - .5 Control schematics
    - .6 Riser diagrams and details
  - .2 Keep these drawings up to date weekly and available for review on site by the Consultant.
  - .3 Turn over to the Consultant a completed set of "as built" drawings upon completion of the project. The as-built drawings shall include changes to the work made during construction. Ensure that corrections are also made on floor plans, riser diagrams, details, schedules, Panel Charts, etc., as applicable:
    - .1 Conduit and wiring and deviations from circuit numbers shown on the Contract Documents.
    - .2 Revise motor control schedules and control schematics as necessary.
    - .3 Revise and/or draw "Details" drawings and schedules.
- .6 Progress Billing Backup Information: Immediately after award of contract, submit a breakdown of the tender price. This will be used in evaluating progress claims which shall be submitted using the form provided in clause 3.18. Include pertinent items including but not limited to the following, separately indicating the pertinent labor and material costs:
- .1 Low Voltage Power Distribution including:
    - .1 Switchboards and transformers.
    - .2 Buses and feeders/wiring, etc.
    - .3 Panelboards.
  - .2 Branch circuit conduit, wiring and outlets split into the following categories
    - .1 Normal power systems.
    - .2 Emergency power systems.
  - .3 Motor control equipment and related conduit and wiring. Also including mechanical equipment connections.

- .4 Grounding
  - .5 Lighting fixtures and lamps.
  - .6 Fire alarm system.
  - .7 Public address system empty conduits.
  - .8 Intercom systems empty conduits.
  - .9 Communication systems, telephone/data empty conduits.
  - .10 Security system empty conduits.
  - .11 Miscellaneous.
  - .12 Cash allowance(s).
- .7 Quality Control: in accordance with Section 01 45 00 - Quality Control.
- .1 Provide CSA certified equipment and material.
  - .2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.
  - .3 Submit test results of installed electrical systems and instrumentation.
  - .4 Permits and fees: in accordance with General Conditions of contract.
  - .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
  - .6 Submit certificate of acceptance from inspection authority upon completion of Work to Departmental Representative.
- .8 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.
- 1.5 **QUALITY ASSURANCE**
- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Act respecting manpower vocational training and qualification.
- .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
  - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings: as part of Manufacturer's Field Services described in Part 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work, at stages listed.
- .1 After delivery and storage of products, and when preparatory Work 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.
- .4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements..
- 1.6 **DELIVERY, STORAGE AND HANDLING**
- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.

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

## 1.7 **SYSTEM STARTUP**

- .1 Instruct Client's operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .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 will aspects of its care and operation.

## 1.8 **OPERATING INSTRUCTIONS**

- .1 Provide Operation and Maintenance (O&M) Manuals in accordance with the requirements of Section 01 30 00 - Submittals and as specified herein.
  - .1 Submit one (1) manual to the Consultant for approval prior to formal submission of all copies to the Owner. Include in manuals information based on the following requirement:
    - .2 Operation and maintenance instructions to be sufficiently detailed with respect to design elements, construction features and component function and maintenance requirements to permit effective start up, operation, maintenance, repair, modification, extension and expansion of any portion of the system.
    - .3 Technical data to be in the form of approved shop drawings, project data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature will not be acceptable.
  - .2 Provide wiring and schematic diagrams and performance curves.
  - .3 Include names and addresses of local suppliers for items included in maintenance manuals.
  - .4 Operation and maintenance data to be compiled in good quality, 3 ring, Type 'D' binders no thicker than 50 mm and no more than 2/3 full. Binders must be clearly and permanently identified on spine and front with project name and number and the binder contents. Insert any material larger than 215 mm by 280 mm (i.e., folded prints) into appropriately sized and properly reinforced envelopes with flap to top of binder. The envelope shall be fitted into the binder rings at the appropriate location and its contents clearly identified on the front and back. Organize the binders as follows:
    - .1 Binder to contain Electrical equipment.
    - .2 .
  - .5 Divide information in O&M Manuals binders into the following categories:
    - .1 Operation:
      - .1 Detailed description of operation of all systems.
    - .2 Equipment:
      - .1 Details of components used
    - .3 Maintenance:
      - .1 Trouble shooting techniques.

- .2 Lubrication and other requirements as applicable.
  - .4 Spare Parts:
    - .1 Receipts for maintenance parts turned over.
  - .5 Warranties:
    - .1 Outline of coverage, starting and expiry dates.
  - .6 Certificates:
    - .1 Electrical Safety Authority acceptance.
    - .2 Fire Alarm Inspection and Certification.
  - .7 Test Reports.
  - .6 Provide Operation and Maintenance information organized in binders as detailed above, for systems/equipment, including the following:
    - .1 Circuit Breakers, Disconnects and Fuses
  - .2 Operating instructions to include following:
    - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
    - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
    - .3 Safety precautions.
    - .4 Procedures to be followed in event of equipment failure.
    - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
  - .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
  - .4 Post instructions where directed.
  - .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
  - .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.
- 1.9 **SPRINKLEPROOF EQUIPMENT**
- .1 Equipment located in sprinklered rooms shall meet the requirements set out by the Inspection Authority and as listed below:
    - .1 Disconnects.
    - .2 Louvers facing outwards and downwards where openings are required for heat dissipation. (Expanded metal screening is not acceptable.)
    - .3 CSA certified sealing rings for rigid steel galvanised conduit and CSA certified raintight connectors for steel galvanised electrical metallic tubing (EMT) where conduits enter the top or sides of enclosures
- 1.10 **ACCEPTABLE MANUFACTURERS**
- .1 The intent of naming acceptable manufacturers in the specification is to indicate that these manufacturers are likely to be able to comply with the detailed requirements of the specifications. Naming of these manufacturers does not reduce compliance with the specified requirements, even if it means modifying standard products to do so.

2 **Products**

2.1 **MATERIALS AND EQUIPMENT**

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: wiring and connections below 50 V which are related to control systems are specified in mechanical sections and as shown on mechanical drawings.

2.2 **POWER AND CONTROLS FOR MECHANICAL EQUIPMENT**

- .1 Power wiring and disconnect switches for mechanical equipment will be provided by Division 26.
- .2 Starters and soft starts will be supplied with mechanical equipment, installed and wired by Div. 26.
- .3 VFD's will be supplied with mechanical equipment, installed by Div. 26 under direction of Div. 22/23, wired by Div. 26.
- .4 Line voltage thermostats will be supplied by Div. 23, installed and wired by Div. 26.

2.3 **ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Supply and deliver inserts, anchors, bolts, sleeves, ferrules and other items to be built into the work of other Divisions, complete with the necessary templates, instructions and assistance for locating and installing.

2.4 **WARNING SIGNS**

- .1 Warning Signs: in accordance with requirements of Authority Having Jurisdiction inspection authorities and Departmental Representative.
- .2 Decal signs, minimum size 175 x 250 mm.

2.5 **WIRING TERMINATION**

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 **EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with nameplates and labels as follows:
- .2 Nameplates:
  - .1 Lamicoid 3 mm thick plastic engraving sheet mechanically attached with self-tapping screws. Lamicoid colours to be as follows:
    - .1 Black face, white core for equipment on Utility Power.
    - .2 Red face, white core for equipment on Emergency Power.
    - .3 White face, black core for communications and security equipment.
  - .2 Standard nameplate sizes are as indicated below, but unless there are space restrictions, the minimum size of nameplate shall be Size 6 and the minimum size of letters shall be 6 mm.

.3 Nameplate Sizes:

|        | Dimensions  | #Lines | Letter Height |
|--------|-------------|--------|---------------|
| Size 1 | 10 x 50 mm  | 1      | 3 mm          |
| Size 2 | 12 x 70 mm  | 1      | 5 mm          |
| Size 3 | 12 x 70 mm  | 2      | 3 mm          |
| Size 4 | 20 x 90 mm  | 1      | 8 mm          |
| Size 5 | 20 x 90 mm  | 2      | 5 mm          |
| Size 6 | 25 x 100 mm | 1      | 12 mm         |
| Size 7 | 25 x 100 mm | 2      | 6 mm          |

.4 Labels:

.1 Embossed plastic labels with 6 mm high letters unless specified otherwise.

.5 Wording on nameplates and labels to be approved by Consultant prior to manufacture. Abbreviations are not permitted on nameplates.

.6 Allow for average of twenty five (25) letters per nameplate and label.

.7 Identification to be English.

.8 Identify at least the following equipment with nameplates of sizes appropriate to the size of the equipment:

.1 Disconnect Switches: Identify in accordance with the drawings and indicate voltage, phases, current capacity, short circuit rating, power source, system and equipment/load controlled.

.2 Terminal Cabinets and Pullboxes: For power system equipment, indicate system, voltage, power source and load.

.3 Miscellaneous Electrical Equipment: Identify in accordance with drawings to clearly indicate function and system data.

.4 Terminal Cabinets and Pullboxes: For other systems equipment, indicate function and system data.

.9 Identify at least the following equipment with labels of size appropriate to the equipment:

.1 Receptacles: Indicate circuit number. Where there is only one receptacle on the circuit indicate this also by using the abbreviation "DED" with the circuit number. Identify housekeeping receptacles by adding "H".

.2 Switches: Indicate circuit number. Also indicate the area served where the switch is remotely located and/or is in a group of switches.

2.7 **WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system. Identify, using numbers, both ends of each cable as well as each conductor in multi-conductor cables.

2.8 **CONDUIT AND CABLE IDENTIFICATION**

- .1 Colour code conduits, boxes and metallic sheathed cables. For boxes, identify the cover as well as inside each box.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 10 m (or less) intervals. Where tape is used, apply a minimum of two (2) wraps.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

|                              | Prime            | Auxiliary     |
|------------------------------|------------------|---------------|
| Up to 46 kV                  | Yellow<br>Yellow |               |
| Up to 600 V, Normal Power    | Yellow           | Green         |
| Up to 250 V, Normal Power    | Yellow           | Blue          |
| Up to 600 V, Emergency Power | Yellow           | Green and Red |
| Up to 250 V, Emergency Power | Yellow           | Blue and Red  |

2.9 **FINISHES**

- .1 Outdoor Electrical Equipment: "Equipment green" finish to EEMAC Y1 1 1955.
- .2 Indoor Distribution Equipment: "Light grey" to EEMAC 2Y 1 1958.

3            **Execution**

3.1         **COORDINATION**

- .1         Cooperate and co-ordinate with other Divisions as required for a satisfactory and expeditious completion of the Work. Coordinate locations of conduits, raceways, junction and pullboxes, etc., with Divisions 22 and 23 as well as other pertinent trades.
- .2         Instruct and supervise those Divisions doing related work.
- .3         Supply the measurements of equipment to other Divisions to allow for the necessary openings to be left in their work.
- .4         Locate equipment so as to maximize usable space. Install neatly and close to the building structure, raceways, fittings, pull boxes, junction boxes, wiring and cables which are to be concealed, in order that the necessary furring can be kept as small as possible.
- .5         Review relevant shop drawings and product data of other Divisions where they affect the work of this Section, prior to commencing the work.
- .6         Refer to mechanical drawings when coordinating locations of starters, panels, etc.

3.2         **DELIVERY AND STORAGE**

- .1         Store materials and equipment delivered to the site and pending installation in a safe, dry and heated location, protected against dust weather, damage, corrosion and theft.
- .2         Remove rejected material and equipment from the site immediately.
- .3         Touch up damage to factory finishes to the Consultant's satisfaction. Use finishes to match existing. Do not paint over nameplates or labels.

3.3         **PROTECTION**

- .1         Take precautions to protect personnel on the job site from injury due to live equipment and circuits. Shield and clearly mark such circuits or equipment "DANGER – LIVE 208 VOLTS" or the applicable voltage.
- .2         Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.
- .3         Adequately protect concrete floors and finished flooring from damage. Take special measures when moving heavy loads or equipment.
- .4         Keep floors free from oils, grease or other materials likely to discolour them or affect bond of applied surfaces.
- .5         Attach and fasten fixtures and fittings in place in a safe, sturdy, secure manner so that they cannot work loose, fall or shift out of position during normal use of the building.
- .6         Protect finished and unfinished work of this and other Divisions from damage due to carrying out of this work.
- .7         Be responsible for and make good any damage caused directly or indirectly by this contractor to walls, floors, ceilings, woodwork, brickwork, finishes, existing installations, etc.

### 3.4 **CUTTING AND PATCHING**

- .1 Perform cutting and patching required to allow passage of pipes and feeders.
- .2 Obtain Structural Engineer's approval before cutting, boring or sleeving load-bearing members and floors.
- .3 Make cuts with clean, true, smooth edges. Make patches inconspicuous.
- .4 After making good, caulk gaps between pipes, sleeves, ducts and conduits, and openings. Maintain fire rating of walls and floors using electrovert "Flameseal" putty #AA400 or approved ULC equivalent.

### 3.5 **WORKMANSHIP**

- .1 Perform the work in a neat and careful manner so that items are and will remain plumb, square and straight. Ensure that materials and equipment are free from warp, twist or other defects.
- .2 Unless specified otherwise, install products in strict accordance with manufacturers' written instructions and recommended usage.
- .3 Workmanship shall be of a high standard throughout, as detailed below and/or in other Sections of the Specifications.
  - .1 Exposed conduit runs including runs in ceiling spaces shall be parallel to the building lines. Panels, boxes, covers, etc., shall be mounted in a similar manner. These conditions shall be determined using spirit levels.
  - .2 Bolts or nuts in a "stripped" or "cross threaded" condition shall be replaced immediately.
  - .3 Avoid connection between dissimilar metals and use of corrosive material in wet or damp locations.
  - .4 Conceal electrical rough-in in all areas except where surface installations are specifically indicated. Where this becomes impossible, obtain ruling from Consultant as to determine what adjustments are to be made before proceeding with work.

### 3.6 **TRIAL USAGE**

- .1 Trial usage of the work or temporary usage for construction purposes if permitted specifically in writing is not to be construed as acceptance of the Work.

### 3.7 **EQUIPMENT IDENTIFICATION**

- .1 Fasten lamicoid nameplates to equipment with self-tapping screws.
- .2 Colour code conduit, outlets, pull and junction boxes as specified in Part 2 of this Section.
- .3 Identify wiring with permanent markers as specified in Part 2 of this Section.

### 3.8 **INSTALLATION**

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

- .3 Provide seismic bracing and restraint systems for all electrical equipment as required by applicable building codes. Provide engineered, stamped shop drawings for all seismic bracing. Consult with the structural engineer of record for the project to determine appropriate load factors.

### 3.9 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

### 3.10 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: PVC, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

### 3.11 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .1 For **non barrier free** installation, install control devices at the following heights unless indicated otherwise on plans or elevations etc. Mounting height of equipment is from finished floor **to centreline** of equipment unless otherwise specified or indicated.
  - .1 Thermostats: 1200 mm
- .2 For **barrier free** installation, install control devices at the following heights. Mounting height of equipment is from finished floor **to the top** of equipment unless otherwise specified or indicated. Refer to architectural drawings for barrier free area.
  - .1 Thermostats: 1200 mm

### 3.12 FIELD QUALITY CONTROL

- .1 Load Balance:
  - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
  - .3 Provide upon completion of work, load balance report as directed: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Ensure circuit protective devices such as over current trips, relays and fuses are installed to required values and settings.

- .3 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
    - .1 Circuits originating from branch distribution panels.
    - .2 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
    - .3 Insulation resistance testing:
      - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
      - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
      - .3 Check resistance to ground before energizing.
  - .4 Carry out tests in presence of Departmental Representative.
  - .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
  - .6 Manufacturer's Field Services:
    - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
    - .2 Provide 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, as directed in PART 1 - QUALITY ASSURANCE.
- 3.13 **COMMISSIONING**
- .1 Participate and assist in commissioning of all electrical devices and equipment. Refer to Section 01 91 13 - General Commissioning (CX) Requirements.
- 3.14 **CLEANING**
- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
  - .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
  - .3 Do final cleaning in accordance with the General Conditions and, specifically, as follows:
    - .1 Clean lighting fixture reflectors, lamps, lenses and other lighting surfaces that have been exposed to construction dust and dirt.
    - .2 Remove debris and vacuum clean within panelboard tubs, switchgear, terminal cabinets and electric heating fixtures.
    - .3 Remove electrical waste and debris from the site.
- 3.15 **OWNER SUPPLIED EQUIPMENT**
- .1 Make final connections to Owner supplied equipment such as, but not limited to shop equipment, washer/dryers, etc. Confirm electrical requirements of actual supplied equipment prior to pulling of wires.

3.16            **SEISMIC CONSIDERATIONS**

- .1            Design and construct electrical services and their fastenings and supports, to be in accordance with clause 4.1.9.1.(15) of the 1997 Ontario Building Code with an importance factor, I, of 1.5. Design of structural support elements, including connections, shall be carried out by a structural engineer, engaged by the Contractor and licensed in the province of Ontario, who shall seal and sign the design drawings. The sealed drawings shall be submitted along with the electrical shop drawings for review. The structural engineer who seals the drawings shall also carry out sufficient on site review of the work to ensure and to certify in writing that the work is in general compliance with his design.
  
- .2            The objective in providing seismic restraint is to provide for a reasonable level of life safety by concentrating the efforts on restraining heavy equipment in place, maintaining essential life safety related systems and protecting the escape routes from the building.
  
- .3            Electrical equipment and associated services requiring seismic restraints shall include but not necessarily be limited to the following items. Compare with the drawings and add to the list as applicable:
  - .1            Equipment:
  
- .4            Escape route considerations: To maintain accessibility in escape routes, electrical installations must be seismically restrained. These shall include:
  - .1            Conduit

3.17            **PROGRESS CLAIM FORM**

- .1            Prior to the first application for payment, submit a schedule of values in the following format. This form shall be used to file all progress claims. In addition keep a record of, and submit with each claim, a summary of all change notices and change orders.

Project name – \_\_\_\_\_

ELECTRICAL PROGRESS CLAIM # ..... DATE .....

| Item | Description                     | Contract Value |        |       | This Claim |        |       | Previous Claim Total | Total Claim to date | % Claim to date |
|------|---------------------------------|----------------|--------|-------|------------|--------|-------|----------------------|---------------------|-----------------|
|      |                                 | Material       | Labour | Total | Material   | Labour | Total |                      |                     |                 |
| 1    | Startup/Setup                   |                |        |       |            |        |       |                      |                     |                 |
| 2    | Conduit & Fittings              |                |        |       |            |        |       |                      |                     |                 |
| 3    | Boxes-Pull/Junction/Outlet etc. |                |        |       |            |        |       |                      |                     |                 |
| 4    | Feeders                         |                |        |       |            |        |       |                      |                     |                 |
| 5    | Branch Circuit Wiring           |                |        |       |            |        |       |                      |                     |                 |
| 6    | Electrical equipment            |                |        |       |            |        |       |                      |                     |                 |
| 7    | Wiring Devices                  |                |        |       |            |        |       |                      |                     |                 |
| 8    | Motor Controls                  |                |        |       |            |        |       |                      |                     |                 |
| 9    | As Built Drawings and Manuals   |                |        |       |            |        |       |                      |                     |                 |
| 10   | Commissioning                   |                |        |       |            |        |       |                      |                     |                 |
| 11   |                                 |                |        |       |            |        |       |                      |                     |                 |
| 12   |                                 |                |        |       |            |        |       |                      |                     |                 |
| 13   | <b>Totals</b>                   |                |        |       |            |        |       |                      |                     |                 |

| CONTRACT STATUS              |  | CLAIMS TO DATE      |  | PERCENTAGE CLAIMED TO DATE |  |
|------------------------------|--|---------------------|--|----------------------------|--|
| Original Contract Price      |  | Original contract   |  | Original contract          |  |
| Change Orders                |  | Change orders       |  | Change Orders              |  |
| <b>Total Contract Amount</b> |  | <b>Total Claims</b> |  | <b>Total</b>               |  |

**END OF SECTION**

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1           **General**

1.1          **RELATED SECTIONS**

- .1       Section 26 05 21 – Wires and Cables – 1000 V

1.2          **REFERENCES**

- .1       CSA C22.2No.65-1956(R1965) Wire Connectors.

2           **Products**

2.1          **MATERIALS**

- .1       Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2       Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3       Bushing stud connectors: to EEMAC 1Y-2 to consist of:
  - .1       Connector body and stud clamp for stranded or round copper conductors, tube, or bar.
  - .2       Clamp for stranded or round copper conductors or bar.
  - .3       Stud clamp bolts.
  - .4       Bolts for copper conductors or bar.
  - .5       Sized for conductors, tubes or bars as indicated.
- .4       Clamps or connectors for armoured cable, mineral insulated cable, flexible conduit, as required.

3           **Execution**

3.1          **INSTALLATION**

- .1       Remove insulation carefully from ends of conductors and:
  - .1       Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
  - .2       Install fixture type connectors and tighten. Replace insulating cap.
  - .3       Install bushing stud connectors in accordance with EEMAC 1Y-2.

**END OF SECTION**

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1 **General**

1.1 **RELATED SECTIONS**

- .1 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings
- .2 Section 26 05 36 – Cable Trays for Electrical Systems
- .3 Section 26 05 37 – Wireways and Auxiliary Gutters
- .4 Section 26 05 20 – Wire and Box Connectors – 0 – 1000 V.
- .5 Section 26 57 01 – Commissioning - Electrical

1.2 **REFERENCES**

- .1 CSA C22.2 No.0.3-92, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No.131-M89(R1994), Type TECK 90 Cable.

1.3 **PRODUCT DATA**

- .1 Submit product data in accordance with Section 26 05 00 – Electrical General Provisions.

2 **Products**

2.1 **BUILDING WIRES**

- .1 Conductors: stranded for 8 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors type RW90: Size as indicated, with 600 V insulation to maximum #10 AWG and 1000 V for #8 AWG and larger, of chemically cross-linked thermosetting polyethylene material (XLPE) insulation.
  - .1 Refer 2.1.5 for underground wiring.
- .3 Branch circuit wiring:
  - .1 Wiring for branch circuits shall be sized to limit the voltage drop from the Panelboard to the farthest outlet/fixture to 2% when carrying 80% of the branch circuit breaker rated current.
  - .2 For 120 volt circuits using shared neutrals, minimum wire sizes shall be:
    - .1 #12 AWG for runs up to 30 m.
    - .2 #10 AWG for runs in excess of 30 m up to a distance that ensures compliance with item 1.3.1 above. #10 AWG shall be used for the entire length of run, starting from the protection device.
    - .3 All shared neutrals shall be oversized, #10 AWG or larger for #12 AWG phase conductors. This applies to power as well as lighting circuits.
    - .4 The shared neutrals shall be oversized, #8 AWG or larger for #10 AWG phase conductors. This applies to power as well as lighting circuits.

- .3 For 120 volt circuits, using separate neutrals, minimum wire sizes shall be:
  - .1 #12 AWG for runs up to 21 m.
  - .2 #10 AWG for runs in excess of 21 m up to a distance that ensures compliance with item 1.3.1 above. #10 AWG shall be used for the entire length of run, starting from the protection device.
- .4 For 347 volt lighting circuits, minimum wire sizes shall be:
  - .1 #12 AWG for runs up to 90 m.
  - .2 #10 AWG for runs in excess of 90 m up to a distance that ensures compliance with item 1.3.1 above. #10 AWG shall be used for the entire length of run, starting from the protection device.
  - .3 All shared neutrals shall be oversized, #10 AWG or larger for #12 AWG phase conductors.
  - .4 The shared neutrals shall be oversized, #8 AWG or larger for #10 AWG phase conductors.
- .5 Voltage drop limits for fixed loads and feeders have been accounted for on the drawings.
- .4 Life Safety System Wiring:
  - .1 Solid tinned copper, annealed conductors with coded PVC insulation, and with overall red PVC jacket. Cables shall be CSA approved 300 V, 105°C.
- .5 Underground Wiring:
  - .1 Type RWU-90 for all underground wiring and to padmounted transformers and other exterior underground installations such as site lighting, etc.
- .6 Pressure type connectors, fixture type splicing connectors, cable clamps as required.

## 2.2 **TECK CABLE**

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
  - .1 Copper: based on the same criteria as for building wires.
- .3 Insulation:
  - .1 Chemically cross-linked thermosetting polyethylene rated type RW90 with voltage rating based on the same criteria as for building wires.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking galvanized steel or aluminum.
- .6 Overall covering: Polyvinyl chloride, flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3-M1985 with maximum flame travel of 1.2 m. Minus 25°C or minus 40°C rating.  
Note: FT rating shall be as required by authorities having jurisdiction and applicable codes.
- .7 Fastenings:
  - .1 One (1) hole steel straps to secure surface cables 50 mm and smaller. Two (2) hole steel straps for cables larger than 50 mm.
  - .2 Channel type supports for two (2) or more cables spaced according to code and manufacturer's recommendations.
  - .3 Six mm dia. threaded rods to support suspended channels.

- .8 Connectors:
  - .1 Watertight approved for TECK cable.

### 2.3 **ARMOURED CABLE**

- .1 Conductors: copper based on the same criteria as for Building Wires.
- .2 Type: AC90
  - .1 Armour: interlocking type fabricated from galvanized steel or aluminum strip.
- .3 Type: ACWU90
  - .1 Armour: interlocking type fabricated from galvanized steel or aluminum strip.
  - .2 ACWU90-PVC flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3-M1985 with maximum flame travel of 1.2 m. Minus 25°C or minus 40°C rating.  
Note: FT rating shall be as required by authorities having jurisdiction and applicable codes.
- .4 Connectors: To manufacturer's recommendations.

## 3 **Execution**

### 3.1 **INSTALLATION OF BUILDING WIRES**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 34.  
Note: All wiring shall be in conduit unless specifically indicated otherwise.
  - .2 In cabletroughs in accordance with Section 26 05 37.  
Note: Cables in open cable tray and ceiling spaces shall be FT rated to the requirements of the code and authorities having jurisdiction. Generally cables installed in return air plenums must carry an FT6 classification where such cables are multiple conductors. The given cables must provide a flame spread rating of not more than 25. Plenum spaces that do not function as return air plenums can be equipped with FT4 classification cables.
  - .3 In trenches and underground ducts in accordance with Section 26 05 44.
  - .4 In wireways and auxiliary gutters in accordance with Section 26 05 37.
- .2 Type THHN will not be permitted in lieu of RW-90.
- .3 Minimum branch circuit conductors shall be #12 AWG except for 120 volt control circuits, minimum size of wire shall be #14 AWG.  
Note: Wire sizes shown on the drawings are based on the ampacities of copper conductors with RW-90 insulation. Where alternative types of wire are permitted, adjust wire sizes for equivalent ampacities to RW-90 of the size indicated.
- .4 Install type RWU-90 for underground wiring and to padmounted transformers and other exterior underground installations such as site lighting, etc.
- .5 Length of conductors at outlets for connection to devices to be not less than 200 mm.
- .6 Make joints or splices only within boxes. Do not pull splices into conduit.

### 3.2 **INSTALLATION OF TECK CABLES**

- .1 Install cables.
- .2 Group cables wherever possible on channels.
- .3 Install cable in trenches in accordance with Section 26 05 44.
- .4 Lay cable in cabletroughs in accordance with Section 26 05 36.  
Note: Cables in open cable tray and ceiling spaces shall be FT rated to the requirements of the code and authorities having jurisdiction.
- .5 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors – 0-1000 V.

### 3.3 **INSTALLATION OF ARMoured CABLES**

- .1 Group runs of AC-90. Do not bundle.
- .2 Install cable in trenches in accordance with Section 26 05 44.
- .3 Lay cable in cabletroughs in accordance with Section 26 05 36.  
Note: Cables in open cable tray and ceiling spaces shall be FT rated to the requirements of the code and authorities having jurisdiction.
- .4 Terminate cables in accordance with Section 26 05 20 – Wire and Box Connectors – 0-1000 V.
- .5 Type AC-90 will be permitted only from:
  - .1 Raceway system junction boxes to individual recessed lighting fixtures in suspended, accessible ceilings. Single run to each lighting fixture, max. 5.0 metre lengths. Do not loop from fixture to fixture.
  - .2 Raceway system junction boxes above suspended accessible ceilings to outlets in hollow gypsum board partitions (max. 10 metre lengths).  
Note: AC-90 shall not to be used in this way in Patient Care areas, where wiring shall be in conduits.
  - .3 AC-90 will not be permitted in masonry or concrete walls.

### 3.4 **INSTALLATION OF SINGLE CONDUCTOR ARMoured AND TECK CABLES**

- .1 Space or group cables in accordance with the recommendations of the manufacturer.
- .2 Install non-magnetic and insulating type plates at all cable termination points. At supply points connectors shall be fitted with a grounding style bushing and a No. 6 copper conductor installed to ground supply end of cable sheath to grounding media.  
Note: Ground cable sheath at supply end only for single conductor cables.
- .3 At load end of cable install a non-metallic plate into which the single conductor cables shall terminate. Non-metallic plates 12 mm fibreboard securely bolted over opening cut in enclosure.

3.5            **GENERAL WIRING INSTALLATION REQUIREMENTS**

- .1      Colour Coding:
  - .1      Colour code throughout building, same colour for same phase throughout, by insulation colour or permanently applied colour banding at all distribution centres, panels and outlet boxes.
  - .2      Colour code to be as follows:
    - .1      Equipment grounding conductor: green
    - .2      Neutral conductor: white
    - .3      Standard 120/208 V and 347/600 V phase wires: red, black, and blue
- .2      Replace at no cost to Owner any wire or cable that does not meet insulation testing.

3.6            **TESTING AND COMMISSIONING**

- .1      Carry out Testing and Commissioning in accordance with Section 26 57 01.

**END OF SECTION**

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1 **General**

1.1 **RELATED SECTIONS**

- .1 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings

2 **Products**

2.1 **SUPPORT CHANNELS**

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.

3 **Execution**

3.1 **INSTALLATION**

- .1 Use lead anchors to secure equipment to solid masonry, tile and plaster surfaces.
- .2 Use expandable inserts to secure equipment to poured concrete.
- .3 Use toggle bolts to secure equipment to hollow masonry walls or suspended ceilings.
- .4 Secure surface mounted equipment with twist clip fasteners to inverted T-bar ceilings. Ensure that T-bars are adequately supported to carry weight of equipment specified before installation.
- .5 Support groups of conduits and cables, and equipment on 41 mm x 41 mm x 2.5 mm thick galvanized channels equal to Unistrut P-series, using clips, spring loaded bolt, cable clamps and the like, designed as accessories to basic channel members. No other type of support channels will be accepted. Support channels on 6 mm threaded rod hangers where direct fastening to building structure is impractical.
- .6 For surface mounting of two or more conduits use channels at 1.5 m or less on centre spacing.
- .7 Fasten exposed conduit or cable to building construction or support systems as follows:  
.1 One-hole steel strap for 50 mm and smaller.  
.2 Two-hole steel strap for larger than 50 mm.  
.3 Beam clamps to secure conduit to exposed steelwork.
- .8 Perforated straps and twisted wire lashing to support or secure raceways or cables will not be accepted.
- .9 Do not use supports or equipment installed for other trades for conduit or cable supports except with the permission of other trades and approval of the Consultant.
- .10 Install to maintain headroom neat mechanical appearance, and to support equipment loads.
- .11 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

- .12 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

**END OF SECTION**

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1 **General**

1.1 **SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit product data in accordance with Section 26 05 00 – Common Work Results for Electrical.

2 **Products**

2.1 **SPLITTERS**

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position. Baked enamel finish
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated, and full length copper bars.
- .3 At least three spare terminals on each set of lugs in splitters.

2.2 **JUNCTION AND PULL BOXES**

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Pull box sizing – use this table to determine sizes of pull boxes:

| Size of Conduit is: | Minimum Size of Pullbox in mm (inches) |               |             | For each additional conduit increase width |
|---------------------|--|---------------|-------------|--|
|                     | Width                                  | Length        | Depth       |  |
| 20 mm (0.75")       | 100 mm (4")                            | 300 mm (12")  | 75 mm (3")  | 50 mm (2")                                 |
| 25 mm (1.00")       | 100 mm (4")                            | 406 mm (16")  | 75 mm (3")  | 50 mm (2")                                 |
| 32mm (1.25")        | 150 mm (6")                            | 500 mm (20")  | 75 mm (3")  | 75 mm (3")                                 |
| 40 mm (1.50")       | 200 mm (8")                            | 685 mm (27")  | 100 mm (4") | 100 mm (4")                                |
| 50 mm (2.00")       | 200 mm (8")                            | 915 mm (36")  | 100 mm (4") | 127mm (5")                                 |
| 65 mm (2.50")       | 255 mm (10")                           | 1065 mm (42") | 127mm (5")  | 150 mm (6")                                |
| 80 mm (3.00")       | 300 mm (12")                           | 1220 mm (48") | 127mm (5")  | 150 mm (6")                                |
| 90 mm (3.50")       | 300 mm (12")                           | 1400 mm (54") | 150 mm (6") | 150 mm (6")                                |
| 100 mm (4.00")      | 380 mm (15")                           | 1500 mm (60") | 200 mm (8") | 200 mm (8")                                |

2.3 **CABINETS**

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, two (2) keys, containing 19 mm G1S plywood backboard for surface or flush mounting as indicated.

**3 Execution**

**3.1 SPLITTER INSTALLATION**

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

**3.2 JUNCTION, PULL BOXES AND CABINET INSTALLATION**

- .1 Only main junction and pull boxes are indicated. Install pull boxes in inconspicuous, accessible locations, so as not to exceed 30 m of conduit run between pull boxes. Identify locations of pull boxes on suspended ceilings below with indicator decal.
- .2 Mount cabinets with top not higher than 1.8 m above finished floor.
- .3 Install terminal block as indicated in Type T cabinets.

**3.3 IDENTIFICATION**

- .1 Provide equipment identification in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Install size 2 identification labels.

**END OF SECTION**

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1 **General**

1.1 **RELATED SECTIONS**

- .1 Section 26 05 29 – Fastenings and Supports
- .2 Section 26 05 21 – Wires and Cables – 1000 V

1.2 **REFERENCES**

- .1 Canadian Standards Association (CSA):
  - .1 CAN/CSA C22.2 No.18-92, Outlet Boxes, Conduit Boxes, and Fittings.
  - .2 CSA C22.2 No.45-M1981-R1992, Rigid Metal Conduit.
  - .3 CSA C22.2 No.56-1977, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  - .4 CSA C22.2 No.83-1985-R1992, Electrical Metallic Tubing.
  - .5 CSA C22.2 No.211.2-M1984-R1992, Rigid PVC Conduit.
  - .6 CAN/CSA C22.2 No.227.3-M91, Flexible Nonmetallic Tubing.

2 **Products**

2.1 **CONDUITS**

- .1 Rigid metal conduit: Zinc-coated steel, galvanized, with reamed ends, manufactured in accordance with CSA 22.2 No. 45-M1981-R1992.
  - .1 Couplings: Threaded rigid galvanized steel.
  - .2 Bushings: Insulated throat, grounding type. All connections to be threaded.
- .2 EMT: Steel galvanized with reamed ends, manufactured in accordance with CSA 22.2 No. 83-M1985-R1992.
  - .1 Couplings: Zinc coated steel setscrew type.
  - .2 Connectors: Zinc coated steel set screw type with nylon insulated throats.
  - .3 Watertight couplings and connectors in access floors, areas exposed to sprinklers and in damp/humid areas.
- .3 Rigid PVC heavy wall conduit with solvent weld fittings, couplings and adapters. Wall thicknesses shall be minimum:

| <b>Size</b> | <b>Wall Thickness</b> |
|-------------|-----------------------|
| 20 mm       | 3.38 mm               |
| 32 mm       | 3.56 mm               |
| 38 mm       | 3.68 mm               |
| 50 mm       | 3.91 mm               |
| 75 mm       | 5.49 mm               |
| 100 mm      | 6.02 mm               |

- .4 Electrical non-metallic tubing (ENT) with compatible manufactured couplings and connectors.

- .5 Flexible metal conduit: To CSA C22.2 No. 56-1977, and as follows:
  - .1 Flexible metal conduit: Spirally wound, interlocked zinc coated strip steel, minimum 20 mm diameter, except for lighting fixture and control connections where minimum 12 mm diameter is permitted.
  - .2 Flexible metal conduit fittings: Threadless hinged clamp style.
- .6 Liquid-tight flexible metal conduit:
  - .1 Continuous interlocked and double-wrapped steel, zinc coated inside and outside, coated with liquid-tight jacket of flexible PVC, minimum 20 mm diameter.
  - .2 Liquid-tight flexible metal conduit fittings: Cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings.
- .7 Rigid aluminum conduit for ground conductors. Fittings same material as conduit.
- .8 Miscellaneous fittings: Locknuts, bushings, reducers, chase nipples, 3-piece unions, split couplings, plugs and expansion fittings specifically designed for their particular application.
- .9 The minimum conduit size shall be 20 mm. except where noted otherwise.

## 2.2 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure surface conduits 50 mm and smaller. Two-hole steel straps for conduits larger than 50 mm
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Minimum 6 mm dia threaded rods to support suspended channels.
- .5 Perforated steel strapping, tie wire and/or field fabricated hangers or supports will not be permitted.

## 2.3 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

## 2.4 EXPANSION FITTINGS FOR CONDUITS

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.
- .4 Weatherproof expansion fittings for linear expansion at entry to panel.
- .5 Install approved expansion fittings in all conduit runs which cross the structural expansion joints of the building.

2.5 **FISH CORD**

- .1 Polypropylene, minimum 180 kg. pull strength

3 **Execution**

3.1 **INSTALLATION**

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal raceway in all areas except in mechanical and electrical rooms, or where otherwise indicated.
- .3 Install EMT throughout except where specified otherwise.
- .4 Install threaded, rigid, galvanized steel conduit in Class I, II and III hazardous locations.
- .5 Install manufactured conduit sealing fittings in hazardous locations and fill with sealing compound after conductors are drawn in.
- .6 Install epoxy coated conduit in corrosive areas and in and below floor slabs of Parking levels.
- .7 Install rigid PVC conduit in or below slabs on grade, in exterior damp locations, and cast in floor slabs of Parking levels and in corrosive areas.
- .8 Install rigid aluminum conduit for ground conductors which are run separate from feeder conductors
- .9 In damp locations slope raceway to provide drainage.
- .10 Use flexible galvanized steel conduit minimum 600 mm and maximum 1000 mm length for connections to equipment which may vibrate (such as transformers or equipment with motors), and to equipment not permanently fixed or which must be moved for servicing.
- .11 Install liquid-tight flexible metallic conduit for applications described in 3.1.10 in damp or corrosive locations.
- .12 Install explosion proof flexible connection for connection to explosion proof motors in a manner similar to that described in 3.1.10.
- .13 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter. Radius of the inner edge of the conduit shall comply with the CEC but shall not be less than 600 mm under any circumstances.
- .14 Mechanically bend steel conduit over 20 mm dia.
- .15 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .16 Install CSA approved expansion fittings, complete with grounding jumpers, where conduits cross building expansion joints. Provide bend or offset in conduit adjacent to building expansion joint where conduit is installed above suspended ceilings.
- .17 Where conduits pass through fire separating floors, ceiling or walls, close off space between conduit with tight fitting metal caps on both sides and non-combustible insulation. Caulk to the approval of the Consultant and authorities having jurisdiction.

- .18 Under no circumstances shall conduits be installed surface mounted across an open floor area.
- .19 Take into account the applicable seismic requirements when installing conduits, especially where conduits cross building joints.
- .20 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .21 Ream raceway ends to remove burrs.
- .22 Clean out and dry conduits. Seal both ends to prevent ingress of foreign materials, dirt and moisture.
- .23 Raceway systems shall be completely installed, and dry and clean, before pulling conductors.
- .24 Install Polypropylene, minimum 180 kg. Pull strength pull cords in empty raceways and fasten cords at each end.
- .25 Provide factory "ELLS" for 90° bends in raceways larger than 25 mm.
- .26 Provide two (2) 25 mm EMT conduits to 150 x 150 x 100 junction box in nearest accessible ceiling space, for future use, from each recessed panelboard.

### 3.2 **SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended and/or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 150 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.
- .7 Do not locate conduits less than 150 mm parallel to exhaust pipes, with minimum of 150 mm at crossovers.

### 3.3 **CONCEALED CONDUITS**

- .1 Run parallel or perpendicular to building lines in all cases e.g., in ceiling spaces and in walls, etc.
- .2 Install raceway in masonry walls during construction of such walls. Do not install runs horizontally in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings

### 3.4 **CONDUITS IN-CAST-IN PLACE CONCRETE**

- .1 Plan conduit runs and obtain the approval of Structural engineer.
- .2 Space conduit runs six conduit diameters apart.

- .3 Avoid crossing conduit runs. Where crossings can not be avoided, the crossing conduit shall run perpendicular to each other.
  - .4 No conduit shall pass over a column, end of a shear wall or column capital. Avoid drop panels.
  - .5 Generally run conduit in the slab "middle strips" which are indicated on the structural drawings. Coordinate with the Structural Engineer.
  - .6 Do not tie conduit run directly over a reinforcing bar in the same direction, as this would reduce concrete bond. Locate conduit runs between parallel reinforcing bars.
  - .7 Exercise great care at hubs such as electrical and communication rooms. Obtain specific approval of Structural engineer of the proposed installation plan.
  - .8 Protect conduits from damage where they stub out of concrete.
  - .9 Do not place conduits in slabs in which slab thickness is less than four (4) times conduit diameter.
  - .10 Install sleeves where conduits pass through slab or wall.
  - .11 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
  - .12 Guidelines for penetrations and sleeves through concrete slabs and walls are as follows:
    - .1 Sleeves may not pass through column capitals or within eight sleeve diameters of columns or end walls unless specifically approved by the Structural Engineer and/or indicated on structural drawings.
    - .2 Sleeves must not disrupt "bottom integrity" reinforcing steel, which runs between columns/walls.
    - .3 As far as possible, locate sleeves within the "middle strips" of the slab or along the side (not end) of shear walls.
    - .4 Space sleeves a minimum of four sleeve diameters apart.
- 3.5 **CONDUITS IN-CAST-IN PLACE SLABS ON GRADE**
- .1 Run 25 mm and larger below slab and encased in 75 mm concrete envelope. Provide 50 mm of sand over concrete envelope below floor slab.
- 3.6 **CONDUITS UNDERGROUND**
- .1 Slope conduits to provide drainage.
  - .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.
  - .3 All underground conduits shall be encased in minimum 75 mm concrete all around.
- 3.7 **COORDINATION**
- .1 Coordinate conduit installations with the work of other trades and related electrical installations including wire and cable, boxes and fittings, panels, etc. Ensure clear access to junction boxes.
  - .2 Coordinate installation of conduit in concrete with work specified in Division 03.

- .3 Coordinate installation of conduit in masonry with work specified in Division 04.
- .4 Coordinate installation of conduit which penetrates roof or waterproofing membranes with work specified in Division 07.
- .5 Coordinate installation of conduit which penetrates fire rated walls, floors or ceilings with firestopping work specified in Division 07 and Division 01. Ensure that integrity of the fire rated element is maintained.

**END OF SECTION**

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1            **General**

1.1         **SHOP DRAWINGS**

- .1         Submit product data in accordance with Section 26 05 00 – Common Work Results For Electrical.
  - .1         Complete product data on:
    - .1         Disconnect switches
    - Circuit breakers.

1.2         **MAINTENANCE MATERIALS**

- .1         Provide three (3) spare fuses of each type and rating indicated. Provide suitable metal storage cabinet, wall mounted in main electrical room.

1.3         **EQUIPMENT MANUFACTURER**

- .1         Install circuit breakers and/or fusible switches in panelboards. New circuit breakers shall match equipment manufacturer (Square D).
- .2         Circuit breakers and disconnect switches to be product of one manufacturer throughout the project.
- .3         Acceptable Manufacturers of power distribution equipment:
  - .1         Schneider Electric
- .4         Equipment supplied shall have interrupting capacities in excess of calculated short circuit values indicated in coordination study or those indicated on drawings or in these specifications, whichever is the highest.

1.4         **SPRINKLERPROOF EQUIPMENT**

- .1         Equipment located in sprinklered rooms shall meet the requirements set out by the Inspection Authority for such equipment, which have openings for ventilation, etc., be provided with shields to prevent direct water entry from sprinklers.
- .2         Comply also with the requirements specified in section 26 05 00.

1.5         **SERIES RATED SHORT CIRCUIT PROTECTION**

- .1         Interrupting ratings shown on the drawings and as specified herein are based on fully rated devices.
- .2         Series rated devices tested and labeled in accordance with CSA C22.2 will be considered as equivalent.
- .3         Submit published tested series ratings with the shop drawings for the intended devices.

2 **Products**

2.1 **DISCONNECT SWITCHES**

- .1 Heavy duty disconnect switches, EEMAC 1 in dry locations, EEMAC 3 in damp locations, quick-make/quick-break mechanisms, visible blades, arc quencher for switches rated 600V.
- .2 Mechanically interlocked cover to prevent opening in 'on' position, except by defeat mechanism.
- .3 ON-OFF switch position indication on switch enclosure cover.
- .4 Provision for padlocking in both 'on' and 'off' positions.
- .5 HRC fuseholders size as indicated.

2.2 **FUSES**

- .1 CSA C22.2 No. 59.1 – M1987 for fuses.
- .2 CSA C22.2 No. 106 – M92 for HRC fuses.
- .3 Fuses: product of one manufacturer.
- .4 HRC-L fuses (formerly Class L).
  - .1 Type L1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type L2, fast acting.
- .5 HRCI-J fuses (formerly Class J).
  - .1 Type J1, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .2 Type J2, fast acting.
  - .3 HRCI-R fuses (formerly Class R). For UL Class RK1 fuses, peak let-through current and I<sup>2</sup>t values not to exceed limits of UL 198E-1982, table 10.2.
  - .4 Type R1, (UL Class RK1), time delay, capable of carrying 500% of its rated current for 10 s minimum, to meet UL Class RK1 maximum let-through limits.
  - .5 Type R2, time delay, capable of carrying 500% of its rated current for 10 s minimum.
  - .6 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.
- .6 HRCII-C fuses (formerly Class C).

2.3 **MOULDED CASE CIRCUIT BREAKERS**

- .1 General:
  - .1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
  - .2 Common-trip breakers: with single handle for multi-pole applications.
  - .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
  - .4 Circuit breakers with interchangeable trips when so indicated on drawings.

- .2 Thermal magnetic breakers – Design A:
  - .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .3 Magnetic Breakers – Design B:
  - .1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

## 2.4 **OVERCURRENT PROTECTION FOR MECHANICAL EQUIPMENT**

- .1 The ratings of some overcurrent devices, indicated on the drawings, are to be confirmed after review of mechanical shop drawings. This may require that these be shipped separately after delivery of panelboards, etc.

## 3 **Execution**

### 3.1 **INSTALLATION**

- .1 Fasten floor-mounted equipment such as switchboards and dry type transformers securely to the floor. Refer to Section 26 05 00 for seismic requirements.
- .2 Check factory made connections for mechanical security and electrical continuity. Verify fuse sizes and trip unit settings with the co-ordination study.
- .3 Adjust isolation pad bolts, tighten conduit connections and fastenings etc., to minimize transformer noise.
- .4 Verify layout of electrical rooms prior to installation, using actual equipment dimensions, to ensure adequate clearances and ventilation.
- .5 Install and wire Distribution Panels and Panelboards.
- .6 Install and wire disconnect switches.

### 3.2 **TESTING AND COMMISSIONING**

- .1 Carry out Testing and Commissioning in accordance with Section 26 57 01.

**END OF SECTION**

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1 **General**

1.1 **REFERENCES**

- .1 CSA C22.2 No. 0.4-1982
- .2 Canadian Electrical Code
- .3 CAN4-S524, Standard for the Installation of Fire Alarm Systems
- .4 CAN/ULC-S537-M86, Standard for Verification of Fire Alarm System Installations

1.2 **INTENT**

- .1 The intent is to demonstrate to the Consultant that the power distribution system and other systems have been properly assembled, installed, inspected and tested, comply with design requirements, and are therefore ready for full operation and service in all respects.
- .2 Testing and Commissioning work is divided into three categories:
  - .1 Category 1: Work that must be done by a Specialist, Professional Testing Agency (PTA) hired and paid by this contractor.
  - .2 Category 2: Work that is not specifically listed as the responsibility of the testing Agency, can be done by the Electrical Subcontractor using his own forces and the pertinent manufacturers of equipment.  
**Note:** The Electrical Subcontractor may choose to assign this work also to the Testing Agency, at his discretion.
  - .3 Category 3: Testing done in the factory by the manufacturer of the equipment.
  - .4 The Electrical Subcontractor shall work with and ensure that all parties carry out their responsibilities whether or not the required work is clearly categorized herein.
- .3 Testing Agency's (PTA) qualifications shall be as follows:
  - .1 The agency employed for this purpose shall have all necessary qualified personnel, instruments, tools and equipment required for carrying out the activities described.
  - .2 The agency may be either a specialized company offering such services as a primary activity, or alternatively it may be the manufacturer of one of the major systems to be provided; but in the latter case it must be a defined Service Department, sufficiently separate from the manufacturing process to offer independent service and advice. The testing agency may be any one of the following, or other approved agency:
    - .1 Rondar
    - .2 Cutler Hammer – Field Service Division.
    - .3 Siemens Canada Field Service Division
    - .4 Schneider Electric – Field Service Division
  - .3 The Testing Agency shall assist this Subcontractor by demonstrating to the Consultant that systems/work listed above, when completed, have been properly assembled, installed, inspected and tested, and are therefore ready for full operation and service in all respects.
  - .4 The Testing Agency shall coordinate and participate in all specified factory and field tests of equipment and systems.
  - .5 The Testing Agency shall review all manufacturer's shop drawings and offer comments to ensure that the correct protective elements will be provided. Submit queries to the Consultant for clarifications.

- .6 The details of Testing, Commissioning, Adjusting, Balancing, Demonstration Seminars are covered later in this Section.
- .7 A brief overview, sequence and coordination of activities of the Testing Agency is as follows:
  - .1 Carry out pre-startup checks.
  - .2 Carry out performance tests, adjusting and balancing in conjunction with the manufacturer's representative(s).
  - .3 Submit test results and reports complete with comments on acceptability and recommendations for any required corrective measures.

### 1.3 SCOPE

- .1 Commissioning shall cover the following aspects:
  - .1 **Component Verification:** Verification of each electrical component's compliance with specifications. Information to be filled in on "PI" Product Information forms.
  - .2 **Component Testing:** Testing of each electrical component to confirm compliance with performance requirements. Information to be filled in on "PV" Performance Verification forms.
  - .3 **System verification:** The intent is to test each electrical system to verify that the installed components are operating properly as a system and meet the specified requirements. This testing is to supplement, but not duplicate the testing already carried out for component verification and component testing.
  - .4 **Demonstration and Instruction:** Conduct sessions to familiarize facility operation and maintenance personnel with electrical systems and their operation and maintenance.

### 1.4 VERIFICATION FORMS

- .1 Develop project specific verification forms for verification of components and systems. Prepare the forms in conjunction with the manufacturer and the testing agency(ies). Complete the verification forms for **all** tests and verifications. The format of the manufacturers' standard forms modified to include the requirements indicated herein, are acceptable. The forms shall cover Product Information "PI" and "Performance Verification".
- .2 "PI" – Product Information Forms: The purpose of the PI Forms is to record, for the purposes of creating a maintenance/inventory database, at least the following:
  - .1 Nameplate data of the component
  - .2 Pertinent shop drawing information
  - .3 Results of visual/physical examination of component for acceptance on site
  - .4 Pre-startup checks
  - .5 Pertinent operations data
  - .6 Additional items as required and as indicated.
- .3 "PV" – Product Verification Forms: The purpose of the PV Forms is to record the results of component tests.
- .4 System verification forms: The purpose of the System Verification forms is to record the results of the test performed to verify that the installed components of each electrical system are operating properly as a system and meet the specified requirements.
- .5 Prepare and complete individual component PI/PV verification forms for the items listed below and as required for additional items:
  - .1 Circuit breakers
  - .2 Disconnect switches

1.5 **SUBMITTALS**

- .1 Submit the required number of copies as per Section 01 33 00 for the following:
  - .1 All proposed tests.
  - .2 All proposed Test instruments.
  - .3 All proposed check sheets and Test Record forms.
- .2 Within one week of award of this work, submit a detailed schedule of activities co-ordinated with the Construction Schedule.
- .3 Submit all test results, signed by the attending technician. Include comments and recommendations for review by Consultant. These reports shall be submitted within one week following the completion of each test segment.

1.6 **QUALITY ASSURANCE**

- .1 All starting, testing procedure shall be in accordance with:
  - .1 Applicable CSA, IEEE, IPCEA, EEMAC, ASTM and CAN/ULC Standards
  - .2 Manufacturer's published instructions. Prior to testing components or systems, obtain and review manufacturer's installation, operation, starting instructions and in particular any testing constraints/cautionary measures that must be observed.
  - .3 Arrange and pay for qualified manufacturer's representatives to supervise starting and testing of the following electrical components and systems:
    - .1 Low voltage switchboard.
    - .2 Fire alarm system.

2 **Component Testing**

2.1 **PRIOR TO ENERGIZING**

- .1 Confirm components nameplate data with characteristics of power supply
- .2 Verify supply voltage and phase rotation
- .3 Ensure all testing as specified has been completed and deficiencies have been corrected
- .4 Close and open all devices to ensure proper mechanical operation
- .5 Megger all feeders and record results on approved verification forms
- .6 Electrical Tests:
  - .1 Ductor test
  - .2 Megger test.
  - .3 Mechanical function test
  - .4 Set all units with adjustable magnetic trip units.
- .7 Record all observations, data and test results on PI/PV forms.

2.2 **MOULDED CASE CIRCUIT BREAKER TO 150A**

- .1 Visual and mechanical inspection as for the larger moulded case breakers.
- .2 Mechanical function test.
- .3 Set all units with adjustable magnetic trip units.

- .4 Record all observations, data and test results on PI/PV forms.

## 2.3 **PANELBOARDS**

- .1 For Distribution, Power and Lighting Panels:
  - .1 Conduct load balancing as defined in this section.
  - .2 Carry out visual inspection
  - .3 Torque all bus connections using calibrated torque wrench
  - .4 Record all observations, data and test results on PI/PV forms.

## 2.4 **LOAD BALANCING**

- .1 Three to six months after the renovations have been completed and the building is occupied, carry out the following work at peak load hours.
  - .1 Measure load balance on all feeders at distribution centres, and panelboards with normal loads (lighting included). If load unbalance exceeds 15%, reconnect circuits to obtain the best possible balance of current between phases. Revise panel board directories and wiring identification accordingly.
  - .2 Measure phase voltages at switchboards, distribution centres and panel boards with normal loads (lighting included). Adjust transformer taps, where required, to within 2% of rated voltage of components.
- .2 Submit, at completion of work, a report listing phase and neutral currents on switchboards, distribution panels and branch circuit panelboards operating under normal loads. State hour and date on which each load was measured and voltage at time of test. Carry out all required adjustments, balancing and corrective work.

## 2.5 **DISCONNECT SWITCHES FUSED AND UNFUSED**

- .1 Visual and Mechanical inspection:
  - .1 Check physical, electrical and mechanical condition. Inspect for cracks or other defects.
  - .2 Compare equipment nameplate data with latest contractual documents/requirements. Operate switch to ensure smooth operation
  - .3 Check tightness of connections using calibrated torque wrench.
  - .4 Check blade alignment.
  - .5 Check each fuse holder for adequate mechanical support of each fuse.
  - .6 Check all electrical and mechanical interlocks.
  - .7 Check proper phase barrier materials and installation.
  - .8 Inspect all indicating devices for proper operation.
  - .9 Clean entire switch using approved methods and materials.
  - .10 Lubricate to manufacturer's recommendations.
  - .11 Exercise all active components.
- .2 Electrical Tests:
  - .1 Perform a contact resistance test across each switch blade and fuse holder
  - .2 Perform an insulation resistance test at the appropriate DC voltage (500V or 1000V) as applicable from pole to pole and from each pole to ground with breaker closed: and across open contacts of each phase.
- .3 Record all observations, data and test results on PI/PV forms.

**2.6 WIRING AND CABLES**

- .1 Test all conductors, including those at distribution centres and panelboards for insulation resistance to ground (megger test).
- .2 Test service grounding conductors for ground resistance.
- .3 Provide Consultant with list of test results on approved verification form showing location at which each test was made, circuit tested and results of each test.
- .4 Remove and replace entire length of cable if cable fails to meet any of the test criteria.

**3 System Testing**

**3.1 GENERAL**

- .1 Inspect, start and test each electrical system to verify that the installed components are operating properly as a system and meet the specified requirements. The intent is to supplement, but not duplicate the testing already carried out for component testing. Note that before System tests can be performed, all components of the system must have been inspected, tested and found to be working satisfactorily in accordance with the specified requirements. Prepare, complete and submit System Verification forms.

**3.2 POWER DISTRIBUTION**

- .1 Verify the Power Distribution System operation to verify all operational aspects as specified, including the following:
  - .1 The correct relationships between all source breakers and the loads controlled as follows. This shall apply throughout except for branch circuits. The source-load relationships to be established shall include:
    - .1 Distribution Panels to individual motor equipment..

**4 System Demonstration and Instruction**

**4.1 GENERAL**

- .1 Provide demonstration and instruction sessions to familiarize facility operation and maintenance personnel with electrical systems and their operation and maintenance.
- .2 Do not commence any demonstration and instruction work until all electrical systems are complete and proven operational.
- .3 Provide three (3) copies of all instructions and information given to the facility staff during the course of these sessions. Include this information in the operating and maintenance manuals.
- .4 Instruct and demonstrate the method of preparation of all equipment for seasonal service.
- .5 Arrange and pay for appropriately qualified manufacturer's representatives to provide or assist in providing electrical equipment and systems demonstration and instruction as specified herein. Provide demonstration and Instruction seminars for the systems listed below:
  - .1 Fire Alarm System.
  - .2 LV Switchboards.
  - .3 Lighting controls

- .6 Also demonstrate site lighting control system.
- .7 Chair demonstration and instruction sessions, and establish agendas for demonstration and instruction sessions in conjunction with the Consultant.
- .8 All Demonstrations and Seminars shall be scheduled during working weekdays between the hours 8.30 am to 11.30 am and 1.00 pm to 4.00 pm.
- .9 The System Demonstration part of the Seminar shall cover at least the following aspects:
  - .1 Start-up and shutdown
  - .2 Sequence of operation, various modes of operation
  - .3 Scheduled and preventative maintenance
  - .4 Troubleshooting
- .10 The Equipment Instruction part of the Seminar shall cover at least the following aspects:
  - .1 Explanation of how equipment operates
  - .2 Recommended preventative and routine maintenance

**END OF SECTION**



**Designated Substance Survey  
Administration Building,  
Beattie Lane, Kemptville College,  
Kemptville, Ontario**

**Type of Document:**  
Final

**Client:**  
Ms. Rebecca Dam  
Rubin & Rotman Architects  
206-190 Somerset Street West  
Ottawa, ON K2P 0J4

**Project Number:**  
OTT-00243092-B0

**Prepared By:** Matthew Laneville, B.A.

**Reviewed By:** Shawn Doherty, P.Eng.

**exp** Services Inc.  
100-2650 Queensview Drive  
Ottawa, ON K2B 7H6  
Canada

**Date Submitted:**  
November 7, 2017

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**Prepared By:**

**exp**

100-2650 Queensview Drive  
Ottawa, ON K2B 8H6  
Canada  
T: 613 688-1899  
F: 613 225-7337  
www.exp.com



---

Matthew Laneville, B.A.  
Environmental Scientist  
Earth & Environment



---

Shawn Doherty, P.Eng.  
Environmental Engineer  
Earth & Environment

**Date Submitted:**

November 7, 2017

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Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **Exp** Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

## Executive Summary

Exp Services Inc. (exp) was retained by Ms. Rebecca Dam of Rubin & Rotman Architects to complete a Designated Substance Surveys (DSS) of the Administration Building located on the Kemptville College Campus in Kemptville, Ontario. It is understood that asbestos surveys were previously completed by others at this building for due diligence purposes. Specifically, the goal of the survey, was to better establish the presence/absence of asbestos, the application of asbestos on the structure and other designated substances prior to the proposed renovations for various areas throughout the building (including the removal of walls and the upgrading of finishes).

The main objectives of the survey were as follows:

- To review existing surveys and better delineate the building materials (interior and exterior) and fixed equipment that contain designated substances/hazardous materials as per section 30 of the Occupational Health and Safety Act (OHSA), as well as other special handling materials;
- To summarize the results of the DSS in a comprehensive report that can be used to assess the level of risk associated with various materials within the building.

The survey included a review of the designated substances as defined by the Ontario Occupational Health and Safety Act (OHSA), with particular emphasis placed on (but not limited to): asbestos-containing materials (ACMs); lead-based paints and lead-containing materials; equipment containing ozone-depleting substances; mercury-containing equipment; PCB's; and, potential sources of silica.

Based on the completion of the current DSS and previous reports, the following designated substances and special handling materials were identified within the subject site building:

- Asbestos;
- Silica;
- Lead;
- Mercury;
- Polychlorinated biphenyls (potential);
- Ozone depleting substances (ODS); and,
- Mould.

No other designated substances or special handling materials were identified.

The recommended remedial/management options for each of the designated substances and/or special handling materials identified during the survey are presented below.

**Table EX-1: Administration Building**

| Substance       | Description  | Recommendation   |
|-----------------|--|--|
| <b>Asbestos</b> | Loose fill vermiculite (attic)   | If the loose fill vermiculite is to be disturbed during the renovation program and/or if the attic is to be accessed by people, it is to be removed using Type 3 operations as per Section 15 through 18 of O.Reg. 278/05. In addition, it is recommended that any opening in the second-floor ceiling be sealed to prevent vermiculite from potentially entering the second-floor space.  |
|                 | Drywall Joint Compound   | If the drywall joint compound is to be disturbed during the renovation program, it is to be removed / disturbed following Type 2 operations as per Section 15 and 16 of O.Reg. 278/05.   |
|                 | Pipe insulation  | If the pipe insulation is to be disturbed during the renovation program, it is to be removed using localized glove bag operations as per Section 16 and 17 of O.Reg. 278/05.   |
|                 | Vinyl flooring – various styles and associated mastics   | If the vinyl flooring is to be disturbed during the current renovation program, it is to be removed following Type 1 (provided the material is thoroughly wetted) operations as per Section 14 of O.Reg. 278/05 provided power tools are not used. I   |
|                 | 1x1 acoustic tile mastic   | If the 1x1 acoustic tile mastic is to be disturbed during the current renovation program, it is to be removed using Type 1 operations as per Section 14 of O.Reg. 278/05.  |
| <b>Lead</b>     | Lead -based paints were observed to be in good-poor condition:   |  |
|                 | The majority of paint<br>Based on the age of the building, all original painted surfaces should be considered lead-based.                      | It is recommended that flaking and peeling paint should be removed in accordance with applicable regulations prior to renovation. The removal of flaking paint is to be done in accordance with Type 2 operations provided hand tools are utilized to remove the flaking paint.<br><br>Activities involving abrasion or sanding of painted surfaces should be minimized no matter the concentration of lead paint. Appropriate personal protective equipment (i.e., respirators, gloves and eye protection) should be worn when undertaking any such activities. The Ontario Ministry of Labour Guideline, Lead on Construction Projects (2011) can be referred to when dealing (scraping, sanding) with paints, no matter the lead content.<br><br>Prior to disposal, a sample of flaking paint debris should be submitted for O.Reg. 558 leachate analysis and the results be compared against the Schedule 4 leachate quality criteria to assess landfill disposal options. |
| <b>Silica</b>   | Poured concrete;<br>Ceiling and wall plaster;<br>Vinyl flooring;<br>Drywall and associated compounds;<br>Acoustic tiles; and<br>Ceramic tiles. | Wet silica-containing area(s) prior to being disturbed and provide daily wet sweeping or HEPA vacuuming of silica dust to minimize generation of dust. Provide workers with appropriate respiratory protection and utilize ventilation during disturbance of silica-containing structures. Refer to the Ontario Guideline "Silica on Construction Projects", April 2011.   |

| Substance                  | Description  | Recommendation   |
|----------------------------|--|--|
| <b>ODSs</b>                | Refrigerator<br>Air Conditioners                                     | All sources of ODSs should be removed from the building / property and re-used/recycled or disposed prior to the dismantling of the refrigeration system. In accordance with O.Reg. 189/94, any removal and disposal of refrigeration equipment should only be undertaken by individuals who hold ozone depleting prevention cards.  |
| <b>Mercury</b>             | Fluorescent lights<br>Thermostat                                     | Prior to any renovations requiring the disturbance of mercury containing equipment, remove and re-use/recycle or dispose of all mercury-containing equipment in accordance with applicable regulations. Where possible, fluorescent light tubes should be recycled at an approved recycling facility.  |
| <b>PCB<br/>(potential)</b> | Fluorescent light ballasts   | When the fluorescent light ballasts are to be removed from service, they are to be stockpiled and assessed for PCB content by comparing the coding on the surface of each ballast with the Environment Canada publication EPS 2/CC/2 entitled "Identification of Lamp Ballasts Containing PCBs", revised August 1991. Ballasts that are found to be PCB-containing should be separated from non-PCB-containing ballasts and then taken to a licensed PCB destruction facility. |
| <b>Mould</b>               | Mould contaminated pipe insulation (potentially asbestos containing) | Prior to any renovations, the mould contaminated pipe insulation should be removed under Type 2 (Glove Bag) conditions per sections 15 through 17 of O.Reg. 278/05, which is also considered adequate for the removal of the mould contaminated materials.   |
| <b>Animal Droppings</b>    | Rodent droppings observed in attic                                   | it is recommended that a Type 2 operation be performed if the attic if people are to enter the attic at regular intervals. A Type 2 abatement includes adequate engineering controls to protect the workers and prevent the spread of contaminants that may be present in the animal droppings during the cleaning procedures.   |

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# 1 Introduction and Background

## 1.1 Introduction

Exp Services Inc. (**exp**) was retained by Ms. Rebecca Dam of Rubin & Rotman Architects to complete a Designated Substance Survey (DSS) of the Administration Building located on the Kemptville College Campus in Kemptville, Ontario. Specifically, the goal of the DSS, was to assess the presence/absence of asbestos and other designated substances prior to the proposed renovations for various areas throughout the building (including the removal of walls and the upgrading of finishes).

In addition, Section 30 of the Ontario OHS Act R.S.O. 1990 states the following: "Before beginning a project, the Owner shall determine whether any designated substances are present at the project site and shall prepare a list of all designated substances that are present at the site." A designated substance is defined by OHS Act as "a biological, chemical or physical agent or combination thereof prescribed as a designated substance to which the exposure of a worker is prohibited, regulated, restricted, limited or controlled." The OHS Act has enacted a regulation for eleven designated substances. Section 30 of OHS Act further requires that a list of designated substances be provided to prospective construction workers on the project. .

## 1.2 Background

The building is described as a two story, concrete and brick, institutional building constructed in the 1920s. The interior finishes range from plaster walls and ceilings, drywall walls, ceramic flooring, carpeting, vinyl wall board and vinyl floor tiles. The building exterior consists of brick and a peaked asphalt shingle roof.

Prior to completing the survey program, **exp** reviewed the annual asbestos reassessment report that was completed by Sendex Environmental Corporation (Sendex) in 2010. Based on this report, it is understood that asbestos was previously identified in the vinyl flooring, acoustic tiles, acoustic tile mastic, pipe insulation and drywall joint compound within the building. Floor plans from the Sendex report have been attached in order to remain consistent with location IDs as door numbers were observed to not be present and/or not match the identifier on the floor plan in various locations.

## 1.3 Objectives

The main objectives of the DSS were as follows:

- To review existing surveys and better delineate the building materials (interior and exterior) and fixed equipment that contain designated substances/hazardous materials as per section 30 of the Occupational Health and Safety Act (OHS Act), as well as other special handling materials;
- To summarize the results of the DSS in a comprehensive report that can be used to assess the level of risk associated with various materials within the building.

## 1.4 Scope of Work

To accomplish the above noted objectives, the following scope of work was followed:

- Review previous reports to identify previously identified asbestos containing materials (ACM);
- Conduct a systematic inspection of all rooms to document the location, type and condition of ACM and designated substances within the building;

- Collect and record representative building material samples for potential laboratory analysis from all accessible rooms;
- Submit representative samples for bulk asbestos analysis and paint samples for lead laboratory analyses from building materials;
- Combine previous asbestos sampling reports with current sampling program to further delineate; and,
- Interpret analytical results and prepare a detailed stand-alone survey report identifying the type, location of the designated substances and special handling materials in the building.

## 2 Survey Methodology and Assessment Criteria

### 2.1 Site Inspection

Exp staff (Matthew Laneville, B.A.), conducted the survey on October 12, 2017 and was unaccompanied for the duration of the survey.

The DSS consisted of a thorough systematic inspection of all accessible areas of the work area to document the location, type, and quantity of designated substances and special handling materials.

Selected photographs taken during the survey have been included in Appendix A. Details regarding the approach used in conducting the field investigation including sampling procedures and analytical methodologies are outlined in the following sections.

The following limitations were encountered during the inspection:

- Roofing materials were not sampled to preserve the integrity of the roof system;
- Mechanical equipment was not sampled (i.e. motors, interior equipment, furnace equipment, etc.) as the equipment is still operational and was not safe to dismantle/assess in detail; and,
- Review of void spaces / materials behind walls was limited to the existing wall and ceiling openings already present within the building.

### 2.2 Asbestos-Containing Materials

The asbestos survey was undertaken in general conformance with Ontario Regulation 278/05 (O.Reg. 278/05), *Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations* which is the current governing Regulation on the detection and handling of asbestos.

Potential ACMs were classified as being either friable or non-friable. Friable material is defined as: *material that, when dry, can be crumbled, pulverized or powdered by hand pressure, or is crumbled, pulverized or powdered.*

The minimum number of samples collected is based on the Table 1 highlighted below. Samples collected from some rooms can be used to assess same materials in other rooms. This is due to the fact that spatial representation is not only achieved in an asbestos survey through sampling but also through visual observation. For example, stipple plaster material from one room is considered to be the same as another room if the material appears to be homogeneous. As such, a building material sample collected from a certain area can be extrapolated to represent other areas within the building. This stems from the visual evidence relating to the similarity of the building materials and the assumption that these materials would have been placed / erected at the same time during the same construction project. Where evidence indicates that this is not the case, (renovation, change in construction methods, potential change in fire rating) additional characterization is required.

A total of twelve (12) bulk samples from four (4) different materials were collected as part of the survey. These materials were not sampled during previous investigations. It was our opinion that the building was well sampled as part of previous surveys and that a limited amount of additional sampling to better establish the presence / absence of asbestos. A sufficient number of samples have been collected in accordance with Table 1 below.

All asbestos samples were submitted to Paracel Laboratories of Ottawa, Ontario, which is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) by the National Institute of Standards and Technology for analysis of bulk materials for asbestos.

**Table 1: Minimum of Asbestos Bulk Material Sample Requirements**

| Item | Type of Material   | Size of Area of Homogeneous Material                      | Minimum Number of Bulk Material Samples to be Collected |
|------|--|---|---|
| 1    | Surfacing material, including without limitation, material that is applied to surfaces by spraying, by troweling or otherwise, such as acoustical plaster on ceilings and fireproofing materials on structural members | Less than 90 square metres                                | 3   |
|      |  | 90 or more square meters, but less than 450 square metres | 5   |
|      |  | 450 or more square metres                                 | 7   |
| 2    | Thermal insulation, except as described in item 3  | Any size  | 3   |
| 3    | Thermal insulation patch   | Less than 2 linear metres or 0.5 square metres            | 1   |
| 4    | Other material   | Any size  | 3   |

Analyses were performed in accordance with the method outlined in the *Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations* made under the Occupational Health and Safety Act Ontario Regulation 278/05, IRSST Method 224-1 and the EPA/600/R-93-116 Method for the Determination of Asbestos in Bulk Building Materials, which is in accordance with Quebec requirements.

In Ontario, ACMs are defined as any material found to contain 0.5% or more asbestos by volume, as determined by the standard polarized light microscopy (PLM) method. The results and recommendations of the ACM sampling are summarized in **Section 3.1**.

## 2.3 Lead

Suspect lead based paints were not sampled during previous investigations as previous studies were limited to asbestos programs.

Painted areas of significant size and different colours from within the common elements were sampled and analyzed for lead. Four (4) paint samples were collected as part of this program.

The number of paint samples collected was considered representative based on observations pertaining to contiguous areas showing similar painted surfaces. Since paint is processed in large batches, paint composition is assumed to be spatially consistent during and after application.

According to the Surface Coating Materials Regulations (October 2010), paints having a lead content greater than 90 mg/kg (90 ppm) are considered to be lead-based. All paint chip samples were submitted to Paracel Laboratories of Ottawa, Ontario. Analyses were performed by inductively coupled plasma atomic emission spectroscopy (ICP-OES). Refer to **Section 3.2** for the Results and Recommendations.

## 2.4 Other Designated Substances

A visual survey of the building was made to identify the presence of any other designated substances including:

- Mercury-containing equipment;
- PCB-containing equipment;
- Ozone-depleting substances;
- Urea-formaldehyde foam insulation;
- Bird and animal dropping;
- Silica; and,
- Mould.

The results and recommendations pertaining to the other designated substances are included in **Section 3.3 to 3.10**.

## 3 Survey Findings and Recommendations

Pertinent site photographs and the sampling layout are presented in Appendix A. A summary table of the wall/ceiling/floor construction, suspected asbestos materials, sampling locations and associated analytical results is presented in Appendix B. This table also outlines the other designated substances observed during the survey. The laboratory certificates of analysis are included in Appendix C.

### 3.1 Asbestos-Containing Materials

#### 3.1.1 Friable Materials

##### 3.1.1.1 Acoustic tiles

- The 2'x4' acoustic tiles described as "deep vertical fissures with dimples (pock mark) and pinholes" were previously identified within the Sendex report as containing 2% amosite asbestos. The acoustic tiles were observed within rooms B07 (one tile observed), room 107 (one tile observed), room 110 (one tile observed) and throughout the north corridor of the first floor (location 6)

*Recommendations:* If the acoustic tiles are to be removed or disturbed during the proposed renovation program, the following asbestos abatement procedures should be followed:

- o... For rooms where one asbestos containing acoustic tile was observed: The tile can be removed following Type 1 asbestos operations as per section 14 of O.Reg. 278/05. Type 1 asbestos operations may be utilized in these areas as the total square footage of the asbestos containing acoustic tiles is under the 7.5m<sup>2</sup> limit as prescribed by O.Reg. 278/05
- o... For areas with multiple tiles: If the asbestos containing acoustic tile within the north corridor (location 6) are to be removed or disturbed the tile should be removed following Type 2 asbestos operations as per sections 15 and 16 of O.Reg. 278/05 as this area is above the 7.5m<sup>2</sup> criteria set by O.Reg.278/05.
- The 1'x1' acoustic tiles were observed within various locations of the first floor above the 2'x4' acoustic tiles. Based on the previous reports, the 1'x1' acoustic ceiling tiles were determined not to contain asbestos whereas the adhesive pucks were reported to contain 2% chrysotile.

*Recommendations:* If the 1'x1' acoustic tile mastic is to be disturbed during the current renovation program, it is to be removed using Type 1 operations as per Section 14 of O.Reg. 278/05.

##### 3.1.1.2 Loose Fill Vermiculite Insulation.

Loose fill vermiculite insulation was observed within various locations beneath the attic floor, mixed within blown-in fiberglass. The vermiculite was also observed within a number of garbage bags stored within the attic space, and scattered on the attic floor in various locations. A total of three (3) samples (sample ID # SA-04a,b,c) of this material were obtained from two (2) access points beneath the attic floor, and from within a garbage bag. Sample SA-04a was found to contain 1% tremolite asbestos. Samples SA-04b,c were subject to positive stop procedures and were not analyzed.

*Recommendations:* If the loose fill vermiculite is to be disturbed during the renovation program and/or if the attic is to be accessed by people, it is to be removed using Type 3 operations as per Section 15 through 18 of O.Reg. 278/05. In addition, it is recommended that any opening in the second-floor ceiling be sealed to prevent vermiculite from potentially entering the second-floor space.

### 3.1.1.3 Pipe Insulation.

Asbestos-containing air cell and parging cement insulation were identified within the Sendex report. The identified Air Cell was found to contain 18% chrysotile asbestos and the parging cement was found to contain 20% chrysotile asbestos. The pipe insulation was observed within ceiling cavities and may be present within solid wall and ceiling systems.

*Recommendations:* If the pipe insulation is to be disturbed during the renovation program, it is to be removed using localized glove bag operations as per Section 16 and 17 of O.Reg. 278/05.

### 3.1.1.4 Drywall Joint Compound

Asbestos-containing drywall joint compound was reported within the Sendex report to contain 2% chrysotile asbestos. The drywall joint compound was observed within various locations within the building.

*Recommendations:* If the asbestos-containing drywall joint compound is to be removed or disturbed as part of the renovation program, it is to be removed following Type 2 operations as per Sections 15-16 of O.Reg. 278/05. Alternatively, if less than 1m<sup>2</sup> of asbestos containing drywall joint compound is to be disturbed it may be done so under Type 1 asbestos abatement operations as per section 14 of O.Reg. 278/05.

***The following materials were observed, sampled, or previously reported and determined not to contain asbestos:***

- Smooth wall plaster: Reported to not contain asbestos within Sendex report.
- Smooth ceiling plaster: Reported to not contain asbestos within Sendex report.
- Acoustic tiles: The following acoustic ceiling tiles were reported not to contain asbestos within the Sendex report.
  - 2x4 acoustic tile - thin vertical fissures with pinholes;
  - 2x4 acoustic tile - small and large pinholes with textured surface;
  - 2x4 acoustic tile - small and large pinholes with textured surface;
  - 2x4 acoustic tile - horizontal fissures with numerous pinholes;
  - 2x4 acoustic tile - deep horizontal fissures with pock marks and pinholes;
  - 2x4 acoustic tile - small non-directional fissures with pinholes;
  - 1x1 acoustic tile - large and small pinholes (mastic is asbestos containing);
  - 2x4 acoustic tile - horizontal fissures with dense pinholes; and,
  - 2x4 acoustic tile - small and large pinholes.
- Parging cement over fiberglass insulation: Reported to not contain asbestos within Sendex report and was reported from limited locations, predominately mechanical room.

There are no special asbestos removal recommendations for these non-asbestos materials.

### 3.1.2 Non-Friable Materials

#### 3.1.2.1 Vinyl Flooring

- The 12"x12" vinyl floor tile described as "white with light brown streaks" was observed within the north stairwell - location 7, room 207, room 210. This vinyl floor tile was reported to contain 2% chrysotile asbestos whereas the associated mastic was not reported to contain asbestos.
- The 12"x12" vinyl floor tile described as "tan with brown streaks" was observed within Room B10, room 110 (beneath visible flooring), and the north stairwell (location 2). This vinyl floor tile was reported in the Sendex report to contain 5% chrysotile asbestos whereas the associated mastic was not reported to contain asbestos.
- The 12"x12" vinyl floor tile described as "white with black specks" was observed within Room 202. This floor tile was reported to contain 7% chrysotile asbestos within the Sendex report whereas the associated mastic was reported to contain 2% chrysotile asbestos.

*Recommendations:* If the vinyl flooring and/or mastic is to be disturbed during the renovation program, it is to be removed following Type 1 operations as per Section 14 of O.Reg. 278/05. If power tools are to be used during the removal, then Type 3 operations as per sections 15 to 18 must be implemented.

#### 3.1.2.2 Laboratory Counter Top

A fume hood laboratory counter described as "solid" was observed within room 202. A total of three (3) samples (sample ID# SA-02a,b,c) were collected from this material room 202. Sample SA-02a was found to contain 20% chrysotile asbestos. Samples SA-02b,c were subject to positive stop procedures and were not analyzed.

*Recommendations:* If the fume hood laboratory counter is to be removed during the renovation program, it is to be removed using Type 1 operations as per Section 14 of O.Reg. 278/05 provided power tools are not used to disturb the material.

***The following materials were observed, sampled, or previously reported and determined not to contain asbestos:***

- The 12x12 vinyl floor tile described as "cream with beige specks" observed within several rooms was reported to not contain asbestos within the Sendex report. It should be noted that asbestos containing 12x12 vinyl floor tile described as "white with light brown streaks" was observed beneath this vinyl floor tile within room 110.
- The 12x12 vinyl floor tile described as "pink" observed within several rooms was reported to not contain asbestos within the Sendex report.
- Rubber flooring observed within the main floor corridor and the main stairwell (location 4) was reported in the Sendex report to contain asbestos.
- Exterior white caulking observed around windows and doors: A total of three (3) samples (sample ID# SA-01a,b,c) of this material was collected from three (3) different window exteriors. All samples were found to not contain asbestos.
- Lab bench counter described as "laminated" was observed within room 202, room 207 and room 210: A total of three (3) samples (sample ID# SA-03a,b,c) of this material were collected from room 202. All samples were found to not contain asbestos.

### 3.2 Lead

Based on the analytical results, all of the paint colours sampled were determined to be lead-based (>90 ppm) and are as follows:

- Beige (PS-01, 44,100ppm): Observed within room B06 and determined to be in good-fair condition.
- Grey (PS-02, 4,640ppm): Observed within room B17 (mechanical room) and determined to be in poor to good condition with sporadic flaking.
- White (PS-03, 197,000ppm); Observed on the exterior window lintels and determined to be in fair to good condition.
- Off white (PS-04, 5,000ppm): Observed on the walls throughout the majority of the building and determined to be in good-fair condition. It was noted that the majority of peeling and flaking paint was observed above the drop ceiling grid.

*Recommendations:* It is recommended that flaking and peeling paint be removed in accordance with Type 2 operations as per The Ontario Ministry of Labour Guideline, Lead on Construction Projects (2011) prior to the renovation program.

Activities involving abrasion or sanding of painted surfaces should be minimized no matter the concentration of lead paint. Appropriate personal protective equipment (i.e., respirators, gloves and eye protection) should be worn when undertaking any such activities. The Ontario Ministry of Labour Guideline, Lead on Construction Projects (2011) can be referred to when dealing (scraping, sanding) with paints, no matter the lead content.

If requested by the landfill prior to disposal, it is recommended that a sample that is representative of the debris pile be submitted for O.Reg. 558 leachate analysis and the results be compared against the Schedule 4 leachate quality criteria to assess landfill disposal options.

### 3.3 Silica

Materials that likely contain silica within the building include:

- Poured concrete;
- Ceiling and wall plaster;
- Vinyl flooring;
- Drywall and associated compounds;
- Acoustic tiles; and,
- Ceramic tiles.

It is noted that damaged plaster is present in a limited number of locations and has settled but could become airborne once renovation begins.

*Recommendation:* Airborne silica can be generated through such processes as blasting, grinding, crushing, and sandblasting silica-containing material. Precautions must be taken to prevent silica-containing particles from becoming airborne during the application of such processes. Such precautions include wetting of silica-containing area(s) to be disturbed and daily wet sweeping or HEPA vacuuming of silica dust. Additionally, appropriate respiratory protection and ventilation must be utilized during disturbance of silica-

containing structures. It is recommended that the Ministry of Labour's Guideline "Silica on Construction Projects", April, 2011 be referred to when dealing with silica containing materials.

### 3.4 Mercury

Fluorescent lighting was observed within the majority of rooms of the building.

One (1) mercury containing thermostat was observed within room B02.

*Recommendations:* Exposure to mercury is regulated under Ontario Regulation 844/90 (amended to O.Reg. 110/04) and Ontario Regulation 347. All mercury containing material and equipment should be removed and re-used/recycled or disposed prior to renovation in accordance with applicable regulations.

Whenever possible, fluorescent light tubes should be recycled at an approved recycling facility.

### 3.5 PCBs

Potential PCB containing light ballasts associated with the fluorescent lighting may be present within the building.

No transformers anticipated to contain oil-bearing oils were observed within the building.

*Recommendation:* The handling and removal of any PCB-containing equipment, including storage, should be conducted as specified in Federal Regulations SOR/2008-273 and Ontario Regulation 362.

When the fluorescent light ballasts are to be removed from service, they should be stockpiled and assessed for PCB content by comparing the coding on the surface of each ballast with the Environment Canada publication EPS 2/CC/2 entitled "Identification of Lamp Ballasts Containing PCBs", revised August 1991. Ballasts that are found to be PCB-containing should be separated from non-PCB-containing ballasts and then taken to a licensed PCB destruction facility.

### 3.6 Ozone Depleting Substances

Refrigeration systems within the building are limited to a small residential style refrigerator and two (2) window air conditioning units.

*Recommendation:* All sources of ODS should be removed from the building/property and reused/recycled or disposed prior to the dismantling of the refrigeration system. In accordance with O.Reg. 189/94, any removal and disposal of refrigeration equipment should only be undertaken by individuals who hold ozone depleting prevention cards. Disposal of any refrigeration equipment and/or refrigerant containers is regulated under O.Reg. 189/94 (amended to O.Reg. 238/01).

### 3.7 Other Designated Substances

Based on field observations and on-site activities, there is no reason to believe that the following substances are present in the construction materials of the building in sufficient quantities to exceed the Ministry of Labour exposure limits: vinyl chloride, isocyanates, arsenic, ethylene oxide, benzene, or acrylonitrile.

### 3.8 Bird and Animal Droppings

An isolated area of suspected rodent droppings was observed within the northwest room/portion of the attic.

*Recommendations:* There are currently no specific procedures for the removal of animal droppings, however, it is suggested that a Type 2 asbestos abatement containment as per Section 15 and 16 of O.Reg. 278/05 be used to clean up the animal droppings. The operation includes adequate engineering controls to protect the workers and prevent the spread of contaminants that may be present in the animal droppings during the cleaning procedures.

### **3.9 Visible Mould**

Visible mould contamination was observed on the pipe insulation within the north corridor (location 1) within the basement. Asbestos containing pipe insulation was also identified within this area.

*Recommendations:* Since the mould contaminated pipe insulation is associated with asbestos-containing pipe insulation, the mould contaminated pipe insulation should be removed under Type 2 (Glove Bag) conditions per sections 15 through 17 of O.Reg. 278/05, which is also considered adequate for the removal of the mould contaminated materials.

## 4 General Limitations

The services performed and outlined herein were based in part upon visual observations of the site and attendant structures. Our opinion cannot be extended to portions of the site that were unavailable for direct observation by objects or coverings at the time of our observations.

Any of our observations relating to designated substances at the site are described in this report. Where testing was performed, it was executed in accordance with our contract for these services. It should be noted that other compounds or materials not tested for might be present in the building.

The objective of this report was to survey the environmental conditions at the site within the context of our contract with respect to the existing regulations within the applicable jurisdiction. Compliance of past and current owners with applicable local, provincial and federal government laws and regulations was not included in our contract for services.

The conclusions of this report are based, in part, on the information provided by others and any testing and analyses described in the report. The possibility remains that unexpected environmental conditions may be encountered at the site locations not explored. Should such an even occur, **exp** should be notified in order that we may determine if modifications to our conclusions are necessary.

This report has been prepared in accordance with generally accepted environmental study and/or engineering practices. No other warranties, expressed or implied, are made as to the professional service provided under the terms of our contract and included in this report.

We trust this report is satisfactory for your purposes. If you have any questions regarding our submission, please do not hesitate to contact this office.

## **Appendix A – Site Photographs**



**Photograph No. 1**

Exterior View of Administration Building



**Photograph No. 2**

Representative view of lead-based exterior white paint



**Photograph No. 3**

View of asbestos containing loose fill vermiculite insulation located beneath the attic floor boards



**Photograph No. 4**

Representative view of vermiculite filled garbage bags within attic



**Photograph No. 5**

View of rodent droppings present within attic



**Photograph No. 6**

Representative view of asbestos containing 12"x12" vinyl floor tile - white with light brown



**Photograph No. 7**

Representative view of 12"x12" asbestos containing vinyl floor tile – white with black specks



**Photograph No. 8**

Representative view of mould contaminated and pipe insulation.  
Asbestos containing pipe insulation was also observed within this area



**Photograph No. 9**

Representative view of asbestos containing pipe insulation.



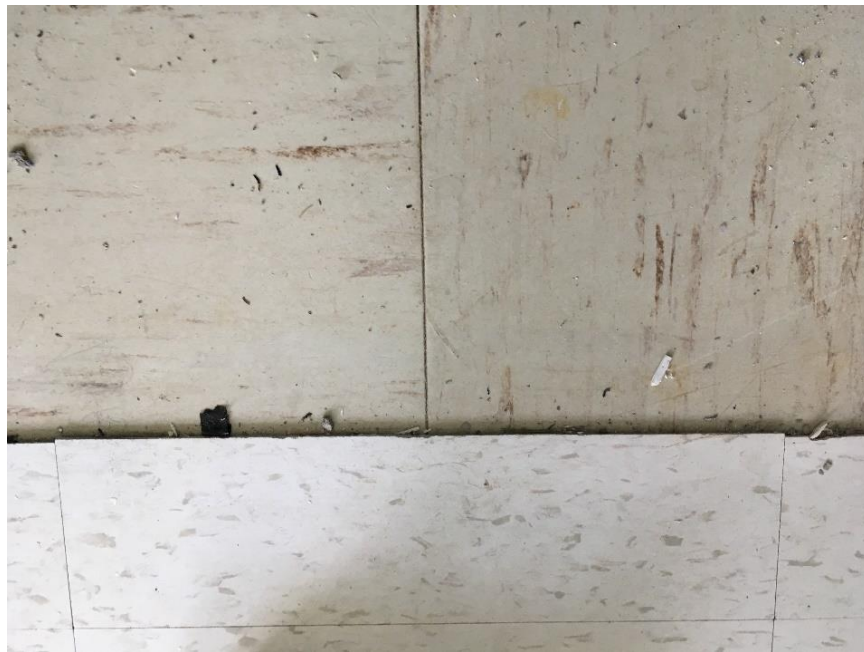
**Photograph No. 10**

Representative view of asbestos containing 2x4 acoustic tiles - deep vertical fissures with pock marks



**Photograph No. 11**

Representative view of non-asbestos containing 1x1 acoustic ceiling tile.  
The mastic used to adhere the tiles to the ceiling was found to be asbestos containing.



**Photograph No. 12**

Representative view of asbestos containing 12x12 vinyl floor tile – white with light brown streaks located beneath the visible non-asbestos flooring within room 110



**Photograph No. 13**

Representative view of asbestos containing drywall joint compound



**Photograph No. 14**

Representative view of mercury containing thermostat

## Appendix B – Summary Table











| Building Section             | Room Number  | General Building Construction                   |  |   |  | Potential Asbestos-Containing Materials   |                             |                                       |   |                     | Potential Lead Materials |          |              |               | Mercury       |                   | PCBs          |               | ODS             | Mould         |
|------------------------------|--|---|--|---|--|---|-----------------------------|---------------------------------------|---|---------------------|--------------------------|----------|--------------|---------------|---------------|-------------------|---------------|---------------|-----------------|---------------|
|                              |  | Floor   | Walls  | Ceiling   | Piping / Ductwork  | Asbestos Sample Description   | Friability (F/NF)           | Sample Number                         | Laboratory Result                           | Condition           | Colour                   | Sample   | Result (ppm) | Condition     | Thermostat    | Fluorescent Light | Ballast       | Transformer   |                 |               |
| Second Floor                 | Room 206   | Carpet (over wood)                              | Plaster  | Plaster   | None Observed  | Plaster   | N/A                         | Previously sampled (Sendex)           | Non-asbestos                                | N/A                 | Purple                   | N/S      | Presume Lead | Good - fair   | None Observed | 12                | 3             | None Observed | None Observed   | None Observed |
|                              |  |   |  | 2x4 acoustic tiles - deep horizontal fissures with pock marks and pinholes (only above windows) |  | 2x4 acoustic tiles - deep horizontal fissures with pock marks and pinholes (only above windows) | N/A                         | Previously sampled (Sendex)           | Non-asbestos                                | N/A                 |                          |          |              |               |               |                   |               |               |                 |               |
|                              | Room 207   | 12x12 vinyl floor tile - tan with brown streaks | Plaster  | Plaster   | None Observed  | 12x12 vinyl floor tile - tan with brown streaks   |                             | Previously sampled (Sendex)           | asbestos - vinyl tile Non-asbestos - mastic | Good                | Off White                | PS-04    | 5000         | Good - fair   | None Observed | 72                | 36            | None Observed | Air conditioner | None Observed |
|                              |  | Laboratory Counter Top                          |  |   |  | Lab Bench Laboratory Countertop (laminated)   | N/A                         | VS SA-02                              | Non-asbestos                                | N/A                 |                          |          |              |               |               |                   |               |               |                 |               |
|                              | Room 208   | Carpet (over wood)                              | Plaster  | Plaster   | None Observed  | 2x4 acoustic tiles - deep horizontal fissures with pock marks and pinholes (only above windows) | N/A                         | Previously sampled (Sendex)           | Non-asbestos                                | N/A                 | Off White                | VS PS-04 | Lead         | Good - fair   | None Observed |                   |               | None Observed | Air conditioner | None Observed |
|                              |  |   |  | 2x4 acoustic tiles - deep horizontal fissures with pock marks and pinholes (only above windows) |  | Plaster   | N/A                         | Previously sampled (Sendex)           | Non-asbestos                                | N/A                 |                          |          |              |               |               |                   |               |               |                 |               |
|                              | Room 210   | 12x12 vinyl floor tile - tan with brown streaks | Plaster  | Plaster   | None Observed  | 12x12 vinyl floor tile - tan with brown streaks   |                             | Previously sampled (Sendex)           | asbestos - vinyl tile Non-asbestos - mastic | Good                | Off White                | VS PS-04 | Lead         | Good - fair   | None Observed | 72                | 36            | None Observed | None Observed   | None Observed |
|                              |  | Laboratory Counter Top                          |  |   |  | Lab Bench Laboratory Countertop (laminated)   | N/A                         | VS SA-02                              | Non-asbestos                                | N/A                 |                          |          |              |               |               |                   |               |               |                 |               |
|                              | Location 10 (North Corridor)   | Ceramic   | Drywall  | Plaster   | None Observed  | Drywall Joint Compound  | F                           | Previously sampled (Sendex)           | asbestos                                    | Good                | Off White                | VS PS-04 | Lead         | Good - fair   | None Observed | 12                | 3             | None Observed | None Observed   | None Observed |
|                              |  |   |  |   |  | Plaster   | N/A                         | Previously sampled (Sendex)           | Non-asbestos                                | N/A                 |                          |          |              |               |               |                   |               |               |                 |               |
|                              | Location 9 (Central Corridor)  | Ceramic   | Plaster  | Plaster   | None Observed  | Plaster   | N/A                         | Previously sampled (Sendex)           | Non-asbestos                                | N/A                 | Off White                | VS PS-04 | Lead         | Good - fair   | None Observed | 12                | 3             | None Observed | None Observed   | None Observed |
|                              | Location 8 (South Corridor)  | Ceramic   | Drywall  | Plaster   | None Observed  | Drywall Joint Compound  | F                           | Previously sampled (Sendex)           | asbestos                                    | Good                | Off White                | VS PS-04 | Lead         | Good - fair   | None Observed | 12                | 3             | None Observed | None Observed   | None Observed |
|                              |  |   |  |   |  | Plaster   | N/A                         | Previously sampled (Sendex)           | Non-asbestos                                | N/A                 |                          |          |              |               |               |                   |               |               |                 |               |
|                              | Location 3 (South Stairwell)   | Ceramic   | Plaster  | Plaster   | Air Cell   | Plaster   | N/A                         | Previously sampled (Sendex)           | Non-asbestos                                | N/A                 | Beige                    | VS PS-01 | Lead         | Good - fair   | None Observed | 12                | 3             | None Observed | None Observed   | None Observed |
| Terrazzo                     |  | Drywall   |  |   | Drywall Joint Compound                                       | F   | Previously sampled (Sendex) | asbestos                              | Good  |                     |                          |          |              |               |               |                   |               |               |                 |               |
|                              |  |   |  |   | Air Cell   | F   | Previously sampled (Sendex) | asbestos                              | Good  |                     |                          |          |              |               |               |                   |               |               |                 |               |
| Location 4 (Main Stairs)     | Rubber   | Plaster   | Plaster  | None Observed   | Rubber   | N/A   | Previously sampled (Sendex) | Non-asbestos                          | N/A   | Beige               | VS PS-01                 | Lead     | Good - fair  | None Observed | 4             | 1                 | None Observed | None Observed | None Observed   |               |
|                              |  | Drywall   |  |   | Plaster  | N/A   | Previously sampled (Sendex) | Non-asbestos                          | N/A   |                     |                          |          |              |               |               |                   |               |               |                 |               |
|                              |  |   |  |   | Drywall Joint Compound                                       | F   | Previously sampled (Sendex) | asbestos                              | Good  |                     |                          |          |              |               |               |                   |               |               |                 |               |
| Location 7 (North Stairwell) | 12x12 vinyl floor tile - white with light brown streaks                    | Drywall   | 2x4 acoustic tiles - horizontal fissures with dense pinholes | None Observed   | 12x12 vinyl floor tile - white with light brown streaks      | NF  | Previously sampled (Sendex) | asbestos - tile Non-asbestos - mastic | Good  | Beige               | VS PS-01                 | Lead     | Good - fair  | None Observed | 4             | 1                 | None Observed | None Observed | None Observed   |               |
|                              |  | Plaster   | Plaster  |   | Drywall Joint Compound                                       | F   | Previously sampled (Sendex) | asbestos                              | Good  |                     |                          |          |              |               |               |                   |               |               |                 |               |
|                              |  |   |  |   | Plaster  | N/A   | Previously sampled (Sendex) | Non-asbestos                          | N/A   |                     |                          |          |              |               |               |                   |               |               |                 |               |
|                              |  |   |  |   | 2x4 acoustic tiles - horizontal fissures with dense pinholes | N/A   | Previously sampled (Sendex) | Non-asbestos                          | N/A   |                     |                          |          |              |               |               |                   |               |               |                 |               |
| Attic                        | Wood   | Brick   | Wood   | Horse Hair Sweat Wrap   | Horse Hair Sweat Wrap  | N/A   |                             | Not suspect ACM                       | N/A   | No painted surfaces |                          |          |              | None Observed | None Observed | None Observed     | None Observed | None Observed | None Observed   |               |
|                              | Loose fill vermiculite (observed under wood floor and within garbage bags) | Wood  |  |   | Vermiculite  | F   | SA-04a,b,c                  | 1% tremolite                          | Poor  |                     |                          |          |              |               |               |                   |               |               |                 |               |
| Exterior                     | Landscaping  | Brick   | Roof Shingle   | None Observed   | White Caulking   | N/A   | SA-01a,b,c                  | Non-asbestos                          | N/A   | White (window trim) | PS-03                    | 197,000  | Good - fair  | None Observed | None Observed | None Observed     | None Observed | None Observed | None Observed   |               |
|                              |  | White Caulking (around windows and doors)       |  |   |  |   |                             |                                       |   |                     |                          |          |              |               |               |                   |               |               |                 |               |

N/A = not applicable  
 N/S = material not sampled or submitted  
 ND = non-detect (asbestos not detected)  
 ACT = acoustic ceiling tile  
 VFT = vinyl floor tile  
 VS = visually similar  
 F = friable  
 NF = non-friable  
 non-asbestos = sampled material determined homogeneous with identified non-asbestos containing material

**exp** Services Inc.

*Designated Substances Survey  
Administration Building  
Beattie Lane, Kemptville, ON.  
OTT-00243092-B0  
November 7, 2017*

## **Appendix C – Laboratory Certificates of Analysis**



## Certificate of Analysis

**exp Services Inc. (Ottawa)**

100-2650 Queensview Dr.  
Ottawa, ON K2B 8K2  
Attn: Matt Laneville

Client PO: Admin  
Project: OTT00243092  
Custody:

Report Date: 19-Oct-2017  
Order Date: 13-Oct-2017

**Order #: 1742004**

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

| Paracel ID | Client ID |
|------------|-----------|
| 1742004-01 | SA-01a    |
| 1742004-02 | SA-01b    |
| 1742004-03 | SA-01c    |
| 1742004-04 | SA-02a    |
| 1742004-05 | SA-02b    |
| 1742004-06 | SA-02c    |
| 1742004-07 | SA-03a    |
| 1742004-08 | SA-03b    |
| 1742004-09 | SA-03c    |
| 1742004-10 | SA-04a    |
| 1742004-11 | SA-04b    |
| 1742004-12 | SA-04c    |

Approved By:



Emma Diaz  
Senior Analyst

Any use of these results implies your agreement that our total liability in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

Certificate of Analysis  
 Client: exp Services Inc. (Ottawa)  
 Client PO: Admin

Report Date: 19-Oct-2017  
 Order Date: 13-Oct-2017  
 Project Description: OTT00243092

**Asbestos, PLM Visual Estimation \*\*MDL - 0.5%\*\***

| Parcel I.D. | Sample Date | Layers Analyzed    | Colour      | Description                | Asbestos Detected: | Material Identification  | % Content         |
|-------------|-------------|--------------------|-------------|----------------------------|--------------------|--|-------------------|
| 1742004-01  | 12-Oct-17   | sample homogenized | White       | Caulking                   | No                 | <b>Client ID: SA-01a</b><br>Non-Fibers<br>Other fibers                   | 98<br>2           |
| 1742004-02  | 12-Oct-17   | sample homogenized | White       | Caulking                   | No                 | <b>Client ID: SA-01b</b><br>Non-Fibers<br>Other fibers                   | 98<br>2           |
| 1742004-03  | 12-Oct-17   | sample homogenized | White       | Caulking                   | No                 | <b>Client ID: SA-01c</b><br>Non-Fibers<br>Other fibers                   | 98<br>2           |
| 1742004-04  | 12-Oct-17   | sample homogenized | Grey        | Laboratory Counter Top     | Yes                | <b>Client ID: SA-02a</b><br>Chrysotile<br>Non-Fibers                     | 20<br>80          |
| 1742004-05  | 12-Oct-17   |                    |             |                            |                    | <b>Client ID: SA-02b</b><br>not analyzed                                 |                   |
| 1742004-06  | 12-Oct-17   |                    |             |                            |                    | <b>Client ID: SA-02c</b><br>not analyzed                                 |                   |
| 1742004-07  | 12-Oct-17   | sample homogenized | Black/Brown | Laboratory Counter Top     | No                 | <b>Client ID: SA-03a</b><br>Cellulose<br>Non-Fibers                      | 70<br>30          |
| 1742004-08  | 12-Oct-17   | sample homogenized | Black/Brown | Laboratory Counter Top     | No                 | <b>Client ID: SA-03b</b><br>Cellulose<br>Non-Fibers                      | 70<br>30          |
| 1742004-09  | 12-Oct-17   | sample homogenized | Black/Brown | Laboratory Counter Top     | No                 | <b>Client ID: SA-03c</b><br>Cellulose<br>Non-Fibers                      | 70<br>30          |
| 1742004-10  | 12-Oct-17   | sample homogenized | Beige       | Small particle vermiculite | Yes                | <b>Client ID: SA-04a</b><br>Tremolite<br>Cellulose<br>MMVF<br>Non-Fibers | 1<br>1<br>1<br>97 |
| 1742004-11  | 12-Oct-17   |                    |             |                            |                    | <b>Client ID: SA-04b</b><br>not analyzed                                 |                   |
| 1742004-12  | 12-Oct-17   |                    |             |                            |                    | <b>Client ID: SA-04c</b><br>not analyzed                                 |                   |

Certificate of Analysis  
Client: **exp Services Inc. (Ottawa)**  
Client PO: Admin

Report Date: 19-Oct-2017  
Order Date: 13-Oct-2017  
Project Description: **OTT00243092**

\* MMVF: Man Made Vitreous Fibers: Fiberglass, Mineral Wool, Rockwool, Glasswool

\*\* Analytes in bold indicate asbestos mineral content.

### Analysis Summary Table

| Analysis                        | Method Reference/Description | Lab Location        | NVLAP Lab Code * | Analysis Date |
|---------------------------------|------------------------------|---------------------|------------------|---------------|
| Asbestos, PLM Visual Estimation | by EPA 600/R-93/116          | 2 - Ottawa West Lab | 200812-0         | 19-Oct-17     |

\* Reference to the NVLAP term does not permit the user of this report to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

### Work Order Revisions / Comments

None



Parcel ID: 1742004



PLM

| Sample ID | Material Description              | Location                | Positive Stop Y/N |
|-----------|-----------------------------------|-------------------------|-------------------|
| SA-01a    | exterior window caulking - white  | exterior window - east  | Yes               |
| SA-01b    |                                   | exterior window - west  |                   |
| SA-01c    |                                   | exterior window - north |                   |
| SA-02a    | laboratry counter top - fume hood | room 202                | Yes               |
| SA-02b    |                                   |                         |                   |
| SA-02c    |                                   |                         |                   |
| SA-03a    | laboratry counter top - lab bench | room 202                | yes               |
| SA-03b    |                                   |                         |                   |
| SA-03c    |                                   |                         |                   |
| SA-04a    | vermiculite                       | attic                   | yes               |
| SA-04b    |                                   |                         |                   |
| SA-04c    |                                   |                         |                   |

Paint

| Sample ID | Description          | Location   |
|-----------|----------------------|------------|
| PS-01     | Beige wall paint     | room B06   |
| PS-02     | grey wall paint      | room B17   |
| PS-03     | white window paint   | exterior   |
| PS-04     | off white wall paint | throughout |

## Certificate of Analysis

**exp Services Inc. (Ottawa)**

100-2650 Queensview Dr.

Ottawa, ON K2B 8K2

Attn: Matt Laneville

Client PO: Admin

Project: OTT000243092

Custody:

Report Date: 19-Oct-2017

Order Date: 13-Oct-2017

**Order #: 1742036**

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

**Parcel ID    Client ID**

1742036-01    PS-01

1742036-02    PS-02

1742036-03    PS-03

1742036-04    PS-04

Approved By:



Dale Robertson, BSc  
Laboratory Director

Any use of these results implies your agreement that our total liability in connection with this work, however arising shall be limited to the amount paid by you for this work, and that our employees or agents shall not under circumstances be liable to you in connection with this work

Certificate of Analysis  
Client: **exp Services Inc. (Ottawa)**  
Client PO: Admin

Report Date: 19-Oct-2017  
Order Date: 13-Oct-2017  
Project Description: **OTT000243092**

**Analysis Summary Table**

| Analysis        | Method Reference/Description | Extraction Date | Analysis Date |
|-----------------|------------------------------|-----------------|---------------|
| Metals, ICP-OES | based on MOE E3470, ICP-OES  | 17-Oct-17       | 17-Oct-17     |

**Sample Data Revisions**

None

**Work Order Revisions/Comments:**

None

**Other Report Notes:**

- n/a: not applicable
- ND: Not Detected
- MDL: Method Detection Limit
- Source Result: Data used as source for matrix and duplicate samples
- %REC: Percent recovery.
- RPD: Relative percent difference.

Certificate of Analysis  
 Client: exp Services Inc. (Ottawa)  
 Client PO: Admin

Report Date: 19-Oct-2017  
 Order Date: 13-Oct-2017  
 Project Description: OTT000243092

### Sample Results

| Lead       |           |       |     | Matrix: Paint          |
|------------|-----------|-------|-----|------------------------|
|            |           |       |     | Sample Date: 12-Oct-17 |
| Paracel ID | Client ID | Units | MDL | Result                 |
| 1742036-01 | PS-01     | ug/g  | 20  | 44100                  |
| 1742036-02 | PS-02     | ug/g  | 20  | 4640                   |
| 1742036-03 | PS-03     | ug/g  | 20  | 197000                 |
| 1742036-04 | PS-04     | ug/g  | 20  | 5000                   |

### Laboratory Internal QA/QC

| Analyte                 | Result | Reporting Limit | Units | Source Result | %REC | %REC Limit | RPD | RPD Limit | Notes |
|-------------------------|--------|-----------------|-------|---------------|------|------------|-----|-----------|-------|
| <b>Matrix Blank</b>     |        |                 |       |               |      |            |     |           |       |
| Lead                    | ND     | 20              | ug/g  |               |      |            |     |           |       |
| <b>Matrix Duplicate</b> |        |                 |       |               |      |            |     |           |       |
| Lead                    | 31.6   | 20              | ug/g  | ND            |      |            | 0.0 | 30        |       |
| <b>Matrix Spike</b>     |        |                 |       |               |      |            |     |           |       |
| Lead                    | 257    |                 | ug/L  | ND            | 102  | 70-130     |     |           |       |



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Page 1 of 2

|   |  |   |
|---|--|---|
| Client Name: Exp Services Inc.                              | Project Reference: 243092 - Admin        | TAT: [x] Regular [ ] 3 Day<br>[ ] 2 Day [ ] 1 Day<br>Date Required: _____ |
| Contact Name: Matt Laneville                                | Quote #17-544                            |   |
| Address: 100-2650 Queensview Drive, Ottawa, Ontario K2B 8H6 | PO #                                     |   |
| Telephone: 613-668-1899                                     | Email Address: matthew.laneville@exp.com |   |

Criteria: [ ] O. Reg. 153/04 (2011) Table \_\_\_ [ ] RSC Filing [ ] O. Reg. 558/00 [ ] PWQO [ ] CCME [ ] SUB (Storm) [ ] SUB (Sanitary) Municipality: \_\_\_\_\_ [ ] Other: \_\_\_\_\_

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

Required Analyses

| Sample ID/Location Name                  | Matrix | Air Volume | # of Containers | Sample Taken |      | PLM | LEAD |  |  |  |  |  |  |  |  |  |  |  |
|--|--------|------------|-----------------|--------------|------|-----|------|--|--|--|--|--|--|--|--|--|--|--|
|  |        |            |                 | Date         | Time |     |      |  |  |  |  |  |  |  |  |  |  |  |
| 1742036-head<br>see attached spreadsheet | O      |            |                 | 12-Oct-17    |      | x   | x    |  |  |  |  |  |  |  |  |  |  |  |
| 2  |        |            |                 |              |      |     |      |  |  |  |  |  |  |  |  |  |  |  |
| 3  |        |            |                 |              |      |     |      |  |  |  |  |  |  |  |  |  |  |  |
| 4  |        |            |                 |              |      |     |      |  |  |  |  |  |  |  |  |  |  |  |
| 5  |        |            |                 |              |      |     |      |  |  |  |  |  |  |  |  |  |  |  |
| 6  |        |            |                 |              |      |     |      |  |  |  |  |  |  |  |  |  |  |  |
| 7  |        |            |                 |              |      |     |      |  |  |  |  |  |  |  |  |  |  |  |
| 8  |        |            |                 |              |      |     |      |  |  |  |  |  |  |  |  |  |  |  |
| 9  |        |            |                 |              |      |     |      |  |  |  |  |  |  |  |  |  |  |  |
| 10                                       |        |            |                 |              |      |     |      |  |  |  |  |  |  |  |  |  |  |  |

Comments: \_\_\_\_\_ Method of Delivery: Walk-in

|   |  |                                       |                                     |
|---|--|---------------------------------------|-------------------------------------|
| Relinquished By (Print & Sign): Matt Laneville<br><u>Matt Laneville</u> | Received by Driver/Depot:<br><u>SUREE POJAN DEKMAI</u> | Received at Lab:<br><u>Karen Cull</u> | Verified By:<br><u>[Signature]</u>  |
|   | Date/Time: <u>OCT 16, 2017 10:50</u>                   | Date/Time: <u>OCT 13/17 4:50</u>      | Date/Time: <u>10/17/17 11:11 am</u> |
| Date/Time: October 13, 2017 @ 4:30pm                                    | Temperature: _____ °C                                  | Temperature: _____ °C                 | pH Verified [ ] By: _____           |

1742036 - head

Parcel ID: 1742036



PLM

| Sample ID | Material Description              | Location                | Pc  |
|-----------|-----------------------------------|-------------------------|-----|
| SA-01a    | exterior window caulking - white  | exterior window - east  | Yes |
| SA-01b    |                                   | exterior window - west  |     |
| SA-01c    |                                   | exterior window - north |     |
| SA-02a    | laboratry counter top - fume hood | room 202                | Yes |
| SA-02b    |                                   |                         |     |
| SA-02c    |                                   |                         |     |
| SA-03a    | laboratry counter top - lab bench | room 202                | yes |
| SA-03b    |                                   |                         |     |
| SA-03c    |                                   |                         |     |
| SA-04a    | vermiculite                       | attic                   | yes |
| SA-04b    |                                   |                         |     |
| SA-04c    |                                   |                         |     |

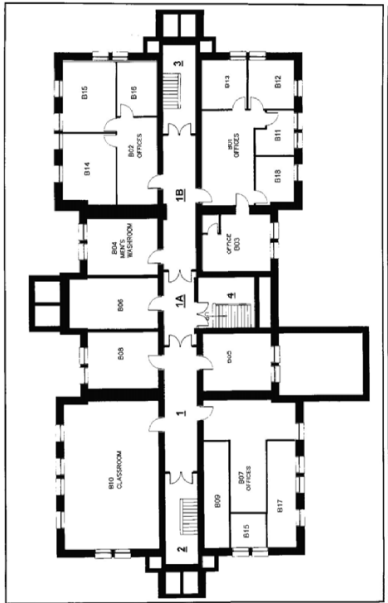
Paint

| Sample ID | Description          | Location   |
|-----------|----------------------|------------|
| PS-01     | Beige wall paint     | room B06   |
| PS-02     | grey wall paint      | room B17   |
| PS-03     | white window paint   | exterior   |
| PS-04     | off white wall paint | throughout |

**exp** Services Inc.

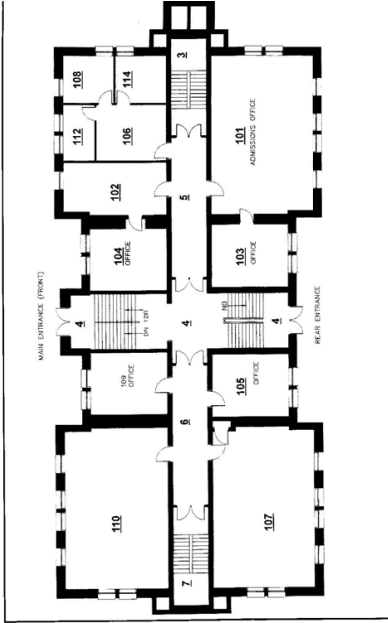
*Designated Substances Survey  
Administration Building  
Beattie Lane, Kemptville, ON.  
OTT-00243092-B0  
November 7, 2017*

## **Appendix D – Sendex Floor Plan**



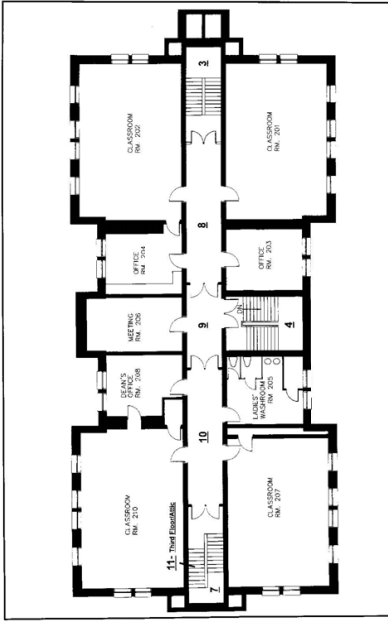
**FIGURE 2-CN-124**  
**BUILDING CONFIGURATION & LOCATION I.D. NUMBERS**  
 Administration Building, Administration  
 Building Number B17-B100  
**ASBESTOS CONTAINING MATERIALS SURVEY**

**NOTES**  
 Source of Data: Site  
 Date: 1-28-2010  
 Scale: 1/8" = 1'-0"



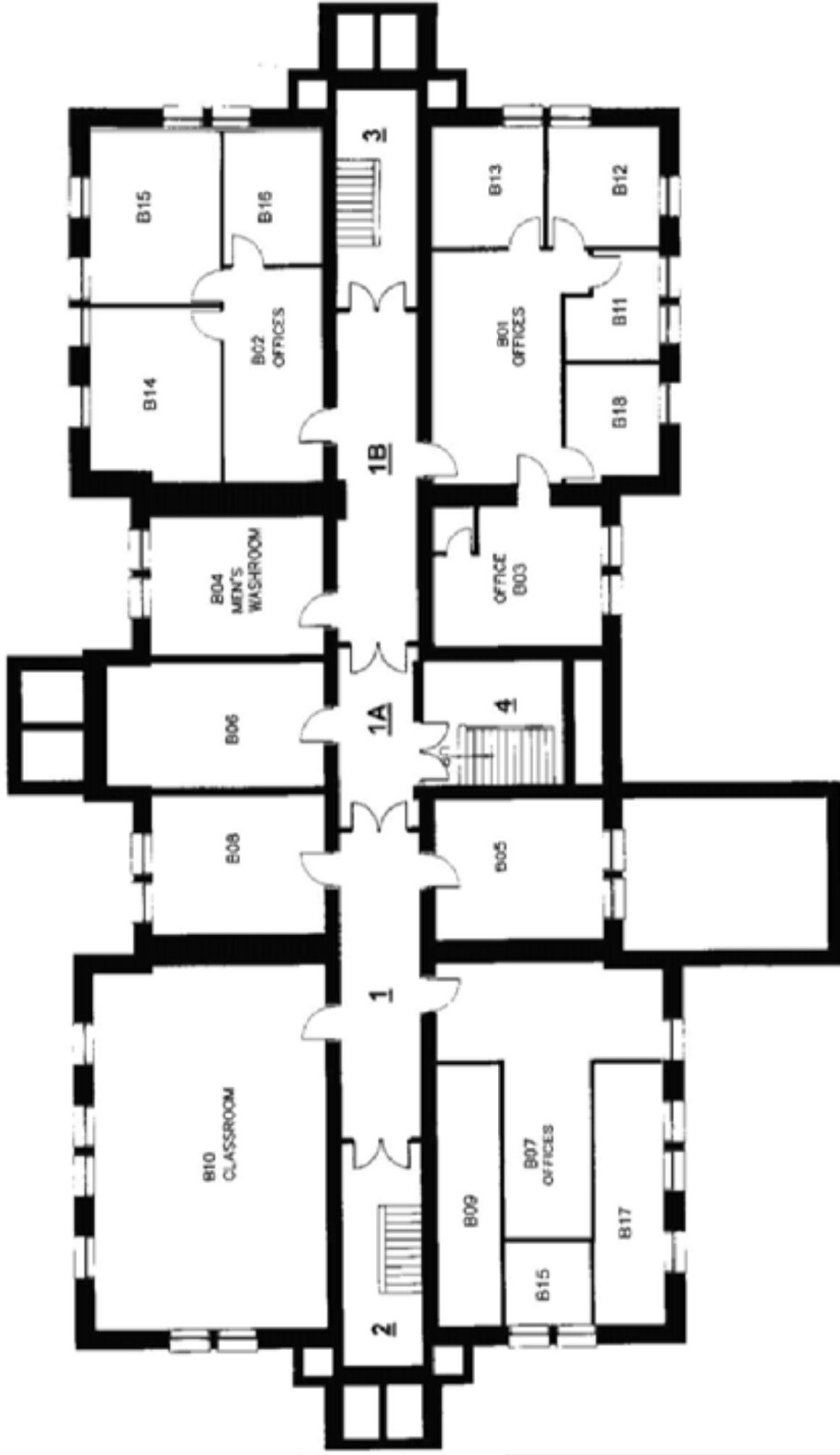
**FIGURE 2-CN-126**  
**BUILDING CONFIGURATION & LOCATION I.D. NUMBERS**  
 Administration Building, Administration  
 Building Number B101-B200  
**ASBESTOS CONTAINING MATERIALS SURVEY**

**NOTES**  
 Source of Data: Site  
 Date: 1-28-2010  
 Scale: 1/8" = 1'-0"



**FIGURE 2-CN-12C**  
**BUILDING CONFIGURATION & LOCATION I.D. NUMBERS**  
 Administration Building, Administration  
 Building Number B300-B400  
**ASBESTOS CONTAINING MATERIALS SURVEY**

**NOTES**  
 Source of Data: Site  
 Date: 1-28-2010  
 Scale: 1/8" = 1'-0"



**FIGURE 2-CN:12A**  
**BUILDING CONFIGURATION & LOCATION I.D. NUMBERS**  
 Administration Building - Basement  
 Campus Number: 12  
 Building Number: B12515  
**ASBESTOS CONTAINING MATERIALS SURVEY**

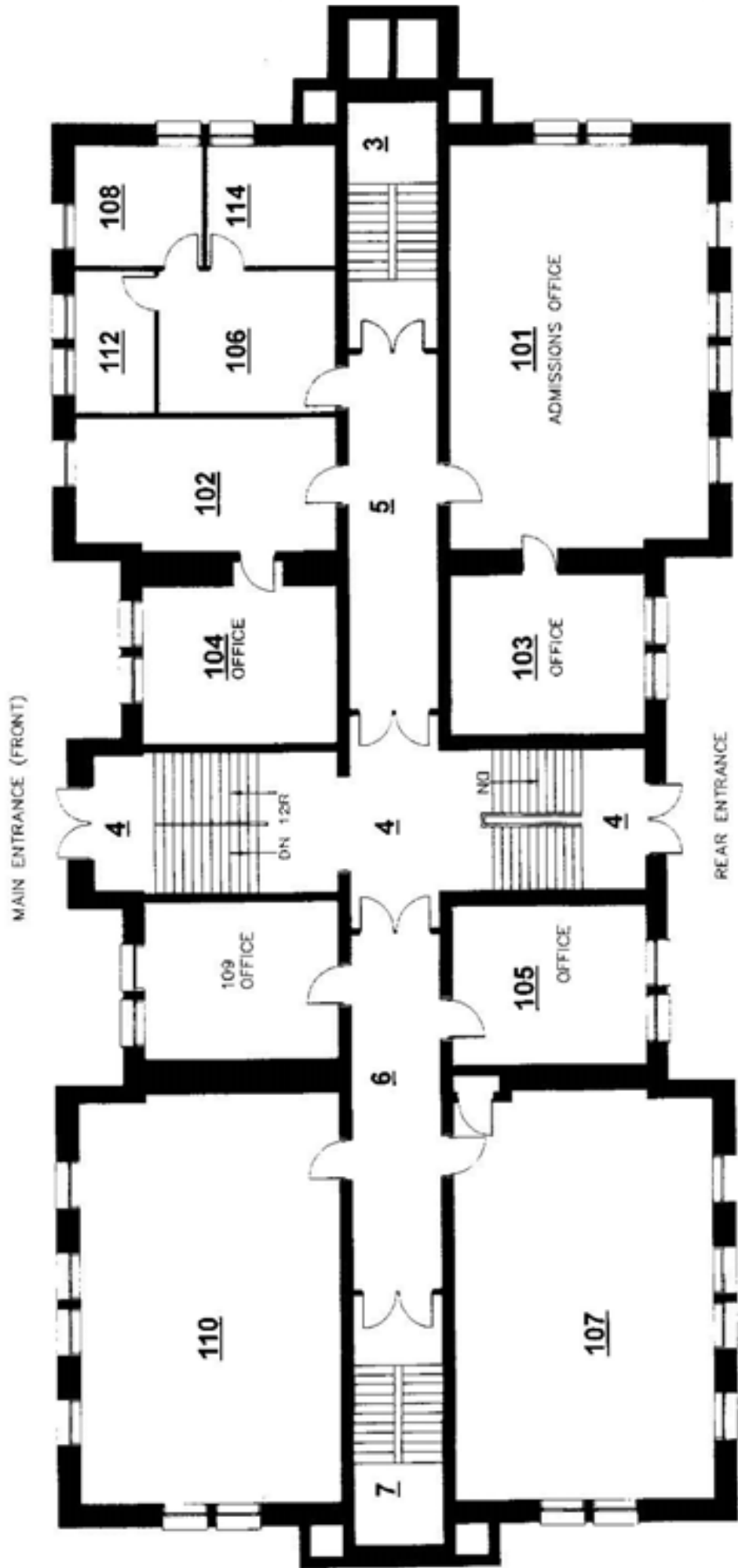
**NOTES**

Source of Base Map:  
 University of Guelph



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**FIGURE 2-CN:12B**  
**BUILDING CONFIGURATION & LOCATION I.D. NUMBERS**  
 Administration Building- Ground Floor  
 Campus Number: 12  
 Building Number: B12515  
**ASBESTOS CONTAINING MATERIALS SURVEY**

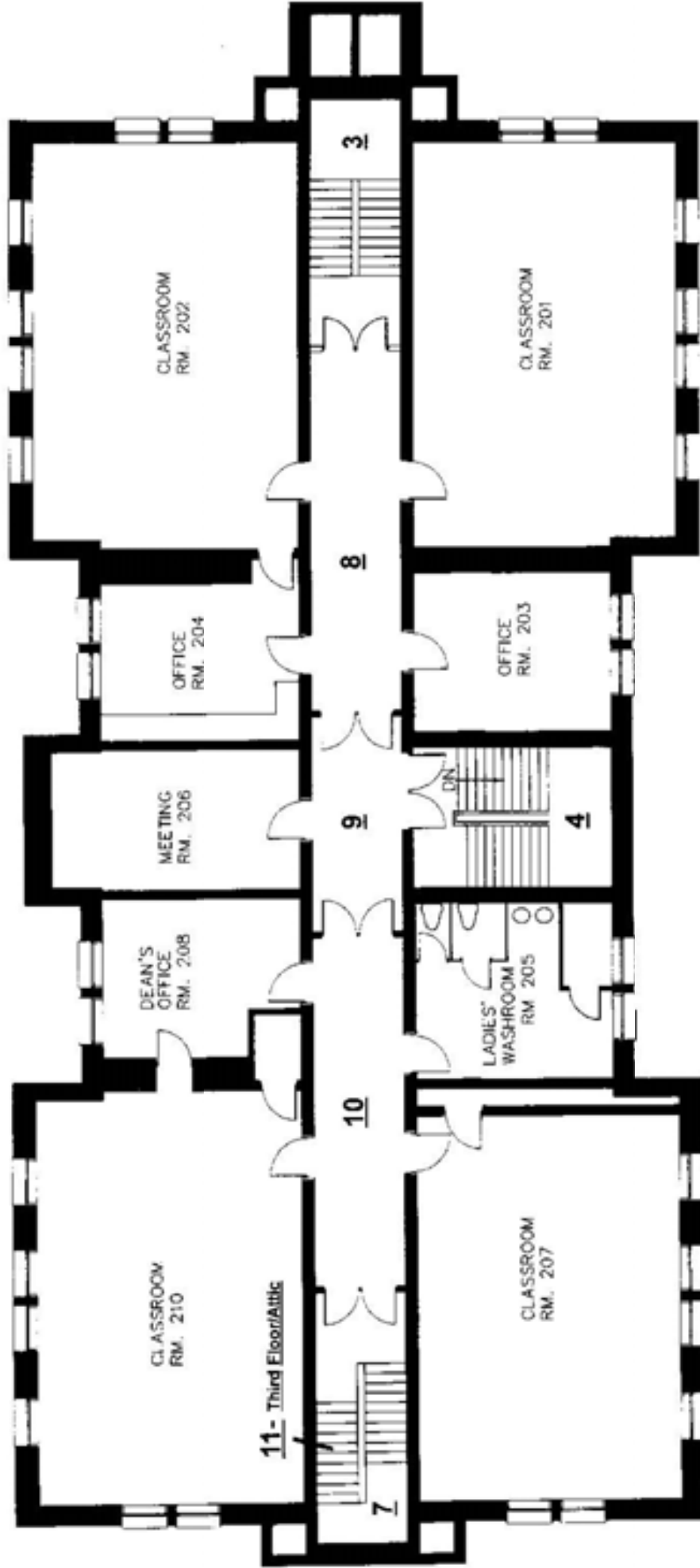
**NOTES**

Source of Base Map  
 University of Guelph

APPROXIMATE SCALE  
 0 feet 10 feet

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**FIGURE 2-CN:12C**  
**BUILDING CONFIGURATION & LOCATION I.D. NUMBERS**  
 Administration Building- Second Floor  
 Campus Number: 12  
 Building Number: B12515  
**ASBESTOS CONTAINING MATERIALS SURVEY**

**NOTES**

APPROXIMATE SCALE  
 0 feet 30 feet

Source of Base Map:  
 University of Guelph

July 2010

